



2017 in charts

Hard lines

The year's main economic and financial indicators

| *Purchasing managers' index*

A synchronised global upswing took hold, as shown by the purchasing managers' index. This fuelled hopes that the world economy has escaped from secular stagnation

| *Consumer prices*

Japan's ten-year battle with deflation dragged on. In America and Europe, inflation picked up. Only in Britain, however, did it overshoot the central bank's target

| *Online retail sales*

From Singles Day to Black Friday, Chinese and Americans are doing more of their shopping online. In America, at least, more bricks-and-mortar shops closed

| *Stockmarkets*

It was a good year for equity investors in developed markets—though in Britain the gains were less impressive. Emerging markets were seen as the biggest beneficiaries of global growth

| *Ten-year government-bond yields*

The perennial declaration of an end to the 30-year bull market in government bonds again proved premature. In America, the yield curve flattened as long-term rates stayed low

| *Volatility indices*

The markets mostly shrugged off political uncertainty. Volatility indices

were subdued. In America the Vix fell below ten, in the past, a rare occurrence suggestive of complacency

| *Currencies against the dollar*

There was no Trump bump in the dollar; quite the reverse. The global recovery meant that investors no longer needed to seek out the haven of the greenback; of major currencies, the euro did best

| *Commodity prices*

It was a mixed year for global commodities, despite the global growth pick-up. The main worry is that Chinese demand for raw materials may slip in 2018

| *Cryptocurrencies*

Those who bought bitcoin early will probably enjoy a happy Christmas. Its sheen rubbed off on other digital assets: there was a boom in “initial coin offerings” ■



图说2017

硬指标

2017年主要经济与金融指标

| 采购经理指数

如采购经理指数所示，全球经济同步上升。这让市场燃起了希望，认为世界经济已摆脱了长期停滞。

| 消费者价格

日本与通货紧缩长达十年的抗争仍在继续。美国和欧洲通胀有所上升，然而只有英国的通胀率超过了央行目标。

| 在线零售额

从“双十一”到“黑色星期五”，中国人和美国人都愈加倾向网购。至少在美国，关门的实体店铺增多了。

| 股市

在发达市场，2017年对股票投资者来说是个好年头，尽管英国的股票收益不尽如人意。新兴市场被认为是全球增长的最大受益者。

| 十年期国债收益率

长达30年的政府债券牛市不断被宣告终结，但今年这一判断又一次言之过早。在美国，由于长期收益率保持在低位，国债收益率曲线趋平。

| 波动率指数

政治不确定性大体上并未影响市场。波动率指数曲线趋于缓和。在美国，Vix波动率指数罕见地跌破了10，暗示投资者出现了自满情绪。

| 各国货币兑美元汇率

“特朗普效应”并没有提振美元需求。恰恰相反，全球经济复苏意味着投资者不再需要用美元充当避风港。主要货币中欧元表现最佳。

| 大宗商品价格

尽管全球增长出现转机，全球大宗商品市场仍喜忧参半。主要的担忧是2018年中国对原材料的需求可能会下降。

| 加密货币

一早买进比特币的人可能会度过一个愉快的圣诞节。高歌猛进的比特币还带动了其他数字资产：2017年“首次代币公开预售”一度热火朝天。■



Battery minerals

The whizz of Oz

The battery revolution has produced a new frenzy in the Australian outback

FORGET the “resource curse”. Australia is blessed with the stuff. For more than a quarter of a century it has not had a recession, thanks largely to Chinese demand for its raw materials. It is only a few years since the end of one such China-led boom, in base metals such as iron ore. A new speculative flurry has started in minerals such as lithium, cobalt and nickel to feed another China-related craze—making batteries for electric vehicles (EVs).

Ken Brinsden, an Australian mining engineer, says he pinches himself over these remarkable turns of fortune. Until 2015 he was a boss at Atlas Iron, which shipped low-grade iron ore to China. In 2011, at the height of the China-led supercycle, it had a valuation of A\$3.5bn (\$3.8bn). This has now shrunk to A\$167m. But he now heads Pilbara Minerals, whose Pilgangoora lithium mine in the outback of Western Australia lies so close to two of Atlas’s former iron-ore mines that he can see them from the top of the dusty-red escarpment.

Since 2015 Pilbara Minerals’ market capitalisation has jumped from A\$25m to A\$1.5bn, as the soaring price of battery-grade lithium has made the economics of producing it from Australia’s spodumene, or “hard rock” reserves, more attractive. Great Wall Motor, a Chinese carmaker, recently bought a small stake in the firm and agreed to take a large share of its spodumene concentrate. Altura Mining, another favourite of speculative investors, is also developing a lithium mine in Pilgangoora, with much of its production already earmarked for China.

Clean TeQ, whose big shareholders are Robert Friedland, an American-

Canadian billionaire, and Pengxin International Mining, a Chinese firm, is also on a battery-powered roll (see chart). Its value has soared by 240% this year to A\$838m, based on its plans to produce nickel and cobalt sulphates, both key raw materials (along with lithium) for lithium-ion battery cathodes.

In most of the world cobalt is extracted as a by-product of copper and nickel, but it has recently become more valuable than nickel because of its scarcity. Such is the anticipated demand for it in the lithium-ion battery industry that shortages are expected within a few years. Clean TeQ says that at today's prices of \$27 a pound (compared with \$10 a pound in 2016) cobalt would be a bigger source of revenue from its mine in New South Wales than nickel.

In each case, the companies argue that they offer a more secure source of raw materials for Chinese battery manufacturers than foreign competitors. First, consider lithium. Although the raw material can be produced more cheaply from brine in South America, political, business and legal risks are lower in Australia. Moreover, Mr Brinsden argues that spodumene can be processed directly into lithium hydroxide, which is preferred by battery-makers to the lithium carbonate that comes from lithium chloride in brine.

Phil Thick, boss of Tianqi Lithium Australia, the majority-owner of Greenbushes, a lithium mine in Western Australia that is the world's largest, foresees no shortage of lithium itself—especially metal that is lower grade than that mined from Greenbushes. But he says there is a lack of processing capacity, so Tianqi, which is Chinese-owned, and its American partner, Albermarle, have plans to lift production of lithium hydroxide in Western Australia for export to China.

As for cobalt, Clean TeQ says that its production will have none of the ethical issues associated with the Democratic Republic of Congo (DRC),

from where 60% of today's supply comes. DRC cobalt is partly produced by "artisanal" miners that often use children with pickaxes to produce the metal. (This week it emerged that the London Metal Exchange has launched an inquiry into whether cobalt mined with child labour is trading on its exchange.) Ben Stockdale, the mining firm's chief financial officer, quips that the biggest risk with Clean TeQ is that its miners "die of boredom"—the mine is on flat, featureless land.

In fact, the biggest risk for all these projects is price, which in turn hinges on whether car firms make good on their plans for a big increase in investment in electric vehicles. That is still an open question. Though Mr Brinsden is convinced China will "surprise the world" with its role in the battery revolution, he also says Chinese carmakers such as Great Wall and Geely see hybrid vehicles as a stepping stone towards EVs, implying that full electrification will still take time to develop.

Another risk is that mining giants such as Rio Tinto will muscle in. Rio was recently rumoured to be contemplating a bid for SQM, Chile's biggest lithium producer, which the rest of the lithium brigade is uneasy about. Mr Thick, though, is confident: "It's a tough business. Even Rio with its huge chequebook won't find it easy." ■



电池矿物材料

澳洲旋风

电池革命在澳大利亚内陆地区引发了一场新狂潮

忘了“资源诅咒”吧，澳大利亚尽享资源之利。该国已有将近三十年未发生经济衰退，主要得益于中国对其原材料的需求。一场由中国引领的贱金属（如铁矿石）热潮才刚过去几年，另一场针对锂、钴、镍等矿产品的新投机风暴又开始了。这一次是为了追随另一轮与中国有关的狂潮——制造电动汽车电池。

澳大利亚矿业工程师肯·布林斯登（Ken Brinsden）说，运势一再出现非同寻常的改观，他得掐自己一下才能相信。2015年之前，他是阿特拉斯铁矿公司（Atlas Iron）的老板，该公司向中国输送低品位矿。2011年，在中国主导的超级周期的鼎盛期，公司估值达35亿澳元（合38亿美元），如今已缩水至1.67亿澳元。不过他现在是皮尔巴拉矿业公司（Pilbara Minerals）的负责人，这家公司位于西澳内陆皮尔甘戈拉（Pilgangoora），其锂矿离阿特拉斯之前的两处铁矿很近——他站在灰红色的悬崖顶端就可以看到。

自2015年以来，随着电池级锂的价格不断飙升，利用澳大利亚硬岩型锂辉石矿藏生产电池级锂变得更具经济吸引力，皮尔巴拉矿业公司的市值也因此从2500万澳元跃升至15亿澳元。中国汽车制造商长城汽车最近收购了该公司的少量股份，并商定大量购买其锂辉石精矿。另一家备受投机投资者青睐的矿业公司阿尔图拉矿业（Altura Mining）也在开发位于皮尔甘戈拉的一个锂矿，它的大部分矿石已经被中国预定。

受到电池需求的推动，Clean TeQ公司也势如破竹（见图表）。这家公司的大股东是有美加双重国籍的亿万富翁罗伯特·弗里兰德（Robert Friedland）和中国的鹏欣国际集团有限公司。今年其市值飙升240%，达到8.38亿澳元，这主要是因为公司的硫酸镍和硫酸钴生产计划。这两种产品（加上锂）都是锂离子电池阴极的主要原料。

在世界大部分地区，钴都是作为铜和镍的副产品提取的，但因其稀缺性，近来钴已经比镍更值钱。锂离子电池行业对钴的预期需求非常大，预计数年内就会出现短缺。Clean TeQ称，以目前每磅27美元的价格（2016年仅为每磅10美元）计算，公司位于新南威尔士的矿山出产的钴将会成为比镍更重要的收入来源。

这两家公司都号称自己为中国的电池制造商提供了比别国竞争对手更可靠的原材料来源。首先来说说锂。尽管南美用卤水可以生产出更便宜的原料，但澳大利亚的政治、商业和法律风险更低。而且，布林斯登说，比起从卤水中提取氯化锂再制得碳酸锂，电池制造商更偏爱直接由锂辉石加工而成的氢氧化锂。

费尔·西克（Phil Thick）是中资企业天齐锂业澳洲子公司Tianqi Lithium Australia的老板，该公司是全球最大锂矿西澳Greenbushes锂矿的最大股东。西克认为锂本身不会短缺，尤其是品味较Greenbushes出产矿石低的锂。但他认为加工能力跟不上。因此，天齐与其美国合作方Albemarle计划提升西澳氢氧化锂的产能，以供出口中国。

至于钴，Clean TeQ称其产品不存在任何像刚果民主共和国那样的伦理问题。目前全球60%的钴供应来自民主刚果，那里有一部分钴是由“手工业的”矿工生产，经常使用童工用铁镐采矿。（本周有消息称伦敦金属交易所已开始调查是否有童工开采的钴矿在该所交易。）Clean TeQ的首席财务官本·斯托克戴尔（Ben Stockdale）打趣说，公司的最大风险是他们的矿工会“无聊死”，因为该矿区位于一片索然无味的平地上。

其实，所有这些项目面临的重大风险是价格，而这又取决于汽车公司能否兑现大幅增加电动汽车投资的计划。这一点还是个未知数。尽管布里斯登相信中国在电池革命中扮演的角色会“震惊世界”，但他也表示，长城汽车和吉利等中国汽车制造商将混合动力汽车视为通往电动汽车的垫脚石，这意味着实现全面电气化仍需要时间。

另一个风险是像力拓（Rio Tinto）这样的矿业巨头将会强势进入。最近，

有传言称力拓正考虑收购智利最大的锂生产商SQM。锂矿界的其他公司为此坐立不安。不过西克却仍有信心：“这门生意不好做。就算有力拓这么厚的家底也一样。”■



Rio Tinto

Ghost in the machine

One of the world's biggest mining firms puts its faith in 300-tonne robots

FOR millennia, man has broken rocks. Whether with pickaxe or dynamite, their own or animal muscle, in a digger or a diesel truck, thick-necked miners have been at the centre of an industry that supplies the raw materials for almost all industrial activity. Making mining more profitable has long involved squeezing out more tonnes of metal per ounce of brawn. Now robots, not man, are settling themselves into the driving seat.

Rio Tinto, one of the world's largest mining firms, is leading that transformation in its vast iron-ore operations in the Pilbara region of Western Australia. It is putting its faith in driverless trucks and unmanned drilling rigs and trains, overseeing them from the office equivalent of armchairs about 1,000km (625 miles) south, in Perth. Jean-Sébastien Jacques, Rio's chief executive, says it is ten years ahead of mining rivals in autonomous technology. For him and for Simon Thompson, a new chairman appointed on December 4th, the question is how much such technology can tame another ancient feature of mining: the boom-and-bust cycle.

On a visit to Rio's Hope Downs 4 mine in the Pilbara, it is eerie at first to watch 300-tonne trucks speeding uphill in a cloud of red dust with no one in the cab. Then it becomes endearing, as you watch supersized robotic mammoths so safety-obsessed that when sagebrush blows in their way, they judder to a halt.

As for the mine's managers, they are struck by the silence; there is no longer a steady stream of banter across drivers' two-way radios. They also welcome the productivity gains. Over a 12-hour period, they say, manned

trucks are competitive, but over 24 hours and longer, the absence of coffee breaks, fatigue and driver changeovers begins to tell. The autonomous trucks stop only once a day for refuelling. “Then you pat them on the bum and out they go again,” one says. He adds that the workforce at the mine is already about one-third lower as a result of automation. The 76 autonomous vehicles in Rio’s 400-strong truck fleet in the Pilbara are an estimated 15% cheaper to run than the rest.

Two hours’ flight away, at Rio’s operations centre in Perth, engineers remotely control the equipment with screens and computers. “You have to blow dust in their faces to make them feel like they’re in the Pilbara, otherwise it’s too comfortable,” quips an executive, as he oversees desk-bound employees operating two of Rio’s six autonomous rigs digging into the Pilbara rock. Rio’s boss of iron ore, Chris Salisbury, says that autonomy enables drilling to run for almost a third longer on average than with manned rigs, and to churn through 10% more metres per hour. The extra data collected helps the firm to evaluate the quality of the ore for further digging.

Next year Rio hopes to win regulatory approval to run the world’s first driverless trains along 1,700km of track between its 16 iron-ore mines and four ports in the Pilbara. It completed a 100km test run in September. According to Mr Salisbury, autonomy can provide a 6% improvement in average speed, and the elimination of three driver-changes in each 40-hour period. This may sound small, but it adds up. Trains will also run closer together, adding more to the system at any one time.

Although Rio introduced its first driverless trucks almost a decade ago, the move to autonomy has been slow, involving finicky fine-tuning with suppliers. Mr Jacques says technological improvements will provide only a third of the \$5bn in additional free cashflow, chiefly from its iron-ore and aluminium operations, which Rio intends to generate over the next five

years. But from 2021 onwards he expects new technologies, and autonomy in particular, to be a bigger driver of returns. By then Rio intends to start iron-ore production at Koodaideri in the Pilbara, which it says will be the first mine designed to be “intelligent”, at a cost of \$2.2bn.

Rio also intends to squeeze out higher returns with more disciplined spending and improved quality. For investors a focus on the bottom line is reassuring—especially as much of Rio’s spare cash is being returned to shareholders in the form of dividends, or being used to de-leverage the balance-sheet. It also makes a change. Under previous management, Rio’s splurges on overpriced assets, such as Alcan, a Canadian aluminium company, in 2007 during the China supercycle, and Riversdale, a coal mine in Mozambique, in 2011, clobbered returns (see chart).

In a sign of their concern, some big shareholders railed against the possibility that Sir Mick Davis, a dealmaking supremo who once led Xstrata, another mining company (and who is now the chief executive of Britain’s Conservative Party), would be named as chairman. Mr Thompson, a financier and former executive at Anglo-American, another mining rival, is seen as a more conservative choice.

His first big task will be to deal with the legacy of Rio’s spendthrift era. In October America’s Securities and Exchange Commission charged the firm, its former boss, Tom Albanese, and another former executive with fraud. It alleged that they failed to disclose the loss of value of the Mozambique transaction to Rio’s board, its auditor or investors, and also released misleading financial statements shortly before raising debt in America. (Rio and its ex-employees deny the charges.)

These headaches aside, the firm’s core mining business is in comparatively good shape. China’s demand for the high-grade iron ore that is a speciality of Rio’s Pilbara operations is buoyant; iron ore accounts for about two-

thirds of its earnings. Aluminium demand is also likely to grow briskly, thanks in part to demand for lighter cars. Mr Jacques insists that Rio will not make overpriced acquisitions even to secure prized battery minerals such as lithium. The future may be driverless, but steadier hands appear to be on the wheel. ■



力拓

机器中的幽灵

世界上最大的矿业公司之一决定信任重300吨的机器人

几千年来，人类都在弄碎石头。无论是用镐或炸药，用自己的或动物的肌肉，用挖掘机或柴油卡车，粗壮的矿工们一直都处在这个为几乎所有工业活动提供原材料的行业中心。要让采矿更有利可图，总是要尽力用每盎司肌肉挤出更多的金属。而如今，机器人正在取代人类，坐到了这项活动的驾驶座上。

在澳大利亚西部的皮尔巴拉（Pilbara）地区，世界上最大的矿业公司之一力拓正在其大规模铁矿石业务中引领这样一场变革。公司开始依赖无人卡车、无人钻机和火车开展作业，只从往南约1000公里外的珀斯（Perth）一个只有几张扶手椅的办公室里监控它们。力拓的首席执行官让-塞巴斯蒂安·雅克（Jean-Sébastien Jacques）表示，在自主技术领域方面，力拓领先其采矿对手十年。对于他和12月4日刚刚被任命为公司董事会主席的西蒙·汤普森（Simon Thompson）来说，问题在于这种技术是否能驾驭矿业另一个古老的特征——繁荣与萧条的周期。

在参观力拓位于皮尔巴拉的霍普唐斯四号矿山（Hope Downs 4）时，起初会看到一辆辆驾驶室空无一人的300吨卡车在红色尘土中飞驰上山，让人感到些许怪异。然后你看到这些超大型的机器巨兽竟如此着迷于安全——如果有山楂树摇曳着挡住它们的去路，它们就会震颤着急停下来，这又让人感到亲切。

对于矿山管理者而言，静寂扑面而来：司机的双向无线电中再没有没完没了的闲谈。他们也对生产率的提高表示欢迎。他们说，在12个小时之内，有人驾驶的卡车是有竞争力的，但超过24小时之后，没有茶歇、驾驶员疲劳以及换班的影响开始显现。自动驾驶卡车每天唯一停下来的一次是去加油。“然后你拍拍它们的屁股，它们就又上路了。”一名管理员说，由于推行自动化，矿山的人员已经减少了大约三分之一。力拓在皮尔巴拉拥有

400多辆卡车，其中有76辆是自动驾驶，运营成本预计比其他车便宜15%。

坐两小时飞机可到达力拓位于珀斯的运营中心，工程师们在这里用屏幕和电脑遥控设备。“你必须把灰尘吹到他们脸上，让他们觉得自己在皮尔巴拉，否则就太舒服了，”一位正在监督员工操作的高管打趣道。力拓共有六个自主钻机在挖掘皮尔巴拉的岩石，他手下坐办公室的员工负责其中两个。力拓的铁矿老板克里斯·索尔兹伯里（Chris Salisbury）表示，自主性使得钻机的平均运行时间比有人钻机长三分之一，并且每小时开挖的距离也要多10%。收集的额外数据有助于公司评估矿石的质量，以便进一步开采。

力拓希望获得监管部门的批准，在连接皮尔巴拉16个铁矿和4个港口之间1700公里长的轨道上运行世界上第一批无人驾驶列车。公司在9月份完成了100公里的试运行。根据索尔兹伯里的说法，自动驾驶可使平均速度提高6%，并且不再需要每40小时让驾驶员换三次班。这听起来可能无关紧要，但累积起来就很可观。火车发车间隔也会更小，在任何时候都给系统增加更多的运力。

虽然自力拓推出第一款无人驾驶卡车以来已近十年，但自主化进程缓慢，因为涉及到与供应商之间苛刻的精细调整。雅克说，力拓计划在未来五年增加50亿美元的自由现金流，主要来自铁矿和铝业务，而技术改进仅会贡献其中的三分之一。但从2021年起，他期望新技术，尤其是自主技术，能够成为更大的回报来源。到那时，力拓计划在皮尔巴拉的库达德利（Koodaideri）启动铁矿石生产，据说它将成为第一个“智能”矿山，耗资22亿美元。

力拓还打算通过严控开支和改进质量来挤出更高的回报。对于投资者来说，公司关注利润这一点令人放心——尤其是力拓的大部分闲置资金都以股息的形式返还给股东，或者被用来去杠杆。它自身也做出了改变。在之前的管理层领导下，力拓在估值过高的资产上出手阔绰，比如2007年在中国市场大热期间购买了加拿大铝业（Alcan），2011年购买了莫桑比克的

里弗斯戴尔煤矿（Riversdale），都让回报率遭受重创（见图表）。

一些大股东曾高声反对米克·戴维斯爵士（Sir Mick Davis）出任董事会主席的可能性，流露出他们的顾虑。戴维斯是交易高手，曾经领导过另一家矿业公司斯特拉塔（Xstrata），目前是英国保守党的首席执行官。另一个矿业竞争对手英美资源集团（Anglo-American）的金融家和前高管汤普森被视为更保守的选择。

他的第一个重要任务是处理力拓挥霍时代的遗留。10月，美国证券交易委员会指控该公司及其前任老板汤姆·阿尔巴尼斯（Tom Albanese）和另一名前高管涉嫌欺诈。据称，他们没有将莫桑比克交易的价值损失披露给力拓董事会、审计师或投资者，还在美国发债前不久公布了误导性财务报表。（力拓及其前雇员均否认该指控。）

抛开这些让人头痛的问题，公司的核心采矿业务状况相对较好。中国高品位铁矿石的需求旺盛，而这正是力拓皮尔巴拉的业务特色——铁矿石占其收入的三分之二左右。铝的需求也可能快速增长，部分原因是对于轻型汽车的需求。雅克坚持一点：哪怕是为了获得锂等备受追捧的电池用矿物，力拓也不会以过高的价格开展收购。无人驾驶也许是未来，但方向盘上似乎还有了一双更稳健的手。■



Artificial intelligence

Algorithm is gonna get you

Machine learning's big shindig

“CORPORATE conferences still suck.” So read the T-shirt sported by Ben Recht, a professor at the University of California, Berkeley, as he collected an award at the Neural Information Processing Systems (NIPS) conference early this Month. Dr Recht, pictured above in lecture mode, was protesting against the flood of corporate money pouring into NIPS, aping the words Kurt Cobain wrote on a T-shirt when he appeared on the cover of *Rolling Stone* in 1992.

“It’s not an academic conference anymore,” Dr Recht says wistfully, perched in the Californian sun on the steps of the Long Beach Convention Centre. He complains that folk would rather go to corporate-sponsored parties these days (Intel’s featured Flo Rida, a rapper), than poster sessions. AI, it seems, is the new rock and roll.

NIPS began in 1987 as a humble little conference on an obscure branch of machine learning called neural networks. It spent the first 13 years of its life in Denver, then moved to Vancouver for a decade. It used to be a quiet affair, with a few hundred mathy computer scientists coming together to explain how they had solved some abstract problem in a new way.

Then, at the 2003 conference, Geoffrey Hinton, a British polymath, and a cabal of AI researchers founded the Neural Computation & Adaptive Perception (NCAP) working group. As a proponent of neural networks, Dr Hinton and the group helped accelerate the pace of research into a form of machine learning known as deep learning, leading to huge advances in image recognition in 2012. Deep learning, which stacks many neural networks on top of one another to learn the features of giant databases,

now powers the image-processing operations of firms like Facebook and Google. As machines, trained with heaps of data to develop clever algorithms, have become capable of carrying out more and more tasks, so interest has grown. Google was sponsoring NIPS by 2010, and this year all of the world's largest tech firms could be found on the sponsor sheet.

For the 7,850 attendees, the big draw is the algorithms presented in halls heaving with mostly male bodies (90% of the authors of NIPS papers were male this year, a gender imbalance widely found in science). They hang on every word of AI wisdom imparted by luminaries from Google and Microsoft; pore over a dizzying number of advances (laid out in more than 670 published papers) from the likes of Facebook, DeepMind (a unit of Google) and Tencent; and devour stories of novel ways to train machines to perform useful tasks.

Those stories come not just from the big names of technology, but also from more old-fangled companies, such as Target, a bricks-and-mortar American retailer. Brian Copeland, one of the firm's data scientists in Minneapolis, says he is trying to apply machine-vision algorithms to the video feeds from the cameras in Target's stores. Retailers employ behavioural experts to watch such videos so they can work out how people use their stores and where to place goods to the best advantage. With the right algorithms, Target could automate the process and run it in real time.

Many firms were also putting on a show as part of the battle for AI talent. They included Mercedes-Benz, a first-time sponsor, which is trying to recruit data scientists to work on its autonomous cars. The German producer is already some way down the road, with Rigel Smiroldo, the firm's machine-learning boss in North America, happy to recite how the E-class Mercedes he drove to NIPS handled 250 miles of highway driving without him needing to intervene.

| *Yes, no and now, maybe*

Mr Smirollo does put his finger on one of the main trends at this year's NIPS: the merging of Bayesian statistics with deep learning. Instead of algorithms presenting deterministic "yes" or "no" results to queries, new systems are able to offer up more probabilistic inferences about the world. This is particularly useful for Mercedes-Benz, which needs driverless cars that can handle tricky situations. Instead of an algorithm simply determining if an object in the road is a pedestrian or a plastic bag, a system using Bayesian learning offers a more nuanced view that will allow AI systems to handle uncertainty better.

Netflix already uses data science to recommend shows to its subscribers. Nirmal Govind, who develops algorithms at the firm, was on the lookout at NIPS for new, improved versions that can handle imagery and video. The firm is particularly interested in automating the generation of promotional material around its original shows and finding ways to make that material more engaging.

Besides fundamental algorithms which firms hope to apply to their own operations, NIPS is also home to applied research, particularly in health care and biology. Becks Simpson from Maxwell MRI, a startup from Brisbane in Australia, showed a way to combine magnetic resonance imaging with deep learning to improve the diagnosis of prostate cancer. Elisabeth Rumetshofer from Johannes Kepler University Linz presented a system that could automatically recognise and track proteins in cells, helping to illuminate the underlying biology. A team from Duke University in North Carolina had used machine learning to detect cervical cancer automatically using a pocket colposcope, to the same level of accuracy as a human expert. Some used AI to mine doctors' notes to estimate the chances that a patient will be readmitted to hospital, to categorise and understand the allergic reactions of children and to model the geographic distribution of naloxone, which can help block the effects of opioids, in order to get a

better grip on the use of such drugs.

Other applications ranged from researchers at the Federal University Lokoja in Nigeria trying to use machine learning to identify potential child suicide bombers to the Donders Institute in the Netherlands presenting a system that can reconstruct pictures of faces that a person sees simply by scanning their brains. Google researchers used machine learning to hide a complete image inside another picture of the same size. What they might do with that remains to be seen.

New hardware for machine learning was on display, too. At its party Intel unveiled its latest chip dedicated to solving AI problems. NVIDIA, a chipmaking rival whose share price has increased ninefold in the past three years thanks to sales of its graphical-processing units for deep learning, displayed its latest wares. Graphcore, a British startup, caused particular waves. It presented benchmarks for its chip's performance on common machine-learning tasks that tripled speeds for image recognition and delivered a claimed 200 times improvement over NVIDIA for the kinds of machine learning required for speech-recognition and translation applications.

Among older hands at NIPS, especially those who can remember its origins, there is a sense that the corporate obsession with machine learning will not last. They should not be so sure. The systems being developed are just beginning to be a broadly useful technology, and new algorithms presented at the conference are likely to be adopted rapidly. Powerful computers and large volumes of data lie waiting for exploitation. The world's most valuable companies have grasped the power of machine learning, and they are unlikely to let go. ■



人工智能

算法算上你

机器学习的狂欢

“商业会议还是很烂。”在本月初举行的神经信息处理系统大会（以下简称NIPS）上，加州大学伯克利分校教授本·雷希特（Ben Recht）身穿写着这句话的T恤上台领奖。雷希特（上图中他正在授课）是在模仿1992年科特·柯本（Kurt Cobain）亮相《滚石》杂志封面时穿的T恤上的字句（Corporate Magazine Still Suck），以示对企业赞助涌入NIPS的抗议。

“这已不再是一个学术会议了。”长滩会议中心外的台阶上，坐在加州阳光里的雷希特语带惆怅地说。他抱怨说，现在大家都宁愿去参加企业赞助的派对（英特尔请来了美国说唱歌手弗洛·里达），而不愿去参加论文展示交流环节了。AI似乎成为了新时代的摇滚。

NIPS始于1987年，最初只是针对机器学习中“神经网络”这个不起眼的研究分支而举行的简单小型会议。前13届的举办地都是丹佛，之后10届转到温哥华。从前这是个低调的活动，几百名精通数学的计算机科学家聚集在一起，阐述自己如何以新方式解决了某些抽象问题。

后来，在2003年的NIPS会议上，英国学者杰弗里·辛顿（Geoffrey Hinton）及一群AI研究人员成立了“神经计算和自适应感知”（NCAP）项目小组。作为神经网络研究的推动者，辛顿及其项目组加速了业界研究“深度学习”这一机器学习技术的步伐，进而令图像识别技术在2012年取得巨大进展。深度学习通过逐层叠加多个神经网络来学习各种庞大数据库内的数据特征，如今已为Facebook和谷歌等公司所用，为图像处理提供支持。机器经过大量数据训练，开发出智能算法，可执行的任务越来越多，受到的关注也随之增长。2010年之前NIPS的赞助商一直是谷歌，到了今年，世界最大的科技公司都在会议赞助商的名单上。

会场中人潮涌动，大多数是男性。（今年NIPS的会议论文作者90%为男

性。性别失衡在科学界普遍存在。)对于7850名与会者来说,最具吸引力的是会议上展示的算法。他们聆听谷歌和微软的专家讲授AI真知时的一字一句,探究Facebook、DeepMind(谷歌的AI研究部门)和腾讯等公司让人目不暇接的各种进展(在670多篇论文中一一展示),津津有味地倾听采用新奇手段训练机器执行实用任务的案例。

讲述案例的不止是科技巨头,还有一些传统企业,比如美国实体零售商塔吉特百货(Target)。该公司在明尼阿波利斯的数据科学家布莱恩·科普兰(Brian Copeland)称自己正在尝试使用机器视觉算法分析店铺内的监控视频。零售商聘请行为学专家观看视频,了解人们如何在店内活动,以确定摆放商品的最佳位置。使用合适的算法,塔吉特可将这一工作自动化并进行实时分析。

许多公司在NIPS登场也是为了争夺AI人才。其中就有首次赞助会议的梅赛德斯-奔驰,它正在寻觅数据科学家参与其无人驾驶汽车的研发。这家德国制造商在这个领域已取得一定进展,其机器学习部门的北美负责人里格尔·斯莫尔德(Rigel Smioldo)欣然讲述载他前往NIPS会场的奔驰E级车如何自行驶过250英里的高速公路,而无须他介入操作。

| “是或否”变“也许”

斯莫尔德确实触及到了今年NIPS会议的热点之一:贝叶斯统计与深度学习的融合。这类新系统并不只是对查询提供确定性的“是”或“否”的答案,而是提供更多有关现实世界的概率推理。这对奔驰特别有用,因为它的无人驾驶汽车要能处理各种棘手情况。不同于那种只判断道路上的物体是行人还是塑料袋的算法,运用贝叶斯学习的系统提供更细致的视野,让AI系统更好地处理不确定性。

Netflix已经在运用数据科学向其用户推荐节目。为该公司开发算法的尼马尔·高文德(Nirmal Govind)在NIPS上密切留意能够处理图像和视频的新型算法。Netflix尤其感兴趣的是能根据其原创节目自动生成宣传材料,并设法提升这些材料的吸引力。

NIPS不仅有企业希望能应用于自身业务的基础算法，还是应用研究的沃土，尤其是在医疗保健和生物学领域。澳大利亚布里斯班的创业公司Maxwell MRI的贝克·辛普森（Becks Simpson）展示了如何把磁共振成像与深度学习相结合，改善对前列腺癌的诊断。奥地利林茨约翰开普勒大学（Johannes Kepler University Linz）的学者伊丽莎白·鲁米舒弗（Elisabeth Rumetshofer）在会上介绍了可自动识别并追踪细胞内蛋白质的系统，有助解释基础生物机制。北卡罗来纳州的杜克大学（Duke University）的研究团队使用迷你阴道镜，利用机器学习技术自动检测宫颈癌，准确度堪比人类专家。有些公司运用AI技术研究医生写的病历，以此估计病人再次入院的几率。有些对儿童过敏反应进行分类和解读。还有些运用AI模拟纳洛酮（可抑制阿片类药物的药效）的地理分布，以便更清楚地了解这些药物的使用情况。

还有其他的应用例子，比如尼日利亚洛科贾联邦大学（Federal University Lokoja）的研究人员正尝试运用机器学习来识别可能的儿童自杀式炸弹；荷兰唐德斯研究所（Donders Institute）的研究人员演示了一个系统，只要扫描大脑就能重构人们看到的面部的图像。谷歌的研究人员则运用机器学习将一整张图片隐藏于另一张相同尺寸的图片中。他们会如何应用这项技术仍有待观察。

在NIPS上登场的还有为机器学习打造的新式硬件。英特尔在会后的派对上推出了最新的AI专用芯片。它的对手、芯片制造商英伟达（NVIDIA）也展示了最新产品。英伟达为深度学习打造的图形处理器大卖，股价在过去三年里已上涨至原来的九倍。英国创业公司Graphcore尤为引人注目，展示了普通机器学习任务中所用芯片的性能标杆，它的芯片令图像识别速度提高了两倍，并声称在语音识别及翻译应用方面的机器学习上达到英伟达硬件性能的200倍。

NIPS的资深与会者，尤其是那些还记得会议起源的人，总感觉企业对机器学习的痴迷不会长久。他们不该如此确信。这些开发中的系统还只是刚刚开始成为应用广泛的技术，而会上展示的新算法很可能被迅速采用。还有强大的计算机和大量数据有待开发利用。世界最具价值的公司已经掌握

了机器学习的力量，它们是不太可能放手的。■



Hedge funds and artificial intelligence

Return on AI

AI-driven hedge funds need human brains, too

ARTIFICIAL intelligence (AI) has already changed some activities, including parts of finance like fraud prevention, but not yet fund management and stock-picking. That seems odd: machine learning, a subset of AI that excels at finding patterns and making predictions using reams of data, looks like an ideal tool for the business. Yet well-established “quant” hedge funds in London or New York are often sniffy about its potential. In San Francisco, however, where machine learning is so much part of the furniture the term features unexplained on roadside billboards, a cluster of upstart hedge funds has sprung up in order to exploit these techniques.

These new hedgies are modest enough to concede some of their competitors’ points. Babak Hojdat, co-founder of Sentient Technologies, an AI startup with a hedge-fund arm, says that, left to their own devices, machine-learning techniques are prone to “overfit”, ie, to finding peculiar patterns in the specific data they are trained on that do not hold up in the wider world. This is especially true of financial data, he says, because of their comparative paucity. Share-price time series going back decades still contain far less information than, say, the image data used to train Facebook’s facial-recognition algorithms.

The trick, then, is to take a more thoughtful approach to deploying AI. Technical prowess obviously matters; Sentient employs a couple of dozen AI experts and constantly researches new methods. But business models matter enormously, too. Sentient started out as a tiny fund a decade ago, managing only its own founders’ money. In the past three years it has expanded into other applications for AI, such as online shopping and website optimisation. Only earlier this year did it launch a hedge fund open

to outside money, on which it hopes to apply the insights gleaned elsewhere in its investment arm.

Another San Francisco hedge fund that draws on an even wider pool of expertise, by virtue of its unusual business model, is Numerai, a firm founded in 2015 that launched its first fund this autumn. It starts by taking financial data and then encrypts them so that they are unrecognisable. Its chief operating officer, Matthew Boyd, says this turns them into a “pure math problem”. The idea is that this avoids biases creeping into models—and appeals to Valley types better than the grubby business of picking securities.

It then runs two-stage competitions for machine-learning algorithms that perform best on the data. Some 1,200 data scientists now take part weekly, competing for virtual prizes (in the fund’s own cryptocurrency) in the first round and cash prizes in the second. That structure seeks to encourage algorithms that do well at picking winners over time. The firm takes the results of the best algorithms, decrypts these results back into financial data, and uses the insights to decide which shares to trade. The fund owes at least as much to crowdsourcing, then, as it does to harnessing AI.

One hedge fund that does tout its machine-dependent model, despite naming itself after the human brain, is Cerebellum Capital. Founded as an arbitrage fund in 2008, it started work on a fully AI-run American equity fund in 2016, and launched it in April this year. The fund uses machine learning not just to crunch data and come up with strategies. The classification system that gauges the relative merits of these strategies is itself run by machine learning. But humans do the actual trading, following the algorithm’s instructions.

However they perform in the long term, therefore, one feature of these new AI funds is already clear. At least in investing, more artificial intelligence

does not necessarily mean less of the human kind. ■



对冲基金与人工智能

AI回报

由AI操盘的对冲基金也离不开人脑

人工智能（以下简称AI）已经改变了一些活动，其中包括某些金融工作，如防范欺诈，但它却尚未用于资金管理和选股。这似乎有些奇怪：作为AI分支的机器学习技术善于运用庞大数据寻找模式并做出预测，似乎是这一领域的理想工具。但伦敦或纽约的大牌“量化”对冲基金往往对该技术的潜力不以为然。然而在旧金山，情况则不同。在这个城市，机器学习司空见惯，路边广告牌上就直接印着这个名词。一批希望利用该技术的新兴对冲基金已在这里涌现。

这些新型对冲基金态度足够谦虚，肯承认对手的一些观点。设有对冲基金部门的AI创业公司感知科技（Sentient Technologies）的联合创始人巴巴克·霍加特（Babak Hojdat）表示，如果不加干预，机器学习技术很可能会出现“过拟合”现象，即在用于训练的特定数据中识别出了特殊模式，却无法在现实世界广泛应用。他指出，金融数据相对稀缺，因此尤其容易引发这一问题。累积几十年的股价时间序列包含的信息远远少于其他数据，例如Facebook用于训练人脸识别算法的图像数据。

那么，关键就在于采取更周密的方式来部署AI。技术实力显然非常重要：感知科技聘请了几十位AI专家，不断开发新方法。但商业模式也极为重要。感知科技在十年前起步时是一家小型基金公司，只管理创始人的资金。过去三年来，公司已扩展到AI的其他应用领域，如网络购物和网站优化。直到今年早前，该公司才推出一只接受外部投资的对冲基金，希望将从其他地方获得的洞见运用在自己的投资部门中。

另一家旧金山对冲基金公司Numerai有着不同寻常的商业模式，从而利用了更多的专业人才。这家成立于2015年的公司在今年秋天推出了首只基金。该公司先是收集金融数据，然后加密，令其无法被识别。公司的首席运营官马修·博伊德（Matthew Boyd）表示，这将数据变成了“纯粹的数

学问题”。公司认为这样可以避免模型中掺杂偏见，而且，相比挑选证券牵涉的肮脏交易，这也更能吸引硅谷人士。

之后，Numerai开展两个阶段的比赛，挑选在运用上述数据时表现最佳的机器学习算法。现在，每周约有1200名数据科学家参加比赛，在第一轮争夺虚拟奖金（该基金公司自己的加密货币），在第二轮争夺现金奖励。如此设计为的是促进开发具备长期优选能力的算法。公司把最佳算法的结果还原为金融数据，利用这些发现来决定交易哪些股票。如此看来，众包对该基金的贡献并不低于AI技术。

对冲基金公司小脑资本（Cerebellum Capital）倒是标榜其高度依赖机器的商业模式，尽管它以人脑命名。在2008年创立之初，该公司是一家套利基金，自2016年开始筹备一只完全采用AI投资美国股票的基金，并于今年4月推出。该基金不只用机器学习分析数据和出谋划策，就连衡量这些策略优缺点的分类系统本身也是由机器学习技术运作的。不过，实际交易操作还是由人工根据算法的指示来完成。

因此，无论这些新型AI基金长期表现如何，它们的一个特点已经明显呈现。至少在投资领域，更多地采用人工智能并不一定意味着需要的人类智慧就少了。■



Artificial intelligence

Battle of the brains

Tech giants are investing billions in a transformative technology

COMMANDING the plot lines of Hollywood films, covers of magazines and reams of newsprint, the contest between artificial intelligence (AI) and mankind draws much attention. Doomsayers warn that AI could eradicate jobs, break laws and start wars. But such predictions concern the distant future. The competition today is not between humans and machines but among the world's technology giants, which are investing feverishly to get a lead over each other in AI.

An exponential increase in the availability of digital data, the force of computing power and the brilliance of algorithms has fuelled excitement about this formerly obscure corner of computer science. The West's largest tech firms, including Alphabet (Google's parent), Amazon, Apple, Facebook, IBM and Microsoft are investing huge sums to develop their AI capabilities, as are their counterparts in China. Although it is difficult to separate tech firms' investments in AI from other kinds, so far in 2017 (see chart 1) companies globally have completed around \$21.3bn in mergers and acquisitions related to AI, according to PitchBook, a data provider, or around 26 times more than in 2015.

Machine learning is the branch of AI that is most relevant to these firms. Computers sift through data to recognise patterns and make predictions without being explicitly programmed to do so. The technique is now used in all manner of applications in the tech industry, including online ad targeting, product recommendations, augmented reality and self-driving cars. Zoubin Ghahramani, who leads AI research at Uber, believes that AI will be as transformative as the rise of computers.

One way to understand AI's potential impact is to look at databases. From the 1980s these made it cheap to store information, pull out insights and handle cognitive tasks such as inventory management. Databases powered the first generation of software; AI will make the next far more predictive and responsive, says Frank Chen of Andreessen Horowitz, a venture-capital firm. An application such as Google's Gmail, which scans the content of e-mails and suggests quick, one-touch replies on mobile devices, is an early example of what could be coming.

As with past waves of new technology, such as the rise of personal computers and mobile telephony, AI has the potential to shake up the businesses of the tech giants by helping them overhaul existing operations and dream up new enterprises. But it also comes with a sense of menace. "If you're a tech company and you're not building AI as a core competence, then you're setting yourself up for an invention from the outside," says Jeff Wilke, chief executive of "worldwide consumer" at Amazon, and adjutant to Jeff Bezos.

Fuelled by rivalry, high hopes and hype, the AI boom can feel like the first California gold rush. Although Chinese firms such as Baidu and Alibaba are also investing in AI, and deploying it in their home market, the most visible prospectors are Western tech firms. Alphabet is widely perceived to be in the lead. It has been making sizeable profits from AI for years and has many of the best-known researchers. But it is early days and the race is far from over. Over the next several years, large tech firms are going to go head-to-head in three ways. They will continue to compete for talent to help train their corporate "brains"; they will try to apply machine learning to their existing businesses more effectively than rivals; and they will try to create new profit centres with the help of AI.

| *Idiot savants*

The most frenzied rush is for human talent, which is far more scarce than

either data or computing power. Demand for AI “builders” who can apply machine-learning techniques to huge sets of data in creative ways has ballooned, far exceeding the number of top students who have studied the techniques.

Today AI systems are like “idiot savants,” says Gurdeep Singh Pall of Microsoft. “They are great at what they do, but if you don’t use them correctly, it’s a disaster.” Hiring the right people can be critical to a firm’s survival (some startups fail for lack of the right AI skills) which has set off a trend of firms plundering academic departments to hire professors and graduate students before they finish their degrees.

Job fairs now resemble frantic “Thanksgiving Black Friday sales at Walmart”, says Andrew Moore, dean of Carnegie Mellon University’s (CMU) school of computer science, a pioneering institution in AI (whose robotics department was famously plundered by Uber in 2015). Academic conferences, such as the Neural Information Processing Systems held early this month in Long Beach, California, double up as places to shop for talent. The best recruiters are academia’s AI celebrities: people like Yann LeCun of Facebook and Geoffrey Hinton of Google—both former professors who keep a university affiliation—can attract others to work alongside them. Proprietary data can also serve as a draw, if the huge salaries are not enough.

If none of that works, companies buy whole startups. The tech industry first took notice of this trend in 2014, when Google spent an estimated \$500m on DeepMind, a startup with no revenue or marketable product but a team of “deep learning” researchers; after the deal they designed a program that beat the world champion at “Go”, an ancient board game. Other firms have also shelled out to buy money-losing startups, which are typically valued not on future profits or even sales but instead receive a price for each employee that can be as much as \$5m-10m.

| *Behind closed doors*

Companies have different philosophies about how to deal with staff. Some, such as Microsoft and IBM, invest heavily in AI research and publish a large number of papers (see chart 2), but do not require researchers to apply their findings to money-making activities. At the opposite end of the scale are Apple and Amazon, which do not have enormous research initiatives, expect all work to feed into products and are tight-lipped about their work. Google and Facebook are somewhere in between on whether researchers must toil only on money-making ventures.

The intense battle for talent may force secretive companies to become more open. “If you tell them, ‘come work with us but you can’t tell anyone what you’re working on’, then they won’t come because you’ll be killing their career,” explains Mr LeCun, who leads Facebook’s AI research lab. This trade-off between secrecy and the need to attract people also applies to the Chinese giants, which are trying to establish Western outposts and hire American researchers. Baidu has opened two research labs with an AI focus in Silicon Valley, in 2013 and this year. Western AI researchers rate them highly but prefer to work for the American giants, in part due to their relative transparency.

If companies can lure the right people in AI, the effect is to extend their workforces exponentially. AI is “like having a million interns” at one’s disposal, says Benedict Evans of Andreessen Horowitz. That computational power is then integrated into firms’ existing businesses.

The advantages of AI are most visible in firms’ predictions of what users want. Automated recommendations and suggestions are responsible for around three-quarters of what people watch on Netflix, for example, and more than a third of what people buy on Amazon. Facebook, which owns the popular app Instagram, uses machine learning to recognise the content of posts, photos and videos and display relevant ones to users, as well as

filter out spam. In the past it ranked posts chronologically, but serving up posts and ads by relevance keeps users more engaged.

Without machine learning, Facebook would never have achieved its current scale, argues Joaquin Candela, head of its applied AI group. Companies that did not use AI in search, or were late to do so, struggled, as in the case of Yahoo and its search engine, and also Microsoft's Bing.

Amazon and Google have gone furthest in applying AI to a range of operations. Machine learning makes Amazon's online and physical operations more efficient. It has around 80,000 robots in its fulfilment centres, and also uses AI to categorise inventory and decide which trucks to allocate packages to. For grocery ordering, it has applied computer vision to recognise which strawberries and other fruits are ripe and fresh enough to be delivered to customers, and is developing autonomous drones that will one day deliver orders.

As for Google, it uses AI to categorise content on YouTube, its online-video website, and weed out (some) objectionable material, and also to identify people and group them in its app, Google Photos. AI is also embedded in Android, its operating system, helping it to work more smoothly and to predict which apps people are interested in using. Google Brain is regarded in the field of AI as one of the best research groups at applying machine-learning advances profitably, for example by improving search algorithms. As for DeepMind, the British firm may not ever generate much actual revenue for Alphabet, but it has helped its parent save money by increasing the energy efficiency of its global data centres (and its Go experiment was a public-relations coup).

Artificial intelligence is also being applied in the corporate world. David Kenny, the boss of Watson, IBM's AI platform, predicts that there will be "two AIs": companies that profit from offering AI-infused services to

consumers and others which offer them to businesses. In practice, the two worlds meet because of the tech giants' cloud-computing arms. Providers are competing to use AI as a way to differentiate their offerings and lock in customers. The three largest—Amazon Web Services, Microsoft's Azure and Google Cloud—offer application-programming interfaces (APIs) that provide machine-learning capabilities to other companies. Microsoft's cloud offering, Azure, for example, helped Uber build a verification tool that asks drivers to take a selfie to confirm their identities when they work. Google Cloud offers a "jobs API", which helps companies match jobseekers with the best positions.

| *AI on the brain*

Many firms in other industries, from retailing to media, stand to benefit from what those in the cloud business tout as the "democratisation" of AI. Providing AI to companies that do not have the skills or scale to build up sophisticated capabilities independently could be a money-spinner in the \$250bn cloud market. But providers often must customise APIs for clients' complex needs, which is time-consuming. Microsoft, with its history of selling software to clients and offering them support, seems likely to do well in this area. It is only a matter of time before AI offerings become "more and more self-help", counters Diane Greene, who runs Google Cloud.

IBM is another contender, having backed a huge marketing campaign for its Watson platform. AI researchers tend to be dismissive of IBM, which has a large consulting business and a reputation for valuing time billed over terabytes. The firm's critics also point out that, although IBM has invested over \$15bn in Watson and spent \$5bn between 2010 and 2015 to buy companies, much of that with the aim of acquiring proprietary data, for the most part it does not have unique data of its own. But IBM's weaknesses may not hold it back. Bosses of most businesses feel pressure to have an AI strategy, and they will pay handsomely to acquire one quickly.

To date tech giants have mostly tried to apply AI to reap profits from their existing operations. In the next few years they hope that AI will let them build new businesses. One area of intense competition is virtual assistants. Smartphones know their users intimately, but AI-powered virtual assistants aim to take the relationship further, whether through phones or smartspeakers. Apple was first to explore their promise when it bought Siri, a voice assistant, in 2010. Since then Amazon, Google and Microsoft have invested heavily: their assistants' speech recognition is better as a result. Samsung, Facebook and Baidu are also competing to offer them.

| *One algorithm to rule them all*

It is unclear whether standalone speakers will become a huge market, but it is certain that people will move beyond text to engage with the internet. "All these companies understand that whoever owns that choke point for consumers will rule the market," says Pedro Domingos, author of "The Master Algorithm", a book about AI.

Further into the future, augmented-reality (AR) devices are another AI-infused opportunity. Mobile apps like Snap, a messaging app, and the game Pokémon Go are early examples of AR. But AR could more radically transform people's relationship with the internet, so that they consume digital information not from a small screen but via an ambient, ever-present experience. AR devices will offer portable AI capabilities, such as simultaneous translation and facial recognition.

In the race for AR, big tech firms have not got much beyond the warm-up phase. Google and Apple have launched AR software-development kits; they both want developers to build apps that use AR on their platforms. There is also a rush to develop AR hardware. Google was early to launch a prototype for AR glasses, but they flopped. Microsoft has developed a headset it calls HoloLens, but with a price of between \$3,000-5,000, it is a niche product. Other firms, including Facebook and Apple, are thought to

be planning their own offerings. Being ahead in AI could translate into big leads in these new fields.

Nowhere is that truer than in the realm of autonomous vehicles. Tech firms are driving millions of miles to build up big, proprietary datasets, and are making use of computer vision to train their systems to recognise objects in the real world. The potential spoils are huge. Personal transportation is a vast market, worth around \$10trn globally, and whoever cracks self-driving cars can apply their knowledge to other AI-based projects, such as drones and robots. Unlike search engines, where people may choose to use a service that is good enough, users are more likely to favour self-driving cars with the best safety record, meaning that the companies that best employ AI to map out the physical world and register the fewest crashes will enjoy outsize benefits.

Each firm is approaching the problem differently. Baidu, the Chinese giant, is trying to create a self-driving-car operating system, much like Google's Android in mobile devices (although it is unclear how it plans to make money). Alphabet has its own autonomous-car effort, as do Uber, Tesla, an electric carmaker, a herd of little-known startups and, increasingly, established carmakers. (Apple is rumoured to have scaled back its car ambitions.)

Self-driving cars are just one example of how technology firms' AI strategies are pushing beyond the virtual world of software into hardware. Many companies, including Alphabet, Apple and Microsoft, are also investing to build specialised, powerful "AI chips" that can power their various activities. These will compete with those made by NVIDIA, a tech firm that has built an empire on powerful chips used in various AI realms, such as autonomous cars and virtual reality.

It is unclear whether the likes of Alphabet and Apple will sell these chips to

rival firms or keep them for themselves. They have an incentive to use their innovations to improve their own services, rather than renting or selling them to rivals—which could become a problem if it means a very few firms develop a meaningful advantage in brute computing power.

That begs the broader question of whether AI will further concentrate power among today's digital giants. It seems likely that the incumbent tech groups will capture many of AI's gains, given their wealth of data, computing power, smart algorithms and human talent, not to mention a head start on investing. History points to the likelihood of concentration; both databases and personal computers ushered in ascendancies, if only for a while, of a tiny group of tech firms (Oracle and IBM in databases, Microsoft and Apple in personal computers).

By the metrics that count—talent, computing power and data—Google appears to be in the lead in AI. It can afford the cleverest people and has such a variety of projects, from drones to cars to smart software, that people interested in machine learning rarely leave. Other firms had to learn to take AI seriously, but Google's founders were early devotees of machine learning and always saw it as a competitive edge.

| *AI's spiritual home*

Some in the tech industry, such as Elon Musk, the boss of Tesla and rocket firm SpaceX, worry about Alphabet and other firms monopolising AI talent and expertise. He and a handful of other prominent Silicon Valley bosses funded OpenAI, a not-for-profit research outfit focused on AI with no corporate affiliation. Mr Musk and others are worried about what might happen when a firm finally cracks “general intelligence”, the ability of a computer to perform any human task without being explicitly programmed to do so. Such a vision is probably decades away, but that does not stop Google from talking about it. “We absolutely want to” crack general AI, says Jeff Dean, the boss of Google Brain. If a firm were to manage this, it could

change the competitive landscape entirely.

In the meantime, much will depend on whether tech firms are open and collaborative. In addition to publishing papers, many companies today make their machine-learning software libraries open source, offering internal tools to rivals and independent developers. Google's library, TensorFlow, is particularly popular. Facebook has open-sourced two of its libraries, Caffe2 and Pytorch. Openness has strategic advantages. As they are used, the libraries are debugged, and the firms behind them get reputational benefits. "Beware of geeks bearing gifts," quips Oren Etzioni of the Allen Institute for Artificial Intelligence, another non-profit research group.

One guru of the field worries that libraries such as TensorFlow will bring in talented researchers but that their owners may start charging later on, or use them for profit in other ways. Such caution may prove wise, but few think about the long term when a gold rush is under way. So it is now in Silicon Valley. Most techies are too consumed by the promise and potential profits of AI to spend too much time worrying about the future. ■



人工智能

大脑之战

科技巨头大力投资一项变革性技术

不论是在好莱坞电影里、杂志封面上，还是铺天盖地的报章新闻中，人工智能（AI）和人类一较高下的主题无处不在，吸引广泛的关注。灾难预言家警告说，AI会消灭职位，违反法律，挑起战争。但这些预言谈论的是遥远的未来。今天的较量并不是发生在人与机器之间，而是在全球科技巨头之间展开。这些大公司正在狂热地投资于AI领域，抢占领先地位。

随着数字化数据呈指数级增长、计算能力飞速提升，以及算法日益强大，AI这个过去在计算机科学中并不起眼的领域已经激发起人们极大的热情。包括Alphabet（谷歌的母公司）、亚马逊、苹果、Facebook、IBM和微软在内的西方最大的科技公司正投入大笔资金加强自身在AI上的实力，中国的科技公司也一样。尽管难以将科技公司对AI的投资与其他方面的投资分开，但数据提供商PitchBook的统计显示，2017年到目前为止（见图表1），全球企业在人工智能领域完成了约213亿美元的并购，比2015年多约26倍。

AI的分支中，机器学习对这些科技公司来说最为重要。计算机无需专门编程，就可以筛选数据、识别模式、做出预测。这项技术如今在科技行业中广泛应用，包括定向网络广告、产品推荐、增强现实和无人驾驶汽车。领导优步AI研究的佐斌·加拉玛尼（Zoubin Ghahramani）认为，AI将和电脑的崛起一样改变世界。

要了解AI的潜在影响，可以看看数据库。自20世纪80年代开始，数据库降低了存储信息、发掘洞见和执行库存管理等认知任务的成本。数据库推动了第一代软件的发展，而风险投资公司安德森霍洛维茨（Andreessen Horowitz）的弗兰克·陈（Frank Chen）表示，AI将让下一代软件的预测性和响应能力大幅提高。谷歌的邮箱应用Gmail初步彰显了AI应用的未来：它可以扫描电子邮件的内容，在移动设备上提供快速的一键回复选

项。

和过去个人电脑及手机的兴起等新技术浪潮一样，AI将助力科技巨头全面变革现有业务、创造新企业，从而可能颠覆这些企业的业务模式。但AI也带来了一种危机感。杰夫·贝佐斯的得力助手、亚马逊全球消费者部门的首席执行官杰夫·威尔克（Jeff Wilke）说：“如果你是一家科技公司，却没把AI作为核心竞争力来打造，那就等着受别人家的AI冲击吧。”

企业激烈角逐，人们寄予厚望，媒体大加炒作，令AI热潮仿佛加州的第一次淘金热。尽管百度、阿里巴巴等中国企业也在投资AI，并在国内市场部署AI，但最引人注目的淘金者还是西方的科技公司。Alphabet被普遍认为在AI发展中领先。多年来它凭借AI获利颇丰，并拥有许多最知名的AI研究人员。但现在一切才刚刚开始，竞赛远未结束。在接下来的几年中，大型科技公司将在三个方面正面交锋：继续争夺人才，帮助训练企业的“大脑”；努力比对手更有效地将机器学习应用于现有业务；努力在AI的帮助下创造新的利润中心。

| 白痴专家

最激烈的竞争是人才之争——人才比数据和计算能力都稀缺得多。AI“构建者”能以创造性的方式将机器学习技术运用于海量数据集，市场对他们的需求激增，远超过学习这些技术的优秀学生的数量。

微软的古尔迪普·辛格·帕尔（Gurdeep Singh Pall）说，今天的AI系统就像“白痴专家”（idiot savant），“它们在擅长的领域如鱼得水，但如果对它们使用不当，后果不堪设想。”聘用合适的人才对于公司的存亡至关重要（一些创业公司正是因缺乏合适的AI技能而失败），为此掀起了一场争夺人才的浪潮，科技公司蜂拥到高校招揽教授和尚未毕业的研究生。

卡内基梅隆大学（CMU）计算机科学学院是领先的AI研究机构（2015年优步挖走了其机器人工程中心的众多人才，此事广为人知），院长安德鲁·摩尔（Andrew Moore）说，现在的招聘会就像“感恩节黑色星期五的沃尔玛促销”那样疯狂。本月初在加利福尼亚州长滩举行的神经信息处理系统

大会这样的学术会议也成了招徕人才之地。学术界的AI大咖就是最好的“招牌”：比如Facebook的杨立昆（Yann LeCun）和谷歌的杰弗里·辛顿（Geoffrey Hinton），两人都曾是大学教授，仍保留学术头衔，能够吸引人才与他们并肩工作。如果高薪还不够吸引人，那么专有数据也可以用作筹码。

如果这些都行不通，大企业就将整个创业公司一举拿下。科技界最早是在2014年注意到这个趋势，当时谷歌斥资约5亿美元收购了DeepMind。这家创业公司根本没有收入或可销售的产品，只有一个“深度学习”研究团队。收购交易完成之后，该团队设计了一个程序，在古老的棋类游戏围棋上击败了世界冠军。其他公司也纷纷斥资收购亏损的创业公司，这些创业公司的估值通常并不以其未来的利润甚或销售额为依据，而是每个员工高达500万至1000万美元的估价。

| 各自精彩

不同的公司在利用员工上有不同的理念。微软和IBM这样的公司在AI领域投入巨大，发表了大量论文（见图表2），但并不要求研究人员将其研究成果应用于能赚钱的项目。苹果和亚马逊的做法完全相反，它们都没有太多的研究计划，期望所有的工作成果最终都能转化为产品，并且对自己的研发守口如瓶。对于研究人员是否必须只在赚钱的项目上苦干，谷歌和Facebook的做法则介于上述两类公司之间。

激烈的人才争夺战可能会迫使喜欢保密的公司变得更开放。Facebook的AI研究实验室负责人杨立昆解释说：“如果跟那些人才说，‘跟我们一起干吧，不过你不能告诉任何人你在做什么’，那他们就不会来，因为这会扼杀他们的职业生涯。”中国巨头正试图在西方建立前哨阵地并聘请美国研究人员，它们同样需要在保密和吸引人才的需要之间做出权衡。百度分别于2013年和今年在硅谷开设了两个以AI为重点的研究实验室，西方AI研究人员对它们的评价很高，但更喜欢为美国大公司工作，部分原因是美国公司相对更透明。

如果企业能够吸引到合适的AI研究人才，就相当于实现了员工数量的指数

级增长。安德森霍洛维茨的本尼迪克特·埃文斯（Benedict Evans）说，拥有AI“就像有了一百万个实习生”可以随意支配。之后公司又会将这种计算能力整合到企业现有的业务中。

AI的优势在企业预测用户需求时最为明显。例如，人们在Netflix上观看内容的约四分之三、在亚马逊网站购买商品超过三分之一都来自系统自动推荐或建议。拥有流行应用Instagram的Facebook利用机器学习来识别贴文、照片和视频的内容，向用户展示关联内容的同时过滤垃圾信息。过去它是按照时间顺序排列帖文，但现在是依照与用户的相关性排列帖子和显示广告，提高了用户参与度。

Facebook的AI应用团队负责人杰奎因·康德拉（Joaquin Candela）认为，如果没有机器学习，Facebook永远也不会达到目前的规模。那些没有在搜索引擎中应用AI或应用太晚的公司都在苦苦挣扎，比如雅虎及其搜索引擎，还有微软的必应。

亚马逊和谷歌在业务中应用AI的程度最深。机器学习提高了亚马逊线上线下的运营效率。该公司在配送中心部署了约八万个机器人，还使用AI对库存进行分类，以及决定用哪些卡车运送包裹。对于生鲜食品订单，亚马逊已经应用计算机视觉来识别草莓或其他水果的成熟度和新鲜度，决定是否可以进行配送，并且正在开发有朝一日可用于送货的自主无人机。

谷歌则利用AI为其在线视频网站YouTube上的内容分组，并删除（一部分）不当内容，还利用AI在其应用“谷歌相册”中识别人物并分组。谷歌的安卓操作系统也嵌入了AI，帮助系统更加顺畅地运行，并预测人们有兴趣使用哪些应用。在AI领域，谷歌大脑团队（Google Brain）通过改进搜索算法等方法，利用机器学习的成果盈利，被认为是这方面最优秀的研究团队之一。而英国公司DeepMind也许从没有为Alphabet创造多少实际收入，但通过提高其全球数据中心的能效，帮助母公司节省了资金（而且它的围棋实验也是一次公关上的巨大胜利）。

AI也在企业界得到运用。IBM的AI平台沃森（Watson）的老板大卫·肯尼

（David Kenny）预测未来将有“两类AI公司”：通过为消费者提供AI服务而获利的公司，以及为企业提供AI服务的公司。在实践中，这两类公司会因科技巨头的云计算部门而有所重叠。服务供应商正在竞相利用AI实现产品差异化，以锁定客户。云计算三巨头——亚马逊的AWS、微软的Azure和谷歌的Google Cloud——提供应用程序接口（API），为其他公司提供机器学习能力。例如，微软的云计算平台Azure帮助优步打造了验证工具，要求司机接送乘客前通过自拍确认身份。Google Cloud提供了一个“岗位API”，帮助公司为求职者匹配最合适的岗位。

| 大脑加AI

从零售到媒体，其他行业的许多公司都能从云计算企业所吹捧的AI“民主化”中受益。在价值高达2500亿美元的云服务市场中，为不具备能力或规模来独立发展先进AI能力的公司提供AI技术具有巨大的获利前景。但是AI提供商往往必须根据客户的复杂需求来定制API，这非常耗时。微软一直向客户销售软件并提供支持，似乎有可能在这方面取得成功。Google Cloud的负责人戴安·格林（Diane Greene）指出，AI服务变得越来越“自助”只是时间问题。

IBM是AI领域的另一个竞争者，之前还为其沃森平台开展了大型营销活动。AI研究人员往往对IBM不屑一顾，IBM有庞大的咨询业务，却以按时收费而不注重数据闻名。批评IBM的人还指出，虽然IBM对沃森的投资已经超过150亿美元，并在2010年到2015年间斥资50亿美元收购公司，且大多数收购主要是为了获取专有数据，但总的来说，IBM并没有自己的独有数据。但IBM的弱点可能并不会成为它的阻碍。大多数企业的老板都觉得AI战略必不可少，如果能尽快花钱解决，都会不吝重金。

迄今为止，科技巨头大都试图通过应用AI而从现有业务中获利。而在接下来的几年里，它们希望能借助AI创建新业务。一个竞争激烈的领域是虚拟助理。智能手机非常了解用户，但以AI驱动虚拟助理则要让两者的关系更进一步，无论是通过手机还是智能音箱。苹果在2010年收购了语音助手Siri，率先探索虚拟助理的潜力。从那时起，亚马逊、谷歌和微软也都投入了大量资金，它们的虚拟助理在语音识别方面因此也表现更好。三星、

Facebook和百度也都在竞相提供虚拟助理。

| 终极算法一统天下

目前还不清楚独立智能音箱是否会成为一个巨大的市场，但可以肯定的是，人们将超越文本，采用其他方式与互联网互动。《终极算法》（The Master Algorithm）一书以AI为主题，作者佩德罗·多明戈斯（Pedro Domingos）说：“所有这些公司都明白，谁占据了面向消费者的“咽喉要道”，谁就会统治市场。”

再往后，增强现实（AR）设备将是又一个基于AI的发展机会。消息应用Snap这样的手机应用以及游戏《精灵宝可梦Go》（Pokémon Go）都是AR的早期例子。但AR或许能更彻底地改变人们与互联网的关系，让人们不再只依赖小屏幕，而是能时时刻刻通过周边环境使用数字信息。AR设备将提供“便携”的AI功能，比如同步翻译和面部识别。

在AR竞赛中，大型科技公司基本还处于热身阶段。谷歌和苹果已经推出了AR软件开发工具包——它们都希望开发者在自己的平台上构建AR应用。开发AR硬件的热潮也在兴起。谷歌很早就推出了AR眼镜的原型，但遭遇惨败。微软开发了名为HoloLens的头戴设备，但3000到5000美元的定价让它只能是个小众产品。外界认为包括Facebook和苹果在内的其他公司都在计划推出各自的AR产品。AI上的领先地位可以转化为这些新领域里的巨大优势。

这一点在无人驾驶汽车领域体现得尤为淋漓尽致。各家科技公司通过数百万英里的行驶测试建立起大型专有数据集，并利用计算机视觉训练它们的系统识别现实世界中的物体。潜在的收益是巨大的。个人交通市场广阔，全球价值约达10万亿美元。无论谁掌握了无人驾驶汽车技术，都可以将它应用于其他基于AI的项目，如无人机和机器人。对于搜索引擎，人们会认为足够好用就可以了，但无人驾驶汽车不同，用户更倾向于选择安全记录最优的。这意味着在利用AI感知实体世界方面做得最好、事故率最低的公司将获得巨大的市场。

各家公司都在以不同的方式发展无人驾驶技术。中国科技巨头百度正在试图建立一个无人驾驶汽车操作系统，很像谷歌在移动设备上的安卓系统（虽然目前还不清楚百度打算如何利用这一系统赚钱）。Alphabet在研发自己的无人驾驶汽车；优步、电动汽车制造商特斯拉、一群不知名的创业公司，以及越来越多的传统汽车制造商也都有这方面的项目。（据传苹果减少了对汽车项目的投资。）

在AI战略的引领下，科技公司正冲出软件的虚拟世界，向硬件领域迈进，无人驾驶汽车只是其中一个例子。Alphabet、苹果和微软等许多公司也都在致力于生产强大的专用“AI芯片”，驱动它们的各种应用。这些芯片将与英伟达（NVIDIA）公司的产品竞争，这家科技公司已建立起一个芯片帝国，其性能强大的芯片已经运用于无人驾驶汽车和虚拟现实等各种AI领域。

目前还不清楚Alphabet和苹果等公司是会将这些AI芯片出售给竞争对手还是仅供自用。它们有动力利用自己的创新改善自身的服务，而不出租或销售给对手。但如果留作自用会导致仅有极少数公司能通过强大的计算能力获得重大优势，可能就会成为一个问题。

这引出了一个更广泛的问题：AI是否会进一步将优势集中到今天的数字巨头手中。鉴于这些大公司拥有丰富的数据、计算能力、智能算法和人才优势，它们很有可能抓住人工智能的诸多好处，更不用说投资先机了。历史表明集中是有可能的：数据库和个人计算机的发展都导致少数科技公司获得了垄断地位，哪怕只是在短时间内，比如Oracle和IBM在数据库领域、微软和苹果在个人电脑领域。

就人才、计算能力和数据等重要衡量标准来看，谷歌似乎在AI发展上占有领先地位。它请得起最聪明的人，拥有从无人机、无人驾驶汽车到智能软件等众多项目，对机器学习感兴趣的人很少会在那里离职。其他公司后来才认识到要认真对待AI，而谷歌的创始人一开始就是机器学习的忠实拥趸，并始终认为它是一种竞争优势。

科技行业中有些人担心Alphabet和其他公司垄断AI人才和专业知识，比如特斯拉和火箭制造公司SpaceX的老板埃隆·马斯克。他和其他一些著名的硅谷老板资助了OpenAI，一家专注于AI的非营利性研究机构，不从属于任何企业。马斯克和其他人都担心，如果一家公司最终掌握了“强人工智能”（即计算机不需专门编程就可执行任何人类任务）会发生什么。这一天到来可能还要几十年，但这并不影响谷歌现在就谈论这个话题。谷歌大脑的负责人杰夫·迪恩（Jeff Dean）说，“我们确实确实想要”攻克服强人工智能。如果有哪家公司在这方面取得成功，就可能完全改变竞争格局。

同时，未来在很大程度上取决于科技公司是否采取开放与合作的态度。除了发表论文之外，现在许多公司都把它们机器学习软件库开源，把内部工具提供给竞争对手和独立开发者。谷歌的软件库TensorFlow尤其受欢迎。Facebook已经将Caffe2和Pytorch这两个软件库开源。开放具有战略优势。软件库可以在使用中得到调试和除错，所属公司也会收获声誉。另一个非营利性研究机构艾伦人工智能研究所（Allen Institute for Artificial Intelligence）的奥伦·伊佐尼（Oren Etzioni）打趣道：“那些极客才不会白给你好处呢。”

这个领域里的一位大咖担心，像TensorFlow这样的软件库将吸引到有才华的研究人员，但是软件库的所有者可能会在以后开始收费，或者以其他方式利用它们牟利。这样的谨慎态度可能是明智的，但淘金热正盛时很少有人会做长远打算。硅谷现在就是这样。大多数技术人员都沉迷于AI的光明前景和盈利潜力之中，无暇担心未来。■



Economic and financial indicators

Commodity prices

Chinese authorities imposed production cuts, helping increase the price of aluminium

The Economist's commodity-price index has risen by 20% from an almost seven-year low in January 2016. Soaring metal prices have pushed up the index, despite an oversupply of nickel earlier this year. Policy changes in China explain much of the rise. In an attempt to curb pollution, Chinese authorities have imposed production cuts which have helped increase the price of aluminium (the largest single weight in our index). The price of copper has also risen this year in response to supply disruptions in Indonesia and Chile. Food prices have stagnated, however, owing to a glut of wheat and oilseeds. The stock-to-use ratio for wheat, a measure of inventories, is forecast to exceed 36% this season, a 30-year high. ■



经济及金融指标

大宗商品价格

中国政府削减铝产能，推高了铝的价格

《经济学人》的大宗商品价格指数已从2016年1月时的近七年来低位上升了20%。尽管今年早些时候镍的供应过剩，飙升的金属价格还是推高了指数。这一上升主要是因为中国的政策变化。为了遏制污染，中国政府削减了铝的产能，推高了铝的价格（铝是我们指数中权重最大的单项）。由于印尼和智利的供应受到干扰，今年铜价也上涨了。不过，食品价格因为小麦和油籽供应过剩而原地徘徊。本季度小麦的库存用量比（库存的一个衡量指标）预计将超过36%，为30年来最高。■



A history of trade

Sticking up for a scapegoat

Douglas Irwin corrects the record of American trade policy over the years

TRADE-policy wonks are gluttons for punishment. In good times, their pet topic is dismissed as dull. In bad, they find trade being faulted for everything. As Donald Trump blames America's economic woes on terrible trade deals, one geek is fighting back. In "Clashing over Commerce", Douglas Irwin of Dartmouth College tells the history of American trade policy, showing that trade is neither dull nor deserving of the attacks on it.

Few could accuse America's early trade history of lacking drama. Rules requiring American ships to send most of their cargo via British shores bred resentment against the colonial rulers. In 1773, when the British government tried to put smugglers out of business by slashing the official duty on tea, the Boston Tea Party protests followed, leading to an embargo and, ultimately, a war of independence.

After the American constitution gave authority on trade matters to Congress, the stage was set for centuries of wrangling. On the surface, tariffs did seem boring. Specific duties for items like molasses, salt and nails were motivated by the need for tax revenue; between 1790 and 1860 tariffs accounted for 90% of the federal tax take. But beneath the tangle of bureaucracy, bigger debates raged. Proponents wanted to shelter nascent industries, but opponents worried that they would shelter inefficient producers, push up prices and encourage smuggling. Alexander Hamilton, one of America's Founding Fathers, justifiably worried that raising tariffs would provoke trading partners to do the same.

Trade creates winners and losers, and in America, these have often lived far from each other, generating divisions in Congress. Before the civil war,

Southern exporters—their cotton competitive in global markets because of their slave labour—despised tariffs, whereas import-competing industries in the North enjoyed the protection. Given America's institutional set-up, the result was stasis: the system has a bias towards the status quo.

Only twice has the broad direction of policy shifted, according to Mr Irwin. Both reconfigurations were triggered by catastrophic events. The civil war led to a new political balance, away from the southerners who favoured free trade. And as federal spending soared after the war, more tax revenue was needed. Special-interest groups organised to cheer their protections, including people like James Swank, founder of the American Iron and Steel Association, who wrote that “protection in this country is only another name for Patriotism.” (He was not the last of his kind.)

The second shift came after the Great Depression, and the self-harming Smoot-Hawley tariff of 1930, which led to retaliation by trade partners. As the American economy collapsed, so did trade flows, and the world descended into disaster. From the rubble a rare consensus emerged, in favour of lowering tariffs at home in order to persuade other countries to lower theirs. With the rest of the world economy in disarray, foreign producers posed little competitive threat, though that changed over the following decades as Japan and Europe regained strength.

As Mr Irwin spins this grand narrative, he also debunks trade-policy myths. During recessions, tariffs have often been assigned more of a role than they really had, low ones for inflicting American producers with excessive competition (as in 1818) and high ones for stimulating domestic production (as in 1893). But tariff changes were often too small or too late to have these purported results; monetary policy and other factors are more often to blame.

Political dynamics would lead people to see a link between tariffs and the

economic cycle that was not there. A boom would generate enough revenue for tariffs to fall, and when the bust came pressure would build to raise them again. By the time that happened, the economy would be recovering, giving the impression that tariff cuts caused the crash and the reverse generated the recovery.

Mr Irwin also methodically debunks the idea that protectionism made America a great industrial power, a notion believed by some to offer lessons for developing countries today. As its share of global manufacturing powered from 23% in 1870 to 36% in 1913, the admittedly high tariffs of the time came with a cost, estimated at around 0.5% of GDP in the mid-1870s. In some industries, they might have sped up development by a few years. But American growth during its protectionist period was more to do with its abundant resources and openness to people and ideas.

Even the Smoot-Hawley tariff bears less responsibility for worsening the Depression than people often think. The Depression was well under way before it came into force. The tariff changes themselves played less of a role than deflation; because the tariffs were set in dollar terms, they loomed larger as prices and wages fell. And the collapse of global trade had more to do with widespread capital controls than a tit-for-tat tariff race.

Readers may wonder whether 700 pages of debunking—some of them a slog—are worth it. But Mr Irwin does think that trade policies have consequences, just not the ones usually trumpeted. Such policies transfer wealth, sometimes by sizeable amounts. In 1885 an average tariff of 30% reshuffled around 9% of America's GDP from foreign exporters and domestic importers to domestic producers and the government. Trade policies also generate costs. In 1984, economists found that consumers were forking out more than \$100,000 in the form of higher prices for each job protected in the clothing industry, where the average wage was around \$12,000 per year.

The other reason to persist with Mr Irwin's tome is for protection against the foes of trade who have populated America's history and are in their pomp again. In 1824, Henry Clay, one of America's great senators, proposed an "American system" of tariffs, a national bank and "internal improvements" like roads and canals to strengthen the economy of the young country. He saw tariffs as a no-lose deal: raising money from foreigners, promoting American industry and creating a balanced, self-sufficient economy. The tariffs passed, but Clay failed to deliver on infrastructure, or on a plan for American industry. It is hard to see his rather less illustrious successors pulling off this tempting but difficult trick.

Of all the clashes Mr Irwin describes, the most important today is not between political parties, or between friends and foes of trade. It is between policymakers and the forces such as technology reshaping the global economy, in the process destroying many manufacturing jobs. At most, protectionism could shelter some of those jobs temporarily. But those jobs already lost are unlikely to come back. ■



贸易史

为替罪羊声辩

道格拉斯·欧文为美国贸易政策多年来的不良记录正名

那些钻研贸易政策的学究总做吃力不讨好的事。光景好时，人们认为他们热衷的话题沉闷无趣；年景差时，大家又把一切问题都归咎于贸易。特朗普指斥糟糕的贸易协定令美国陷入经济困境，现在，一个书呆子站出来反击了。在《贸易之争》一书中，达特茅斯学院的道格拉斯·欧文

（Douglas Irwin）记述了美国贸易政策的沿革，表明贸易既不无聊，且遭受的攻击也有失公允。

几乎没有人会说美国早期的贸易史平淡无奇。殖民统治者要求美国货船须经由英国海岸运送大部分货物，这引起了美国的不满。1773年，英国政府为了打压走私者，大幅削减茶叶关税。波士顿茶党发起抗议，导致了对英国货物的禁运，最终引发了一场争取独立的战争。

美国宪法将管理贸易事务的权力授予国会，为持续几个世纪的纷争埋下了伏笔。从表面上看，关税确实无聊。向糖浆、盐、钉子等商品征收从价关税是因为政府需要税收收入：1790至1860年间，关税贡献了90%的联邦税收。但在官僚主义的乱局之下，掀起了更大的争论。关税的支持者希望能庇护新兴产业，而反对者担心它会保护那些低效的生产者、推高价格、助长走私。美国开国元勋之一亚历山大·汉密尔顿的担忧不无道理：提高关税会刺激贸易伙伴以牙还牙。

贸易既造就赢家也产生输家，而在美国，这两方往往相隔甚远，在国会中便产生了分歧。内战爆发之前，南方的出口商（因为有奴隶做苦工，他们的棉花在全球市场颇具竞争力）厌恶关税。而在北方，需要与进口产品竞争的行业却很享受关税的保护。考虑到美国的体制，结果便是停滞：这一体系更倾向于维持现状。

欧文认为，贸易政策的整体方向只发生过两次转变，都是由灾难性的事件

引发。内战实现了新的政治平衡，支持自由贸易的南方人不再是有影响力的一方。此外，战后联邦开支激增，需要更多税收。特殊利益群体开始有组织地歌颂自己获得的保护，詹姆士·斯万克（James Swank）便是其中一员。这位美国钢铁协会（American Iron and Steel Association）的创立者曾写道：“在这个国家，保护只是爱国主义的另一个名称。”（他并不是最后一个为保护主义大唱赞歌的人。）

第二次转变发生在大萧条和斯姆特-霍利关税法（Smoot-Hawley）实施之后。这项自毁式法案于1930年签署，引发了贸易伙伴的报复。贸易往来随着美国经济一道崩溃，整个世界滑向灾难的深渊。残败之中，人们罕见地达成了一个共识：降低本国关税，从而说服其他国家采取同样的行动。由于世界其他地区的经济已陷入混乱，外国生产者几乎不会构成竞争威胁。不过接下来的几十年里，这一局面因日本和欧洲恢复实力而发生了改变。

在铺陈这一宏大叙事的过程中，欧文也破除了关于贸易政策的种种迷思。在经济衰退期，人们常常高估了关税的作用，比如认为低关税令美国生产商饱受过度竞争之苦（1818年），而高关税刺激了国内生产（1893年）。但关税的变化往往幅度太小或者起效太晚，并不能像他们以为的那样产生上述结果。货币政策及其他因素往往要负更多的责任。

政治因素会让人们误以为关税和经济周期间存在一种联系。经济繁荣时会产生足够的收入来降低关税，而当经济陷入衰退，再度提高关税的压力就会增强。而当关税真正提高时，经济也差不多要复苏了。这就给人一种印象，好像削减关税重创了经济，而提高关税推动了经济复苏。

欧文还条分缕析地驳斥了一种观点：是贸易保护主义让美国成为一个伟大的工业强国——一些人还认为这一理念可供今天的发展中国家借鉴。1870年到1913年，美国在全球制造业的份额从23%增长至36%，而这期间公认的高关税也带来了成本，估计相当于1870年代中期GDP的0.5%左右。高关税也许确实加速了某些行业的发展，令其领先了若干年。但美国在实行保护主义期间实现增长，更多是因为其丰富的资源以及对人员和思想流动的开放态度。

即使是斯姆特-霍利关税法也不像人们常常以为的那样，要为大萧条的恶化负很大的责任。早在该法案实施之前，大萧条就已开始。关税变动本身的影响不及通货紧缩。由于关税是以美元结算，物价及工资水平下降时其变化便会愈加显眼。再者，全球贸易的萎缩更多是由于广泛的资本管制造成的，而不是以牙还牙的关税竞赛。

读者也许会怀疑，是否值得用700页的篇幅去破除种种迷思（要拆穿其中的某些实在是件苦差）。但欧文认为贸易政策确实会产生后果，只不过不是人们常常宣扬的那些。贸易政策会转移财富，有时数额相当可观。1885年，30%的平均关税将约占美国GDP9%的财富从外国出口商及国内进口商那里转移至国内生产者及政府的手中。贸易政策也会产生成本。1984年，经济学家发现，消费者通过支付更高的价格，为制衣业每一个受保护的职位承担了超过10万美元的成本，而该行业的平均年薪为1.2万美元左右。

坚持阅读欧文这本大作还有另外一个原因：抵御那些在美国历史上层出不穷、如今又重获声势的反贸易人士。1824年，美国最重要的参议员之一亨利·克莱（Henry Clay）提议建立一个“美国体系”，来巩固这个年轻国家的经济。这一体系包含关税、一个国家银行，以及包括道路和运河建设等在内的“内部改进”。克莱认为征收关税是一笔稳赚不赔的买卖：可以从外国人那里筹措资金，促进美国工业的发展，创造出一个平衡且自给自足的经济体。虽然提高关税的法案通过了，但克莱并没有实现他关于基础设施的构想，也没有为美国工业制订出一套规划。很难说他那些没那么杰出的继任者中有谁能完成这一诱人却困难的任务。

在欧文描述的种种冲突中，对当下而言最重要者并非政党之间的分歧，或贸易的支持和反对方之间的矛盾，而是政策制定者和各种重塑了全球经济的力量之间的冲突，例如破坏了大量制造业岗位的科技。保护主义顶多也就能为其中某些岗位提供暂时的庇护，而那些业已消失的则不大可能重现了。■



Repairing roads

A hole in one

Potholes are the latest problem to be felled by sensors and algorithms

IN THE grand scheme of things, potholes may seem like a trivial problem. But tell that to the many mayors and local politicians whose success is judged by their ability to keep roads free of them. One such, Alfonse D'Amato, an American politician, was nicknamed "Senator Pothole" by his grateful constituents.

Most potholes start as small cracks in a road's surface, which allow water to seep in. In winter, when the water freezes, it expands, widening the crack. If the water repeatedly thaws and refreezes, the hole can grow quickly, especially since cars will worsen the damage as they drive over it. Small potholes are a nuisance; big ones can damage cars, and even cause fatal accidents.

Better, then, to fix them while they are still small. In practice, that is tricky. In America, for instance, both state and federal governments find potholes by manually examining video footage of the country's 4.12m miles of roads. That is both expensive and laborious. Officials in Kansas City have come up with a better idea. As Bob Bennett, its chief innovation officer, describes, the city is using a mix of sensors and computer algorithms to work out where potholes are most likely to form. Mr Bennett reckons his new system can anticipate potholes with a success rate of about 85%. Having a list of likely trouble spots means less need to spend money on surveillance, which allows the city's road-maintenance budget to stretch about 30% further than before.

Kansas City's innovation was borne of necessity, says Mr Bennett. Like many cities, it is strapped for cash. Its road-maintenance budget is enough

to repair about 4% of the city's 6,400 miles of roads each year, but that is far short of the roughly 10% that actually need fixing. So, in collaboration with Xaqt, a small firm based in Chicago, Mr Bennett put cameras onto traffic-light poles and buried pressure sensors into the road across the 51 city blocks with the heaviest volume of traffic. Xaqt combines data from those sensors with meteorological information such as temperature, precipitation and the like. That stew of data is seasoned further with information such as the date on which the road was last repaired, the type of asphalt used, whether the road lies on a bus route, and whether it has proved prone to potholes in the past. The scheme has been so successful that Mr Bennett hopes to extend the sensors and the statistical model to the entire city.

The next step is to combine such systems with data provided by cars themselves. A number of firms, including Ford and Jaguar Land Rover, are developing ways of using forward-facing cameras (which are increasingly common on new cars) to detect potholes, in order to adjust the car's suspension before it hits them. Given that such cars will also be connected to the internet, they could pass such data on to local highway-maintenance departments. Senator Pothole retired in 1999. Automation may do his successors out of a job. ■



道路修理

一举平坑

这一次，传感器和算法要对付的是路面的坑洼

放诸宏伟的大千世界，路面的坑坑洼洼似乎是微不足道的小问题。但对许多市长和地方政客而言可不是这么回事。要评定他们成功与否，得看他们能否把道路填平。他们当中有一个人——美国政客阿方斯·达马托（Alfonse D'Amato）——就被感恩的选民昵称为“平坑参议员”。

大多数坑洼一开始只是道路表面可令积水渗入的小裂缝。冬天，积水结冰膨胀，将裂缝撑大。假如积水反复消融结冰，坑洞会迅速扩大，尤其是车辆驶过时加剧破坏。小坑洼惹人讨厌，大坑洞则会损坏汽车，甚至导致致命事故。

那么，最好是在坑洼还不大的时候就修复路面，但这实践起来却很棘手。举例来说，在美国，各州和联邦政府都是通过人工检查录像排查国内总长412万英里的道路上的坑洼，成本高昂又费时费力。堪萨斯城的官员想到一个更好的办法。该市首席创新官鲍勃·本奈特（Bob Bennett）表示，堪萨斯城正运用一系列传感器和计算机算法来寻找最可能形成坑洼的地点。本奈特估计他的新系统预见坑洼的成功率在85%左右。列出可能出现问题的地点，就可以减少在视频监控上的投入，令该市的道路维护预算的利用效率增加了约30%。

本奈特说，堪萨斯城的创新做法是出于不得已。和许多城市一样，该市也面对资金紧缺的问题。其道路维护预算每年可供修复全城6400英里道路中的4%，但实际需要维修的道路约占10%，缺口很大。于是，本奈特与芝加哥的一家小公司Xaqt合作，在交通灯杆上安装摄像头，并在城中交通最繁忙的51个街区的路面下埋入压力传感器。Xaqt把这些传感器收集到的数据和温度、降水等气象信息相结合，再辅以其他信息，如该道路上次维修日期、使用的沥青种类、道路是否处于公共汽车路线上、过去是否经常出现坑洼等。这套方案非常成功，本奈特希望把这些传感器及统计模型应用

于整个城市。

下一步是将这些系统和汽车提供的数据结合起来。包括福特和捷豹路虎在内的多家公司正在开发使用前视摄像头（在新车上愈加常见）检测坑洼的方法，好让汽车可以通过调整悬挂系统，以躲避路面坑洞。由于这些汽车也将接入互联网，这些数据还可以被传送到当地高速公路维护部门。那位“平坑参议员”在1999年退休，自动化也许会让他的继任者无事可做。■



Chinese finance

Stormy weather

A regulatory clean-up dents China's markets, but not yet its economy

IT IS the kind of company that for years was a safe bet for investors. China City Construction is big, government-owned and focused on building basic infrastructure such as sewers. But the bet, it turns out, was not so safe after all. In November China City missed interest payments on three separate bonds, after failing to refinance its hefty debts. It is one of a growing number of victims of the government's clean-up of the financial system, or what is known in China as the "regulatory storm".

The storm has been gathering strength for the better part of a year but its intensity over the past couple of weeks has caught many off-guard. The government wasted little time after an important Communist party meeting in October before taking on some of the riskier parts of the financial system. As a result, China's risk-free interest rate—ie, the yield on government bonds— has shot up. Overall, it has risen by a percentage point since the start of 2017.

For firms, even those closely tied to the state, the rise in borrowing costs has been even steeper. The yield on ten-year bonds issued by China Development Bank, a "policy bank" that finances state projects at home and abroad, has soared to nearly 5%, the highest in three years (see chart).

Rising interest rates are partly a sign of strength. An industrial recovery has fuelled a return of inflation after years of sluggish growth, and investors are pricing in rate rises from the central bank. But the jump in yields also reflects a bout of nervousness. The CSI 300 index, which comprises shares in the biggest companies listed in China, fell by 3% on November 23rd, its largest drop in 17 months.

The fear—or the hope, depending on your perspective—is that the government means business when it talks of cutting debt. Going into this year, China's leaders said their economic priority was to control financial risks. Debt is the biggest of all, having climbed from 160% of GDP to roughly 260% over the past decade. Much of it is held off-balance-sheet by banks. So the government's efforts have had two aims: to slow the rise in debt and to clarify the full extent of existing liabilities.

Its actions, though welcomed by ratings agencies, are causing market indigestion. The latest worry for investors is the central bank's proposal on November 17th for an overhaul of wealth-management products (WMPs), deposit-like instruments with relatively high interest rates that are sold by banks. New rules would mean banks could no longer guarantee investors against losses. They would also need to price WMPs according to their current market value and do a better job of matching the duration of their liabilities and assets.

The WMP market was worth nearly 30trn yuan (\$4.5trn) at its peak, or more than a third of China's GDP. The draft rules are likely to cause it to shrink and, in so doing, to leave banks with less free cash to invest in bonds. Zhang Yu of Minsheng Securities, a local brokerage, notes that banks have until mid-2019 before the rules are enforced. But investors are not waiting. They have already started trimming their bond holdings, pushing yields higher.

Another focus for the government has been internet microlenders, lightly regulated institutions that often charge exorbitant interest rates. On November 21st officials ordered a halt in licence approvals for new online lenders. They have also sounded the alarm about the property market, vowing to stop homebuyers from borrowing funds illegally.

The question is how far the government will go. With the battle against risk

so high on the political agenda, few think it will ease. A financial-stability committee, a powerful new body tasked with closing regulatory loopholes, held its inaugural meeting on November 8th. Zhou Xiaochuan, China's veteran central-bank governor, has spoken on four separate occasions in the past two months about rising financial dangers.

Yet there are signs of a pushback. Banks are said to be lobbying against the most stringent of the proposed WMP rules, arguing that forced asset sales will only cause more serious financial stress. The value of bonds in default in November was 9bn yuan, a single-month record for China.

Officials can afford to allow their regulatory storm to rage on for now. China is still enjoying sunshine: its campaign to curb indebtedness is in its early days and yet to have much negative impact on economic growth. But the market ructions of the past couple of weeks point to rougher weather ahead. ■



中国金融

风暴来袭

监管部门的清理行动打击了中国的市场，不过尚未影响中国经济

对投资者而言，有一家公司多年来一直是个稳妥的赌注。中国城市建设控股集团是一家大型国有企业，专注于下水道这类基本基础设施的建设。然而，这个赌注到头来却并不稳妥。在为自身的高额债务再融资受挫后，中国城建在11月又未能按时兑付三期债券的利息。因政府清理金融体系的行动（在中国被称作“监管风暴”）而受创的企业越来越多，中国城建只是其中之一。

在大半年的时间里，这场风暴一直在逐步加强，但近几周的猛烈程度还是让很多人猝不及防。在10月党的一次重要会议结束后，政府立即着手处理金融体系中某些风险较高的部分。结果，中国的无风险利率（即政府债券的收益率）急剧上升：自2017年年初以来总体已上升了一个百分点。

企业借贷成本的增幅更大，连那些与政府有紧密联系的企业也不例外。为国内外的政府项目提供资金支持的“政策性银行”——国家开发银行发行的十年期债券收益率飙升，逼近5%，为三年来的最高水平（见图表）。

利率提升在一定程度上是实力的表现。经过多年的缓慢增长后，工业复苏引发通胀抬头，投资者也预期央行将加息。然而债券收益飙升也是一轮紧张情绪的反映。11月23日，由中国最大上市公司股票构成的沪深300指数下跌3%，是17个月以来的最大跌幅。

人们担忧——或者说希望，视你的角度而定——政府在减少债务方面会言出必行。去年年末，中国领导人表示首要经济任务是防控金融风险。其中债务为重中之重：过去十年来，债务占GDP的比例已从160%升至大约260%，大多是由银行在表外持有。因此，政府的行动有两个目标：减缓债务上升速度，以及全面理清现有债务的严重性。

中国政府的行动受到评级机构的欢迎，但却令市场难以消化。最近一次引发投资者担心的，是央行于11月17日发布的《关于规范金融机构资产管理业务的指导意见（征求意见稿）》。该指导意见建议全面改革理财产品（WMP），即银行出售的利率相对较高、与储蓄类似的投资工具。新规定将意味着银行再也不能向投资者保证保本。银行还需根据现行市价为理财产品定价，以及更好地匹配资产与负债久期。

在高峰期，理财产品市场价值近30万亿元（4.5万亿美元），相当于中国GDP的三分之一还多。上述意见稿可能会令这一市场缩水，而这也许又会造成银行用于投资债券的自由现金减少。内地券商民生证券的张瑜指出，在新规实施之前，银行还有一年半的缓冲期。然而投资者已没有耐心等待。他们已开始减持债券，结果又推高了收益率。

政府经济工作的另一个重点是网络小额贷款公司。这些贷款机构只受到轻微的监管，且通常收取高额利息。11月21日，政府下令暂停新批设网络小额贷款公司。此外，政府也就房地产市场发出警告，誓言将阻止购房者非法借贷。

问题在于政府会将这场风暴推进到何种程度。政府视对抗风险为当务之急，因此几乎没有人认为风暴会有缓和的可能。11月8日，国务院金融稳定发展委员会成立并召开第一次会议。这个颇具影响力的新机构将负责弥补监管漏洞。过去两个月，长期担任央行行长的周小川已在四个不同的场合谈到金融风险加剧的问题。

不过也有迹象显示央行的行动遭遇反弹。据说，各家银行正在游说取消意见稿中最严格的内容，声称强制的资产出售只会引发更严重的金融压力。11月，债券违约金额高达90亿元，是中国单月数字的最高记录。

目前政府还可以任由监管风暴愈演愈烈。眼下中国仍旧沐浴在阳光下：其抑制债务的行动还处于早期阶段，尚未对经济增长造成太大的负面影响。但过去两周市场的骚动清楚地表明，接下来的风暴会更剧烈。■



Schumpeter

Control freaks

Lessons in the dark arts of corporate control from the tycoons of the new economy

THIS month Schumpeter visited the Barnes Foundation, a gallery in Philadelphia full of paintings by Picasso, Matisse and Van Gogh. Albert Barnes, born in 1872, is notable for two things. He made a fortune from an antiseptic that cured gonorrhoea. And he stipulated exactly how his art collection should be posthumously displayed. The result is hundreds of paintings jammed together nonsensically, often in poky rooms, and the creepy feeling of a tycoon controlling you from the grave.

Barnes's string-pulling comes to mind when considering today's prominent tycoons, who often hail from technology, e-commerce and media. At the moment they seem omnipotent. But many founders are gradually cashing in shares in their companies. The consequences will vary by firm, with some tycoons gradually ceding control, and others clinging on to it.

A flurry of selling activity has been in evidence of late. On September 13th Jack Ma and Joe Tsai, co-founders of Alibaba, a Chinese e-commerce behemoth, said they planned to sell up to \$4bn of stock by the end of 2018. Nine days later Mark Zuckerberg said he would dispose of Facebook shares worth up to \$13bn by early 2019. Jeff Bezos has cashed in \$2bn of Amazon stock this year. Pony Ma, the boss of Tencent, a Chinese digital giant—and no relation to Jack—intends to sell \$5bn of its stock (although the timetable is unknown). The transactions add up to a tenth of the total value of these founders' holdings in their companies.

More sales can be expected. Mr Tsai has just spent \$1bn buying 49% of the Brooklyn Nets, a basketball team. Mr Bezos needs \$1bn a year for a space-rocket project, and Mr Zuckerberg and Pony Ma harbour philanthropic

ambitions. None of the firms pay substantial dividends. They also pay their staff in stock, diluting existing owners (and thus reinforcing the effect of founders' share sales).

To see the effect of stock disposals and dilution, consider eight founder-run firms: Alibaba, Alphabet, Amazon, Facebook, Netflix, Tencent, Tesla and SoftBank. The median economic stake of their founders is 13%. On the current trajectory that will fall to 8% in half a decade; the tech tycoons might cash out even faster.

Each firm has its own structure, reflecting how ruthless its founder was early on and how much share capital it has raised, among other things. But there are two main kinds of company: those run by control freaks, and those run by control fanatics.

At control-freak firms, economic and voting power is aligned. As the founders sell, their legal powers decline, too. Reed Hastings at Netflix is furthest down this path. He has cut his stake from 7% in 2007 to 3% but dominates Netflix by sheer force of personality. That is impressive but he is more vulnerable as a result.

Amazon is also heading in this direction. Mr Bezos's economic and voting stake has fallen from 25% in 2007 to 16%. At the present pace the top three institutional investors will, together, be able to outvote him by late 2018. Elon Musk owns 20% of Tesla's economic and voting rights, but his stake will probably fall, too. His personal finances appear stretched—he has taken out loans secured against some of his shares. And Tesla needs to issue more equity to fund its ambitious plans, which will dilute him. Such leaders are lionised and it is hard to imagine their firms without them, as once it was difficult to imagine Microsoft without Bill Gates. But over a decade they could shift to institutional ownership. Apple and Microsoft have already made the leap.

The destiny of firms run by control fanatics, the second category, is murkier. Their founders use dual classes of shares or other mechanisms to keep voting rights even as they lower their economic exposure. Alphabet has three share classes; Larry Page and Sergey Brin have an 11% economic stake but 51% of voting rights. If they sell slugs of stock, as they have done in the past, they could cut their economic stake to as low as 6% while keeping majority control. Facebook's two share classes allow Mark Zuckerberg to have 51% of the votes with 14% of its economic rights. This year he considered a scheme to concentrate power in his hands still more, but abandoned it in September after shareholders sued.

Asia's control fanatics use different levers. Masayoshi Son owns only 21% of SoftBank's economic and voting rights. But he has set up an associated \$100bn investment vehicle, the "Vision Fund", over which he seems to have near-total control. Pony Ma owns 9% of Tencent's economic and voting rights, down from 13% in 2007. Naspers, a South African media firm, has a stake over three times bigger but has less influence. That is partly because Pony Ma has majority stakes in Tencent's two key subsidiaries in mainland China, which he has agreed to allow Tencent to run.

Alibaba has the most accomplished fanatics. Jack Ma and Mr Tsai have designed a triple-lock system. A pact obliges other strategic shareholders to vote with them. A majority of board seats must be appointed by the "Alibaba Partnership", a club of senior staff whose permanent members are Jack Ma and Mr Tsai. Jack Ma has a majority holding in several key subsidiaries in China, which Alibaba operates. Alibaba's construct resembles the legal equivalent of a surrealist painting (the government is probably the only body that could possibly wrest away control).

| *Painting it black*

The control fanatics are still relatively young and may hope to go on for as long as Warren Buffett and Rupert Murdoch, who have used dual share

classes to keep control into their ninth decade. But today's corporate chieftains are already pushing the limits. The gap between their economic stakes and voting stakes is far larger than for Mr Buffett or Mr Murdoch now. And their firms are among the most important in the world. When growth eventually slows and the aura of genius fades, the tensions created by their concentration of power will build. Albert Barnes's estate became mired in legal disputes and arguments. Today's tycoons should visit his eccentric gallery for a reminder of the pitfalls of seeking to hold on too tight, for too long. ■



熊彼特

控制狂

新经济大亨们控制企业的“暗黑艺术”

本月，熊彼特专栏记者参观了费城的巴恩斯基金会（Barnes Foundation）。这是一家画廊，收藏了大量毕加索、马蒂斯和梵高的画作。阿尔伯特·巴恩斯（Albert Barnes）出生于1872年，他有两件事值得了解。一是靠一种能治愈淋病的杀菌剂发了笔大财，二是明确规定了自己死后自己的艺术藏品该如何被展示。结果就是成百上千幅画作毫无章法地挤在一起——通常都是在狭小的房间里，并且有一种让人毛骨悚然的感觉——一个大亨从坟墓里控制着一切。

说到今天那些来自科技、电子商务和媒体行业呼风唤雨的大亨们，就会想起巴恩斯那紧拽着木偶扯线的形象。目前他们看起来无所不能，不过许多创始人正在逐步将自己在公司的股票套现，结果将因公司而异：有些大亨会逐渐放弃对公司的控制权，另一些会抓住不放。

最近，一些公司创始人接连出售股权，引人注目。9月13日，中国电子商务巨头阿里巴巴的联合创始人马云和蔡崇信表示，他们计划在2018年底前出售40亿美元的股票。9天后，马克·扎克伯格表示，到2019年初他将卖掉价值130亿美元的Facebook股票。今年，杰夫·贝索斯已将20亿美元的亚马逊股票套现。中国数字巨擘腾讯的老板马化腾（非马云亲戚）打算卖出50亿美元的公司股票（尽管时间表未知）。这些交易额的总和相当于这些创始人在公司中所持股份总价值的十分之一。

预计未来还会有更多的套现行为。蔡崇信刚刚斥资10亿美元收购了布鲁克林篮网队（Brooklyn Nets）49%的股份；贝索斯每年需要10亿美元投入太空火箭项目；扎克伯格和马化腾都立志发展慈善事业。这些公司中没有一家有可观的分红。它们还向员工发放股票，摊薄了现有股东的股权（从而也增强了创始人出售股份这一举动的影响）。

要了解股权出售和摊薄的影响，我们来看八家由创始人经营的公司：阿里巴巴、Alphabet、亚马逊、Facebook、Netflix、腾讯、特斯拉和软银。其创始人持股的中位比例为13%。按照目前的趋势，这一比例将在五年内降至8%——科技大亨们可能会以更快的速度套现。

每家公司都有自己的股权结构，可反映出公司创建之初其创始人集权的程度、后来筹集到多少股本等等。不过这几家公司大体分为两类：由“控制怪人”经营的公司，以及由“控制狂人”经营的公司。

在由控制怪人掌管的公司中，持股比例和投票权相对应。创始人出售股权后，其法定权力也相应减弱。Netflix的里德·黑斯廷斯（Reed Hastings）在出售股权这条道路上走得最远。他已将自己的持股比例从2007年的7%降至3%，但仍凭借纯粹的人格力量掌控着Netflix。这一点令人赞叹，但他的地位也因此更不稳固。

亚马逊也在朝着这个方向发展。贝索斯的持股比例和投票权从2007年的25%下降到16%。按照目前的速度，三大机构投资者的投票权加在一起将在2018年底超过贝索斯。埃隆·马斯克在特斯拉的持股比例和投票权比例为20%，但也可能会减少。他已用部分股份抵押贷款，个人财务状况似乎较为紧张。特斯拉需要发行更多的股票为其雄心勃勃的计划融资，这又将摊薄马斯克的股权。这些领导人受到热捧，很难想象公司没有他们会怎样，就像曾经很难想象没有比尔·盖茨的微软会如何。但十年后，这些公司可能都会转为机构持股。苹果和微软已朝此方向迈出了一大步。

第二类由控制狂人掌管的公司命运就更捉摸不定了。这些公司的创始人采用双重股权结构或其他机制，让自己在减持股份的同时仍能保持多数投票权。Alphabet有三类股权，拉里·佩奇（Larry Page）和谢尔盖·布林（Sergey Brin）共持股11%，但拥有51%的投票权。如果他们像过去那样继续减持股票，那么持股比例可能降至6%，但仍能保留多数控制权。Facebook的两种股权让马克·扎克伯格以14%的持股比例拥有51%的投票权。今年他曾考虑将权力更多地集中在手中，但在股东提起诉讼后于9月放弃了这一计划。

亚洲控制狂人们的集权手段有所不同。孙正义仅拥有软银21%的股票和投票权，但他建立了一个价值1000亿美元的联合投资工具——“愿景基金”（Vision Fund），并似乎拥有该基金将近百分之百的控制权。马化腾在2007年拥有腾讯13%的股权和投票权，现在降至9%。南非一家传媒集团Naspers的创始人在腾讯的持股是马化腾的三倍多，但控制权却更小。这在一定程度上是因为马化腾在腾讯中国的两家关键子公司拥有多数股权，他同意这两家子公司由腾讯运营。

阿里巴巴拥有最高超的控制狂人。马云和蔡崇信设计了一个三重保障机制。两人与其他战略股东达成协议，要求他们投票时与自己保持一致。董事会的多数席位必须由“阿里巴巴合伙人”任命，合伙人由公司持股高层担任，其中马云和蔡崇信是永久合伙人。马云在中国几家由阿里巴巴运营的关键子公司中拥有多数股权。阿里巴巴的架构就像一幅法律版的超现实主义画作（也许只有政府能够夺走对它的控制权）。

| 黑色警示

控制狂人们相对来说还很年轻，他们可能希望能像巴菲特和默多克一样长久保持控制权——这二人利用双重股权结构在八十多岁时仍大权在握。但如今的企业领袖已经在突破极限了。他们的股权与投票权之间的差距远大于巴菲特或默多克现在的水平，而且他们的公司在世界上举足轻重。当公司的增长最终放缓，天才的光环褪去，他们的权力集中产生的冲突就会加剧。巴恩斯的遗产深陷法律纠纷和争议。今天的大亨们应该去参观一下他那古怪的画廊，警醒自己握权太紧太久的隐患。 ■



Schumpeter

Walmart fights back

The beast of Bentonville battles Amazon, the king of the e-commerce jungle

A BOA constrictor swallowing capitalism. A cyclone dragging the economy into its vortex. If you look back at how people described Walmart a decade ago, it is eerily similar to how Amazon is viewed now. The supermarket chain has “a scale of economic power we haven’t encountered before”, warned “The Walmart Effect”, a best selling book in 2006. But capitalism never stands still. The world’s largest company by sales is now the perceived underdog in an escalating grocery war with Amazon to fill 320m American bellies. The struggle will probably end in a messy stalemate. That will mean mediocre returns for investors—and happy days for consumers.

Just when Walmart’s aura was at its most intimidating, in 2006, stagnation beckoned. Its reputation for bullying its suppliers and staff became toxic. Over the next decade it hit saturation point. About 95% of Americans shop at Walmart at least once a year. It has three square feet of shop space for every adult in the country and has sunk \$83bn into a fixed-asset base that is the fourth-largest owned by any American firm. Investors have worried for years that this empire of aisles and tills run from Bentonville, Arkansas, would become obsolete—what did Walmart’s executives, schooled in the arts of beating up baked-beans suppliers, know about the slick world of e-commerce being dreamed up in Silicon Valley and Seattle?

More than you might think. This year Walmart’s shares have risen by 40% on hopes that it has more than a fighting chance. It is clear that selling groceries online is very different from selling books. In food, penetration of e-commerce is low, at 2%, compared with 9% for all retail. Food is perishable. People will not stuff it in their mouths unless they trust its provenance. They also want flexibility—to buy food in a store, to order

online and pick it up themselves, or to have it delivered to their homes. So some physical infrastructure is helpful. “I wouldn’t want another set of assets,” Doug McMillon, Walmart’s boss, told the Economic Club of New York in November.

He has run Walmart’s businesses in Europe and Asia, where e-commerce for groceries is more developed. In 2016 Walmart spent \$3bn buying Jet.com, an e-commerce firm whose boss, Marc Lore, now runs all Walmart’s online operations. Walmart has launched internet-based services such as “Easy reorder” and “Pickup discount” and formed a partnership with Latch, which lets its users open and lock their front doors remotely. On September 29th it acquired Parcel, a logistics startup. On December 6th it changed its legal name from Walmart Stores, to just Walmart.

There are three reasons to be optimistic. First, Walmart’s performance has improved. In the most recent quarter, same-store sales rose by 2.7% year on year, and store traffic by 1.5%. Food sales increased at their fastest pace in six years. Sales from e-commerce represent only about 2% of the total but are rising at an annual rate of 50% (customers who shop online and in stores typically spend twice as much as those who only go to stores). Walmart has the second-most-downloaded retail app, after Amazon’s.

Second, Amazon’s behaviour is a backhanded compliment. In June it spent \$14bn on Whole Foods, a mid-sized grocery chain, The deal brings Amazon more physical locations to sell, sort and dispatch goods. It also gives it trusted private-label brands, of the kind Walmart already has. If you type “spinach” into Amazon.com, bags of Whole Foods branded greenery appear.

Lastly, the example of China points to a fusion of the online and physical worlds. In some ways the country is more advanced than America; e-commerce comprises 9% of grocery sales, according to Alliance Bernstein,

a research firm. On November 20th Alibaba, an e-commerce giant, bought 36% of Sun Art Retail, a hypermarket retailer. Four of the six biggest Chinese supermarket chains have partnerships with e-commerce platforms. (Walmart, which has 424 stores in China, has teamed up with JD.com.)

The duel between Walmart and Amazon could go in two directions. It might escalate into a war across America, for both companies hate losing. Or each firm might conquer different geographical areas and demographic groups. Amazon could seize well-to-do cities, where population density is high and home delivery is more efficient. Walmart could continue to rule suburbia.

Either way, margins will probably be squeezed as Amazon throws money at the fight with its customary abandon. Mr McMillon knows this. “One of the challenges at Walmart is that we don’t have free money—we are expected to make a profit,” he says. The danger is that it overestimates how much physical presence it needs. If it went back to its position in 2006, it could cut its domestic asset base by 34% and still have 90% of Americans within 15 miles of a store. For every dollar of sales, it has twice as many square feet of sales and distribution space as Amazon’s retail operation (including Whole Foods). If Mr McMillon is brave he will sell stores and return capital to investors. Walmart needs to make its balance-sheet leaner.

| *What’s in store for Amazon*

Walmart is probably the most formidable adversary Amazon has ever faced. Disrupting the music, book and media industries, each known for their Corinthian spirit and long lunches, was child’s play compared with taking on Walmart, with its fanatical commitment to low prices.

Walmart’s history is also a warning. If you examine the two companies’ financials, Amazon today looks almost identical to Walmart in 1999. It has annual sales of \$160bn or so, low margins, fast growth, a ballooning asset

base and massive capital investment. The firm's managers are on a high and investors have dizzying expectations for the future. But for the ten years after 1999, Walmart's share price was as flat as a pancake, because all the good news was already baked in. The actual business of world domination turned out to be a long, hard slog. ■



熊彼特

沃尔玛回击

本顿维尔的猛兽挑战电子商务丛林之王亚马逊

一条吞噬资本主义的巨蟒。一场将经济卷入漩涡的龙卷风。回头看看十年前人们是怎么形容沃尔玛的，你会发现它和今天人们对亚马逊的观感诡异地相似。2006年，畅销书《沃尔玛效应》（The Walmart Effect）提醒世人，这家连锁超市具有“我们未曾领教过的经济影响力”。但资本主义从不会停下脚步。在一场不断升级的食品杂货业对决中，这家销售额全球第一的公司已经沦为世人眼中的弱者。沃尔玛与亚马逊争相填饱3.2亿美国人的胃，最后可能陷入混乱的僵局。这意味着投资人只能获得平庸的回报，而消费者却能享受好日子。

沃尔玛2006年威震四方之时，停滞的苗头已经开始萌芽。压榨供应商和员工的恶名给它带来了严重的危害。接下来的十年里它的业务达到了饱和。如今约95%的美国人每年至少在沃尔玛购物一次；其超市的面积已达到每个美国成年人三平方英尺；固定资产基数达830亿美元，在美国企业中列第四位。多年来，投资者一直担心这个从阿肯色州本顿维尔

（Bentonville）发展起来的实体超市帝国会过时。毕竟，沃尔玛的主管们接受过的教育都是关于如何打压烤豆供应商的，对于硅谷和西雅图构建的时髦的电子商务世界，他们又懂什么？

比你以为的要多。今年，沃尔玛的股价已经上升了40%——可见人们认为它的处境还没到只能最后一搏的地步。有一点已经很明显，那就是在网上卖食品杂货和卖书很不一样。电子商务在食品行业里的渗透度很低，仅有2%，而整个零售业为9%。食品会腐坏。人们唯有信任食物的来源才会把它们塞进嘴里。他们也需要灵活度——既可以到商店里购物，也可以在网上下单自己取货，还可以直接送到家门口。因此一定的实体基础设施是有益的。“我不应该再另搞一套资产了。”沃尔玛的老板董明伦（Doug McMillon）上月对纽约经济俱乐部（Economic Club of New York）表示。

他已经在欧洲和亚洲开展业务，那里的食品杂货电子商务比美国更发达。2016年，沃尔玛花30亿美元收购电商Jet.com，该公司的老板马克·罗尔（Marc Lore）如今负责沃尔玛所有在线业务。沃尔玛已经推出了基于互联网的服务，比如“再来一单”和“自提折扣”，并和智能锁具公司Latch达成合作，后者的产品可让用户遥控开关家门。今年9月29日，沃尔玛收购了物流创业公司Parcel。本月6日，沃尔玛将其法定公司名称从“沃尔玛商城”改为“沃尔玛”。

对沃尔玛保持乐观的原因有三个。首先，其业绩已经改善。最近一个季度，同店销售额同比上升2.7%，店内人流量增长1.5%，食品销售增速达六年新高。电子商务销售额仅贡献了整体销售额的2%左右，但年增长达50%（那些线上和线下同时购物的顾客的消费额通常是只在实体店购物的人的两倍）。在零售类应用中，下载沃尔玛应用的人数仅次于亚马逊。

其次，亚马逊的行动从侧面恭维了沃尔玛。今年6月，亚马逊花140亿美元买下中等规模连锁杂货店全食超市（Whole Foods）。这使得亚马逊拥有了更多实体地点来销售、筛选和发配商品。这也让它拥有了沃尔玛已经拥有的那种高信誉度的自营品牌。如果你在Amazon.com搜索“菠菜”，就会看到一包包“全食”品牌的绿色蔬菜。

最后，中国的例子指向一个线上线下世界融合的未来。从某种角度看，中国的发展已经超越了美国：据调研公司联博（Alliance Bernstein）的统计，电子商务占中国食品杂货销售额的9%。上月20日，电商巨头阿里巴巴买下了大卖场运营商高鑫零售36%的股份。中国最大的六家连锁超市中，已有四家和电商平台达成合作（在中国有424家分店的沃尔玛已和京东合作）。

沃尔玛和亚马逊的决斗可能朝两个方向发展。因为谁也不想输，所以这场战争可能会升级，进而席卷整个美国。又或者它们会各自征服不同的地理区域及特定人群。亚马逊可能会拿下富裕的城市，那里人口密集，送货上门也更高效。沃尔玛则可能会继续统治郊区。

无论哪一种，鉴于亚马逊会以其特有的恣意挥霍来投入战斗，利润可能会遭挤压。董明伦明白这一点。“沃尔玛面临的挑战之一是我们没有闲钱。人们要我们盈利。”沃尔玛的危险在于高估自己需要多少实体店面。假如回到2006年时的状况，它可以将国内资产基数削减34%而仍然将九成美国人纳入距其超市15英里以内的范围。对于每一美元的销售额，其销售面积是亚马逊零售业务（包括全食超市）的两倍。如果董明伦够有胆魄，他将卖掉一些商场，将资金回馈给投资者。沃尔玛的资产负债表需要瘦身。

| 等待着亚马逊的

沃尔玛可能是亚马逊遭遇过的最强劲对手。和对战沃尔玛相比，颠覆音乐、图书和媒体产业都成了小儿科。毕竟后者这些圈子以彬彬有礼的竞赛风格、漫长的午餐而闻名，而沃尔玛可是不遗余力打低价战的疯狂斗士。

沃尔玛的历史也是对亚马逊的一种警示。审视两家公司的财务状况，你会发现今天的亚马逊看起来几乎和1999年的沃尔玛一模一样。它拥有约1600亿美元的年销售额、低利润、高增长、不断膨胀的资产基数和庞大的资本投资。公司主管自我感觉良好，而投资者对于未来有着令人晕眩的期许。但1999年后的十年里，沃尔玛的股价平淡无奇，因为所有的好消息都已经反映在了价格中。而要继续称霸世界的实际工作却是漫长而艰辛的苦差事。 ■



Economic and financial indicators

Economic outlook

The Economist's latest poll of forecasters, December



经济与金融指标

经济前景

《经济学人》12月对各家预测机构的最新调查



British empire history

Food and fate

The best way to gain an empire is through its stomach

IN 1879 a group of British soldiers at the battle of Rorke's Drift in South Africa struggled to defend themselves against thousands of Zulu warriors. For shelter they threw up an improvised barricade. And the material they chose? Bricks of biscuit tins made by Carr's of Carlisle.

It is an image that nicely sums up "The Taste of Empire", in which Lizzie Collingham, a British historian of curry and of the Raj, argues that food was not an adjunct to Britain's imperial might but fundamental to it. Usually it is assumed that Britain's empire appeared and then Britain's food trade—that vast tonnage of tea, flour, sugar, bully beef and Crosse & Blackwell pickle that swept across the seven seas—appeared to feed it. Ms Collingham turns that idea neatly on its head. It was not so much the empire that began the trade, but trade that began the empire.

The book opens on July 18th 1545, a "fish day" on the *Mary Rose*, an English warship that would be wrecked before the month was out. Genetic analysis of fish bones found aboard shows that some of the fish the sailors ate came from the waters off Newfoundland, where the shoals of cod were so thick that you were "hardlie...able to row a Boate through them". British fisherman returned there, and the island was eventually claimed as a colony. In other words, Britain never fished for cod in Newfoundland because it was a British colony; it became one because British fishermen caught cod there.

The importance of the Newfoundland fish trade in "laying the foundations of the British empire", Ms Collingham writes, has been "frequently overlooked". And yet food is so fundamental. As much as war, it has driven

international revolutions. Between 1846 and 1850 1m Irish died in the potato famine. In the four years that followed, 2m more emigrated. Food has driven innovation, too: biscuit makers such as Carr's were using the production line long before Henry Ford got in on the game.

Food did not just drive the expansion of empire. It could, like those Carr's tins in the barricade at Rorke's Drift, be used to shore it up too. "The Englishwoman in India", a handbook dating from 1864, instructed its readers to bring out with them not only clothes but also table linen, Wedgwood china, cutlery and crystal glasses. The idea was to mirror the "best regulated establishments" at home and show the "natives" how to do it. Dinner was less a meal than a statement of imperial intent.

Just as well it was not all about the culinary experience, as some of those starchy eating habits made for quite inedible food. When one British woman dined at the house of an Indian dignitary she arrived hoping for a nice curry. Instead, she was served a dismal procession of pseudo-Anglo fare: "terrible soup, terrible roast meat" finished off by cheese and biscuits so ancient that they had "little walkies [weevils] and their eggs clinging to the sides".

Such details are the strength of this book—and its weakness. Paragraphs are as studded with dates and numbers as a plum pudding with raisins. Still, it is hard to mind when many of them are so interesting. And what other book would offer its reader instructions on "how to make the best liquid laudanum"? (Top tip: add a hefty dash of saffron and do not stint on the opium.) ■



大英帝国史

食物与命运

建立帝国，食物先行

在1879年的南非罗克渡口（Rorke's Drift）战役中，一群英国士兵艰难地抵御数以千计的祖鲁战士，他们仓促搭建了一个临时路障作掩护。用的是什么材料呢？是用英国卡莱尔市（Carlisle）卡氏公司（Carr's）的饼干盒为“砖块”垒起来的。

这个场景贴切地概括了《舌尖上的帝国》（The Taste of Empire）一书的主旨。在书中，研究咖喱和英统印度时期的英国历史学家莉齐·科林厄姆（Lizzie Collingham）提出，食物不是英帝国实力的补充，而是其根本。人们通常认为是先有大英帝国，然后才有供养起整个帝国的食品贸易——成千上万吨茶叶、面粉、糖、牛肉罐头以及Crosse & Blackwell出品的腌菜席卷全球。但科林厄姆彻底颠覆了这种观点。她认为，与其说是帝国开创了贸易，不如说是贸易开创了帝国。

这本书的开篇回到1545年7月18日，英国战舰玛丽·罗斯号（该船于当月失事）上的人们度过了一个“吃鱼日”。对船上发现的鱼骨的基因分析表明，水手们吃的鱼有一些来自纽芬兰附近海域，那里鳕鱼极稠密，“几乎……难以划船穿过鱼群”。英国渔民返回那里，纽芬兰岛最终被宣称为英国的殖民地。也就是说，英国从未因为纽芬兰岛是其殖民地而在那里捕捞鳕鱼，而是因为英国渔民在那里捕捞鳕鱼，纽芬兰岛才成为了英国的殖民地。

科林厄姆写道，纽芬兰的鱼类贸易“奠定了大英帝国基础”，其重要性却“经常被忽视”。然而民以食为天。食物和战争一样，引发了国际间的变革。1846到1850年间，一百万爱尔兰人死于“马铃薯饥荒”。之后的四年里，两百万人移居国外。食物也驱动了创新：早在亨利·福特的流水线问世之前很多年，卡氏这样的饼干制造商就已经开始使用流水线了。

食物不仅推动了帝国的扩张，甚至还可以像罗克渡口战役中用来搭建路障

的卡氏饼干罐一样，起到稳固帝国的作用。早在1864年时就有一本名为《在印度的英国女人》（The Englishwoman in India）的手册，教导读者出国不光要携带衣物，还要带餐桌布、韦奇伍德瓷器、餐具和水晶玻璃杯。此举是为了反映英国国内“最规范的生活方式”，并向“当地人”展示如何遵循这种生活方式。就餐不只是吃饭，更是要表述帝国的意图。

一顿难吃的饭菜并不完全是厨艺问题，一些刻板的饮食习惯同样会让食物难以下咽。一个英国女人到一位印度要员家中吃饭，她本希望能吃到一顿可口的咖喱餐，然而招待她的却是一道接一道差劲的伪英国菜——“难喝的汤，难吃的烤肉”，最后还以陈年奶酪和饼干收尾，上面长着“小象鼻虫，还有虫卵粘在边上。”

这类细节是本书的长处，却也是它的短处。字里行间充斥着日期和数字，就像葡萄干布丁上满是葡萄干一样。然而，这些内容中有很多实在有趣，读者也就不怎么介意了。再者，还有哪本书会告诉读者“如何制作出最好的液体鸦片酊”呢？（本书给出的秘籍是：加入大量的藏红花，不要吝惜鸦片。） ■



Digital news organisations

Buzz kill

The last in our series on the future of journalism looks at digital news outlets

GREAT expectations attended digital journalism outfits. Firms such as BuzzFeed and Mashable were the hip kids destined to conquer the internet with their younger, advertiser-friendly audience, smart manipulation of social media and affinity for technology. They seemed able to generate massive web traffic and, with it, ad revenues. They saw the promise of video, predicting that advertising dollars spent on television would migrate online. Their investors, including Comcast, Disney and General Atlantic, an investment firm, saw the same, pouring hundreds of millions of dollars each into Vice Media, BuzzFeed and Vox (giving them valuations of \$5.7bn, \$1.7bn and over \$1bn, respectively).

They have had successes. Some became ninjas in “SEO” long before most print journalists knew it stood for “search engine optimisation”. They introduced “clickbait” to the lexicon. Some, like BuzzFeed and Vice, worked out that fortunes were to be made in brand-supported viral hits—or “native advertising” that looks similar to the sites’ own snazzy editorial content. They gave the internet “listicles” like BuzzFeed’s “19 Mindblowing Historical Doppelgangers” (sponsored by Virgin Mobile) and uplifting stories, like those from Upworthy, where “you won’t believe what happened next”.

But a brutal winter is setting in. BuzzFeed will probably miss its revenue target, of \$350m this year, by 15-20%, and is to lay off 100 of its 1,700 staff. Vice is also expected to fall short of its revenue target, of \$800m. Mashable, a once-trendy site valued in 2016 at \$250m, in November agreed to be sold for \$50m to Ziff Davis, a print-turned-digital publisher. Other news sites are up for sale, cutting their staff or closing shop, sending ink-free scribes in

search of work. Digital media are, in other words, enduring similar woes to their print peers. “There was this hype bubble that convinced everybody that these digitally native companies are different but they are not,” says an executive at one such previously overvalued firm. “People need to readjust their expectations.”

The natives have run into much the same problem as print newspapers have encountered: the duopoly of Alphabet (owner of Google and YouTube) and Facebook. The tech giants rule digital advertising in two ways. First, by dominating the business of selling and servicing ads, they take a healthy cut of those sold by publishers themselves. Second, they get advertisers to bypass publishers and spend directly on their platforms. Such is the demand that AdStage reckons ad prices on Facebook nearly tripled in only eight months this year, to \$11.17 per 1,000 impressions. That is still a lot cheaper than native advertising—the bespoke ads made by firms such as BuzzFeed and Vice. Google’s and Facebook’s tools for targeting users strike advertisers as a more efficient, scalable way to reach specific audiences.

The duopoly are expected to get a majority of digital ad sales in America this year, and almost all of the growth. The media firms that supply Google and Facebook’s users with content are mere “vassals”, including digital news sites, says one executive. Digital publishers often act as such, attuning their strategies to the platforms in the chase for clicks. After Facebook prioritised video content last year, so many sites made a “pivot to video” that it became an industry joke. It has not worked out well, as short videos are difficult to make and monetise at volume.

Publishers would be wiser to get users to stay on their own sites, so that they can profit from the relationship. Some are trying to do so with their journalism. Gizmodo Media Group, a group of tech and culture sites, has an investigative team. Vox makes in-depth explainer videos on current events. BuzzFeed regularly breaks big stories. The site holds its audience: the

“bounce rate” of BuzzFeed’s visitors—the share that leave after visiting one page—is 34%, which compares pretty well with 54% for the *New York Times* (the numbers come from SimilarWeb, an analytics firm).

Advertising still provides the bulk of revenue. But publishers are also selling things to visitors, both their own merchandise and other companies’ products, on which they take a cut. The Gizmodo sites (owned by Univision) get about one-quarter of their revenue from e-commerce; BuzzFeed has started doing the same. Membership fees may be another option.

Smaller digital operations are also using a variety of strategies. The Ringer, a sports and culture site in Los Angeles, has established a niche in podcasts, on which it generates millions in sponsorship. The Information, in San Francisco, has more than 10,000 subscribers paying \$399 a year for its technology news. At VTDigger, a non-profit site started by a laid-off journalist, dogged coverage of politics and corruption in Vermont has attracted strong readership and a mix of donations, grants and sponsorships from local businesses. There are several clear paths to long-term survival, but not to billion-dollar valuations. Expectations have indeed been readjusted. ■



数字新闻机构

一盆冷水

新闻业前景系列收官篇，探讨数字新闻媒体

数字新闻媒体曾被寄予厚望。BuzzFeed和Mashable等公司除拥有能接受广告的年轻受众，还善用社交媒体、谙熟科技手段，曾被认为是必将征服互联网的新一代弄潮儿。它们似乎能生成巨大的网络流量，并借此带来广告收入。它们看到了视频内容的潜力，预测电视广告费将转移到网络上。这些数字媒体的投资者也这样认为。包括康卡斯特（Comcast）、迪士尼和泛大西洋投资集团（General Atlantic）在内的各路投资者各向Vice Media、BuzzFeed、Vox投资数亿美元，将这三家媒体的估值分别推高至57亿美元、17亿美元和超过10亿美元。

它们的确战绩累累。早在大多数印刷媒体记者弄明白SEO是“搜索引擎优化”的意思之前，一些数字媒体已经成了这方面的超能“忍者”。它们首创了“标题党”（clickbait）一词。BuzzFeed和Vice等数字媒体则从品牌赞助的爆红内容中发掘出商机——这些广告看起来与这些网站自制的花里胡哨的内容无异，被称为“原生广告”。它们在网上炮制“清单体文章”（listicles），例如BuzzFeed的《史上19对酷肖人物》（由维珍移动赞助），还大推振奋人心的故事，例如新闻聚合网站Upworthy上那些声称“你绝对猜不到接下来发生了什么”的文章。

然而，寒冬正在来袭。BuzzFeed原定今年的营收目标是3.5亿美元，但实际收入可能会低15%到20%，而且公司将在1700名员工中裁员100人。Vice预计也无法达到原定八亿美元的营收目标。曾风靡一时的网站Mashable在2016年估值为2.5亿美元，但今年11月同意以5000万美元的价格出售给转型为数字媒体的老牌杂志出版商Ziff Davis。其他新闻网站不是挂牌出售，就是裁员或倒闭，令不少网络作者失业。换句话说，数字媒体正在面临和印刷媒体类似的苦况。“之前数字原生媒体受到大肆吹捧，让人们以为它们与众不同，但其实它们没什么两样。”来自一家被高估的数字媒体的高管说。“人们需要重新调整期望。”

数字原生媒体面对的问题跟印刷媒体的遭遇大致相同：Alphabet（谷歌和YouTube的母公司）和Facebook的双头垄断。这两家科技巨头通过两种方式统治数字广告市场。首先，通过垄断广告的销售及维护业务，它们分走了出版商广告收入中很可观的一部分。其次，它们让广告主绕过出版商，直接在其数字平台上投放广告。这一需求非常之大，据AdStage估计，今年Facebook的广告价格在仅仅八个月内就已升至原来的三倍，每千次展示的价格涨到11.17美元，但仍大大低于BuzzFeed和Vice等公司定制原生广告的价格。广告客户认为谷歌和Facebook定位用户的工具在影响特定受众上更有效、更易于规模化。

今年，这两大巨头预计将获得美国数字广告的大部分销售收入，并包揽几乎全部的增量。一位行业高管表示，向谷歌和Facebook用户提供内容的媒体公司只是其“附庸”，包括数字新闻网站。数字出版商行动上往往也确实唯巨头马首是瞻，追随数字平台调整自己的策略，追逐点击率。继去年Facebook开始注重视频内容后，许多网站也随之实施“视频转向”，成为业内笑话。结果并不理想，毕竟短片难以迅速大量制作和带来收入。

对出版商而言，更明智的做法是把用户留在自己的网站上，以便利用这一关系获利。有些出版商试图通过提升自己的新闻报道达到这一目的。科技与文化网站集团Gizmodo媒体集团（Gizmodo Media Group）成立了一支新闻调查队伍。Vox就时事要闻制作深度解读视频。BuzzFeed经常首先揭露大新闻。该网站成功留住了读者：其访客“跳出率”（即浏览一页后就离开的访客比例）为34%，相比《纽约时报》的54%（数据来自分析公司SimilarWeb），BuzzFeed的表现相当不俗。

广告仍然是主要的收入来源。不过出版商也开始向访客出售产品，既有自家商品，也有其他公司的产品，并从中提成。Gizmodo下属各网站（由美国西班牙语媒体公司Univision所有）的收入约有四分之一来自电子商务。BuzzFeed也开始了类似的业务。收取会员费可能会是另一个选择。

较小的数字媒体机构也在运用各种各样的策略。洛杉矶的体育和文化网站The Ringer在播客领域建立起自己的利基市场，凭借商业赞助获取数百万

美元的收入。旧金山媒体The Information有超过一万名订阅用户，他们每年支付399美元订阅其科技新闻。由一位被解雇的记者创办的非营利网站VTDigger坚持不懈地报道佛蒙特州的政治及贪腐事件，吸引了一批铁杆读者，并获得当地企业的各种捐款和赞助。要实现长期生存，目前已有几条清晰的路径，不过这些并不会带来几十亿美元的估值。大家的期望确实已有所调整。■



Robonurses

Machine caring

Thousands of Japanese nursing homes are testing robots on residents

AT SHINTOMI nursing home in Tokyo, men and women sit in a circle following exercise instructions before singing along to a famous children's song, "Yuyake Koyake" ("The Glowing Sunset"). They shout out and clap enthusiastically even though the activities are being led, not by a human fitness guru, but by Pepper, a big-eyed humanoid robot made by SoftBank, a telecoms and internet giant.

Japan leads the world in advanced robotics. Many of its firms see great potential in "carerobos" that look after the elderly. Over a quarter of the population is over 65, the highest proportion of any country in the OECD. Care workers are in desperately short supply, and many Japanese have a cultural affinity with robots.

For now the market is small. Although the government expects it will more than triple between 2015 and 2020, to ¥54.3bn (\$480m), that is a long way below the revenues from industrial and service robots. One big reason for that is expense; few individuals can afford their own robots. Private firms partly rely on government subsidies to develop them; the main customers are nursing homes, which also receive subsidies. Some 5,000 nursing-care institutions are now testing robots.

Yoshiyuki Sankai, founder of Cyberdyne, a robotics firm that makes some of the most expensive gear, is undeterred. "When Steve Jobs invented the personal computer there wasn't a market for it," he says. He has managed to persuade private health-insurance firms such as AIG to help cover the cost of some of his products.

At Shintomi and elsewhere, much of the equipment helps workers lift, move and monitor residents. A bed from Panasonic, a maker of appliances, splits in two, with one half turning into a wheelchair. Cyberdyne's lumbar-support suit responds to bioelectric signals from the wearer's body and helps care-home staff as they bend and lift. Sensors above beds alert workers when a patient moves near the edge and is in danger of falling out. At some homes, excretion sensors on the body monitor intestinal movements to predict when someone needs the lavatory.

Robots that communicate and provide companionship are among the most popular at the Shintomi home. Paro, a baby harp seal made by Intelligent System, a Japanese manufacturer, responds to touch and sound, turning to and nuzzling patients who stroke or talk to it. Sony's Aibo, a robo-dog originally invented as a gizmo for those who had it all during Japan's bubble years, has become another pet for the old.

Multi-purpose robots such as Pepper seem especially promising. In other businesses, Pepper specialises in customer service. But in nursing homes it talks to patients and monitors corridors at night (as well as running exercise classes).

Robot technology has much further to go if the machines are to replace human carers. "That will not happen until they have *sontaku*," says Yukari Sekiguchi, Shintomi's manager, referring to the Japanese concept of understanding by implication. "It cannot tell from a glance that someone fancies a cup of tea. I can." Human social interaction is still much easier to solve using robots than manual tasks are, says Kenichi Yoshida, who runs SoftBank's robotics division. For now, only humans can do tasks such as brushing a patient's teeth or shaving them.

Even so, many residents at Shintomi are keener on the robots than they are on some of the care workers, notes Mr Sekiguchi. A recent nationwide

study found that using robots encouraged over a third of residents to become more active and autonomous. The earliest adopters of robotics may well be people in the later stages of life. ■



机器人护工 机器关怀

成千上万家日本养老院正在试验用机器人提供关怀和护理服务

在东京的新富养老院，老头老太太们按指令围坐一圈，跟着著名儿歌《晚霞渐淡》（Yuyake Koyake）的音乐唱起来。他们热烈地拍手高歌，尽管带领他们的并非人类健康专家，而是由电信及互联网巨头软银（SoftBank）制造的大眼睛人形机器人佩珀（Pepper）。

日本的先进机器人技术世界领先。许多日本公司都认为照顾老人的“关怀机器人”（carerobos）具有巨大潜力。日本四分之一以上的人口超过65岁，在经合组织国家中比例最高。护工非常短缺，而许多日本人在文化上也对机器人有亲近感。

不过目前这个市场还很小。尽管政府预计2015年到2020年间其规模将会扩张两倍多，达到543亿日元（合4.8亿美元），但仍远低于工业和服务机器人的销售额。其中一大原因是价格——很少有个体能买得起自己的机器人。私营企业部分依靠政府补贴来研发机器人，主要客户是同样享受政府补贴的养老院。现在约有5000家养老护理机构正在测试机器人护工。

对此，机器人公司Cyberdyne的创始人山海嘉之并不气馁。这家公司生产的一些设备在最贵之列。他说：“乔布斯发明个人电脑的时候，个人电脑市场还不存在呢。”他成功说服了美国国际集团（AIG）等私营医疗保险公司把他的一些产品纳入保障范围。

在新富养老院和其他地方，很多机器人帮助护工搬移老人，监控他们的状况。家用电器制造商松下公司的机器轮椅床可拆分成两半，一半可以折成轮椅。Cyberdyne的腰部支撑服可对穿戴者身体的生物电信号做出反应，在护工弯腰搬抬重物时提供助力。当病人靠近床边、有跌落的风险时，病床上方的传感器会向工作人员发出警报。在一些养老院，老人身上的排泄传感器会监测其肠道运动的情况，预测何时需要提供洁具。

在新富养老院，具备沟通和陪伴功能的机器人非常受欢迎。日本制造商 Intelligent System 制造的海豹宝宝形象的机器人帕罗（Paro）会对触摸和声音做出回应，会转向抚摸它或对它说话的人并亲昵地贴蹭过去。索尼公司的机器狗爱宝（Aibo）最初是为经济泡沫时期生活富足的日本人发明的一个小玩意儿，现在已成为老年人的又一新宠。

看起来，像佩珀这样的多功能机器人市场前景尤佳。在其他行业，佩珀专事客户服务，但是在养老院里，除了组织锻炼之外，它还会和老人说话、在晚上监控走廊。

要取代人类护工，机器人技术还有很长的路要走。新富养老院的经理关口由加里说：“要等到机器人有了‘sontaku’的能力才可能替代人。”Sontaku 在日语中是揣摩、推测的意思。“机器人不能从你的一个眼神里看出来你想喝茶。我能。”不过，软银机器人部门的主管吉田健一表示，用机器人解决人类社交互动的问题还是要比用它们完成人工作业容易得多。目前，只有人可以完成帮病人刷牙或剃须等任务。

尽管如此，关口指出，相较于人类护工，新富养老院的许多老人更喜欢机器人。最近日本一项全国性研究发现，使用机器人让养老院里超过三分之一的老人变得更加积极主动。最早接受机器人的人很可能恰恰是处于人生暮年的老人。■



Surgery

Renaissance

A new generation of surgical robots is about to enter the operating theatre

ROBOTS have been giving surgeons a helping hand for years. In 2016 there were about 4,000 of them scattered around the world's hospitals, and they took part in 750,000 operations. Most of those procedures were on prostate glands and uteruses. But robots also helped surgeons operate on kidneys, colons, hearts and other organs. Almost all of these machines were, however, the products of a single company. Intuitive Surgical, of Sunnyvale, California, has dominated the surgical-robot market since its device, da Vinci, was cleared for use by the American Food and Drug Administration in 2000.

That, though, is likely to change soon, for two reasons. One is that the continual miniaturisation of electronics means that smarter circuits can be fitted into smaller and more versatile robotic arms than those possessed by Intuitive's invention. This expands the range of procedures surgical robots can be involved in, and thus the size of the market. The other is that surgical robotics is, as it were, about to go generic. Many of Intuitive's patents have recently expired. Others are about to do so. As a result, both hopeful startups and established health-care companies are planning to enter their own machines into the field.

Though the word "robot" suggests a machine that can do its work automatically, both da Vinci and its putative competitors are controlled by human surgeons. They are ways of helping a surgeon wield his instruments more precisely than if he were holding them directly. Da Vinci itself has four arms, three of which carry tiny surgical instruments and one of which sports a camera. The surgeon controls these with a console fitted with joysticks and pedals, with the system filtering out any tremors and

accidental movements made by its operator. That, combined with the fact that the system uses keyhole surgery (whereby instruments enter the patient's body through small holes instead of large cuts, making procedures less invasive), reduces risks and speeds up recovery. But at more than \$2m for the equipment, plus up to \$170,000 a year for maintenance, da Vinci is expensive. If a new generation of surgical robots can make things cheaper, then the benefits of robot-assisted surgery will spread.

| *Arms and the man*

This summer Cambridge Medical Robotics (CMR), a British company, unveiled Versius, a robot that it hopes to start selling next year (a picture of the machine can be seen [here](#)). Unlike da Vinci, in which the arms are all attached to a single cart, Versius sports a set of independent arms, each with its own base. These arms are small and light enough to be moved around an operating table as a surgeon pleases, or from one operating theatre to another as the demands of a hospital dictate. This way, the hospital need not dedicate a specific theatre to robotic surgery, and the number of arms can be tailored to the procedure at hand.

Unlike a da Vinci arm, which is like that of an industrial robot, a Versius arm is built like a human one. It has three joints, corresponding to the shoulder, the elbow and the wrist. This means, according to Martin Frost, CMR's chief executive, that surgeons will be able to use angles and movements they are already familiar with, instead of having to learn a robot-friendly version of a procedure from scratch. The company has yet to decide how much the arms will cost, but Mr Frost expects that operations which employ Versius will work out to be only a few hundred dollars more expensive than those conducted by humans alone. With da Vinci, the difference can amount to thousands.

Versius will compete with da Vinci on its own turf—abdominal and thoracic surgery. Others, though, want to expand robotics into new areas.

Medical Microinstruments (MMI), based near Pisa, in Italy, has recently shown off a robot intended for reconstructive microsurgery, a delicate process in which a surgeon repairs damaged blood vessels and nerves while looking through a microscope. This robot allows the surgeon to control a pair of miniature robotic wrists, 3mm across, that have surgical instruments at their tips.

MMI's device does away with the control console. Instead, the surgeon sits next to the patient and manipulates the instruments with a pair of joysticks that capture his movements and scale them down appropriately. That means he can move as if the vessels really were as big as they appear through the microscope.

Such a robot could even be used for operating on babies. "In their case," observes Giuseppe Prisco, MMI's boss, "even ordinary procedures are microsurgery." The company is now doing preclinical tests. Dr Prisco reckons the market for robotic microsurgery to be worth \$2.5bn a year.

A third new firm hoping to build a surgical robot is Auris Robotics. This is the brainchild of Frederic Moll, one of the founders of Intuitive Surgical (though he left more than ten years ago). Auris remains silent about when its robots will reach the market, but the firm's patent applications give some clues as to what they might look like when they do. Auris appears to be developing a system of flexible arms with cameras and surgical instruments attached, which could enter a patient's body through his mouth.

That tallies with an announcement the firm made earlier this year, saying that the robot will first be used to remove lung tumours. Lung cancer is the world's deadliest sort, killing 1.7m people a year. What makes it so deadly, Auris notes, is that it is rarely stopped early. Opening someone's thorax and removing parts of his lung is risky and traumatic. It is not always

worthwhile if the tumour is still small, because small tumours do not necessarily grow big. If they do, though, they are usually lethal if left *in situ*—but much harder to remove than when they were small. Auris's design could ease this dilemma by passing surgical instruments from the mouth into the trachea and thence to the precise point inside the affected lung where they are needed, in order to cut away only as much tissue as required.

Auris, CMR and MMI are all startups. But two giants of the medical industry are also joining the quest to build a better surgical robot. One is Medtronic, the world's largest maker of medical equipment. The other is Johnson & Johnson, which has teamed up with Google's life-science division, Verily, to form a joint venture called Verb Surgical.

Like Auris, Medtronic is keeping quiet about the design of its robot. But it has said that it plans to begin using it on patients in 2018. Also like Auris, though, some information can be deduced from other sources. In particular, Medtronic has licensed MIRO, a robot developed by Germany's space agency for the remote control of mechanical arms in space. MIRO is made of lightweight, independent arms. These, presumably, could be fixed directly onto the operating table.

A robot based on MIRO would let surgeons rely on touch as well as sight, since MIRO's instruments are equipped with force sensors that relay feedback to the joysticks used to operate them, and thus to the operator's hands. The lack of such haptic feedback (the ability to feel the softness of tissues, and the resistance they offer to the surgeon's movements) has long been a criticism of da Vinci. Surgeons often rely on touch, for example, to discern healthy from tumorous tissue.

Verb Surgical was formed in 2015 and demonstrated its latest prototype to investors earlier this year. Scott Huennekens, the firm's boss, says the

machine will be particularly suitable for gynaecological, urological, abdominal and thoracic surgery.

| *Robot, teach thyself*

Verb wants not just to build surgical machines, but to get its robots to learn from one another. The firm plans to connect all the machines it sells to the internet. Each bot will record data about, and videos of, every procedure it performs. These will be fed to machine-learning algorithms for analysis, to tease out what works best.

Mr Huennekens compares this to the way Google's driverless-car division collects data on its vehicles' journeys in order to improve their performance. A couple of years after its launch, and after processing enough images, the system could start helping surgeons to tell sick tissue from healthy, to decide where nerves and blood vessels are, and to plan procedures accordingly. Later, when the algorithms have swallowed many more years' worth of data, the robots may be able to help surgeons make complex decisions such as how to deal with unexpected situations, what the best way is to position the robotic arms, and where and how to cut.

As for Intuitive, it, too, has noticed the size of the lung-cancer market. In collaboration with Fosun Pharma, a Chinese firm, it has announced a new system for taking biopsies of early-stage lung cancers in order to determine how threatening they are. It has also announced the launch of the da Vinci X, a lower-cost version of its workhorse. Robots may already be in many theatres, but a bigger part awaits. ■



外科手术

手术机器人复兴

新一代手术机器人即将进入手术室

机器人协助外科医生手术已有多多年。2016年，全球各地的医院约有四千多台机器人，参与了75万次手术，大多数是前列腺和子宫手术。不过机器人也在肾脏、结肠、心脏和其他器官的手术中协助外科医生。然而，几乎所有手术机器人都是由同一家公司生产的：位于加利福尼亚州桑尼维尔市（Sunnyvale）的Intuitive Surgical公司。该公司的达芬奇外科手术系统于2000年获美国食品和药物管理局批准使用，之后便主导了手术机器人市场。

不过，这种情况可能很快就会改变，有两个原因。一是电子设备不断小型化，意味着智能电路可以安装在比Intuitive公司发明的产品更小、用途更广的机器人手臂上。这扩大了外科手术机器人可参与的手术范围，也扩大了市场规模。另一个原因是手术机器人眼看就要变成非专利产品了。Intuitive的许多专利最近已经过期，还有一些将要到期。因此，胸怀抱负的创业公司和老牌医疗企业都在计划将自己的机器人投放市场。

尽管“机器人”一词是指能够自动完成工作的机器，但达芬奇系统及其公认的竞争对手都受人类外科医生控制。比起外科医生自己手持器械做手术，机器人的辅助可以使操作更精准。达芬奇系统有四条机械臂，三条夹持微型手术器械，一条操作摄像头。外科医生利用装有操纵杆和踏板的控制台来控制这些机械臂，系统会过滤掉操作者的任何手颤和意外动作，再加上机器人系统进行的是微创手术（手术器械通过小孔而不是大的切口进入患者体内，降低了手术的侵入性），使得手术风险减少，术后恢复更快。但达芬奇系统价格不菲，售价超过200万美元，每年还有高达17万美元的维护费用。如果新一代外科手术机器人可以降低成本，那么机器人辅助手术的好处就能广为传播。

| 人机合作

今年夏天，英国剑桥医疗机器人公司（CMR）推出了一款名为Versius的机器人，希望于明年开始销售（照片见上图）。达芬奇机器人所有的机械臂都装在一个基座上，Versius则不同，它的机械臂分别安装在不同的基座上。这些机械臂既小又轻，可以依照外科医生的想法在手术台周围移动，或者根据医院的要求从一个手术室移动到另一个手术室。这样，医院就无需为手术机器人专门配备手术室，还可以根据手术的需求调整机械臂的数量。

达芬奇的机械臂就像工业机器人的一样，而Versius的则形似人类的手臂，有三个关节，对应人的肩、肘和手腕。CMR的首席执行官马丁·弗罗斯特（Martin Frost）认为，这样的设计让外科医生可以继续按照他们已经熟悉的角度和动作工作，而不必从零开始学习一套配合机器人的手术动作。CMR还没有敲定Versius的售价，但弗罗斯特预计，使用Versius做手术只会比仅依赖人类贵几百美元。换做是达芬奇，价格差别可达数千美元。

Versius将会在达芬奇的地盘——腹部和胸腔手术——与之竞争。不过其他人则希望将机器人推广到新的领域。位于意大利比萨附近的医疗微器械公司（MMI）最近展示了一种用于显微重建外科手术的机器人。这种手术十分精细，医生要在显微镜下修复受损血管和神经。MMI的机器人可以让医生控制一对3毫米粗、末端装有手术器械的微型机器人手腕来实施精细手术。

MMI的设备不用控制台，外科医生可直接坐在病人旁边，用一对操纵杆操纵机器人。操纵杆会感应医生的动作并恰当地缩小幅度。这意味着医生可以按照显微镜下看到的血管大小进行操作。

这种机器人甚至可以用于婴儿手术。MMI的老板朱塞佩·普里斯科（Giuseppe Prisco）指出：“对婴儿来说，即便是普通手术也相当于显微手术。”MMI正在进行临床前试验。普里斯科估计机器人显微手术的市场规模为每年25亿美元。

希望打造手术机器人的第三家新公司是Auris机器人公司（Auris Robotics），它由Intuitive的创始人之一（不过已在十几年前离开）弗雷德里克·莫尔（Frederic Moll）一手创立。Auris对其机器人何时上市只字未提，不过从该公司的专利申请中大概可以猜到其产品面世后会是什么模样。Auris似乎正在开发一个柔性机械臂系统，上面装载手术器械和摄像头，通过病人口腔进入身体。

这与该公司今年早些时候发布的一项声明相符。当时它说自己的机器人将首先用于切除肺部肿瘤。肺癌是世界上最致命的疾病，每年造成170万人死亡。Auris指出，肺癌之所以如此致命，是因为病情很少能在早期得到遏制。通过开胸手术切除肺部病灶风险高、创伤大。如果肿瘤尚小，就不总是值得开刀，因为小肿瘤不一定会长大。但如果真的长大，不做处理又往往是致命的，但这时切除肿瘤要比肿瘤还小时难很多。Auris的设计可以缓解开刀还是不开刀这个两难局面：机械臂可将手术器械从口腔送入气管，并由此精准到达需要手术的肺内病变位置，只切除需要切除的部分。

Auris、CMR和MMI都是创业公司，但医疗行业的两大巨头也在加入它们的行列，力求打造更好的手术机器人。一个是世界最大的医疗设备制造商美敦力（Medtronic），另一个是强生公司。后者与谷歌的生命科学部门Verily联手，组建了名为Verb Surgical的合资企业。

美敦力对自己机器人的设计和Auris一样讳莫如深。但它表示计划从2018年开始用机器人为患者做手术。不过和Auris一样，人们也可从其他消息来源推断出一些信息，特别是美敦力公司已获得德国航空航天中心的许可，使用后者开发的、能在太空遥控机械臂的机器人MIRO。MIRO有着轻巧的独立的机械臂，应该可以直接固定在手术台上。

基于MIRO的机器人可以让外科医生既依靠视力，也依靠触觉，MIRO的手术器械上配备了力传感器，因而可以将反馈信息传递给操纵手术器械的操纵杆，进而传递到医生手上。缺乏这种触觉反馈（感受组织的柔软度以及其对外科医生动作的阻力）一直让达芬奇备受批评。外科医生经常依靠触觉做出判断，比如辨别健康组织和肿瘤组织。

Verb Surgical成立于2015年，今年早些时候向投资者展示了最新的产品原型。公司老板斯科特·胡恩肯斯（Scott Huennekens）说，该机器人特别适用于妇科、泌尿外科、腹部和胸腔手术。

| 机器人，自学吧

Verb公司不仅要生产手术机器人，还要让机器人相互学习。该公司计划将其销售的所有机器人联网。每个机器人都会记录其参与的每场手术的数据和视频，提供给机器学习算法进行分析，梳理并得出最佳经验。

胡恩肯斯认为，这与谷歌无人驾驶汽车部门的做法无异：该部门为改善汽车性能，收集车辆行程数据。推出几年后，等到分析了足够多的图像，系统就可以开始帮助外科医生辨识健康组织和病变组织，确定神经和血管的位置，并相应地规划手术方案。再之后，等算法获得了更长时间的数据，机器人也许还能帮助外科医生做出复杂的决定，例如如何应对突发情况，怎样最好地放置机器人手臂，在何处下刀以及如何下刀。

Intuitive公司也注意到了肺癌市场的规模。它与中国的复星医药合作，宣布推出一项新的早期肺癌活检系统，可以确定肿瘤的威胁程度。它还宣布推出其拳头产品达芬奇的低成本版：达芬奇X。机器人可能已经出现在许多手术室中，但今后还会发挥更大的作用。■



Free exchange

Home rules

Buying local is an appealing slogan, but often makes for misguided and costly policy

RANDY KULL, a businessman based in Illinois, sells traffic signs. His products have international appeal, with signs for anglophones (STOP), Spanish-speakers (ALTO) and horses (WHOA). But for some customers, he must stay local. When America's Department of Transportation is involved, he must use American-made sign-mounting brackets, and fill in a form confirming their source. Mr Kull's supplier in Arkansas is happy, but he himself is dubious. "We live in a global economy," he scoffs. The weight of the evidence backs his instinctive scepticism.

To many, buying local seems sensible—wholesome, even. Keeping money close to home is supposed to foster thriving communities and generate jobs. To the administration of President Donald Trump, it is a source of national strength. Around the world, such sentiments are gaining ground. Global Trade Alert, a watchdog, has picked up 343 examples of new local-content requirements imposed since November 2008. In America, it estimates that the share of imports potentially snared by localisation restrictions has risen fivefold since 2009. Proposals for a tightening of existing restrictions on government procurement are due on Mr Trump's desk by November 24th.

That may be because a soft approach—encouraging but not mandating buying local—does not work. Offering more information, for example, can backfire. In Britain in 1887, a new legal requirement that goods "Made in Germany" were so labelled was meant to protect local producers. It became a badge of quality. Labels might sway some patriots. But for government agencies, hard-nosed investors and cash-strapped shoppers, information is not enough. "Everyone gravitates towards price," says Mr Kull.

Governments justify intervention in different ways. In Argentina, where 30% of the music broadcast on local radio must be made locally, it is seen as championing local culture. In China data-localisation laws are justified on national-security grounds. Rules on locally produced sources of clean energy, coupled with subsidies, are often defended as environmental protection.

More often, localisation measures are a straightforward grab for jobs and business. In theory, local-content requirements could fix market failures. Companies may not take into account the benefits of being part of a cluster and so may be overly eager to outsource or to use their distant supply chains. By overcoming a failure of co-ordination, content regulations could force local learning-by-doing and foster innovation.

In practice, these policies are protectionist (and banned by the World Trade Organisation). They lock out foreigners, shelter local providers from competition and prevent them from taking advantage of global value chains. A review by Gary Hufbauer, Jeffrey Schott, Cathleen Cimino, Martin Vieiro and Erika Wada for the Peterson Institute for International Economics (PIIE) in 2013 estimated that they lowered global trade by \$93bn annually.

Rather than nurturing the strong, such policies appear to coddle the weak. Reviews by the PIIE, the OECD and the UN found no evidence that they stimulate innovation. In supposed success stories such as China's solar-cell industry, it is unclear whether local-content requirements drove success, or whether innovation was hampered as foreign firms fled. In Brazil's health-care sector, the PIIE's analysis suggests that local-content requirements make it slow to adopt new devices and drugs. Protectionism has caused America's once proud shipbuilding industry to wither.

Local-content restrictions generate hassle. American government agencies

can appeal to a list of exceptions for items that are impossible to source locally (it includes capers, goat- and kidskins, cobra venom and quinine). Those American companies that want to sell vehicles to their government must wade through an 83-page rule-book. The biggest costs, however, are in cash. Between 2009 and 2011 the PIIIE authors estimate that the Obama administration's buy-local requirements for steel cost the government about \$5.7bn. Canadian restrictions on wind turbines meant utilities in Ontario and Quebec spent \$500m more than if they had bought American ones.

Proponents of "buy local" policies tend to think too narrowly. Pricier locally produced inputs mean less cash to spend on other things. A new paper by Peter Dixon, Maureen Rimmer and Robert Waschik of Victoria University puts the short-run benefit to the American economy of ditching its local-content requirements at around 300,000 jobs. They find that the steel sector would not lose out by much—the government represents a tiny fraction of overall demand. But the savings from cheaper inputs would allow the government to cut taxes.

| *Unwelcome party*

Localisation measures are often considered in isolation. But if they lead to retaliation, everyone loses. To make the point, Mexican trade negotiators have reportedly responded to American threats of limited access for their exporters to public-procurement markets by suggesting Mexico would reciprocate with similar restrictions. Even within an economy local-content requirements create hidden victims. They favour particular sectors, with effects that ripple through the rest of the economy. Surveying a range of restrictions around the world, the OECD finds that they lower exports in sectors not themselves the target of rules by a little over 0.5% in America, and by even more in Brazil and India.

Snappy "buy local" sound bites do not make sensible economic policy. By

directing money at one group, another is shut out. By picking a winner in one place, a loser wilts elsewhere—and perhaps closer to home than you might think. They also have a nasty political undercurrent. Calls to buy local inevitably act to exclude outsiders, fostering a sense of “them” and “us”. What seems wholesome has a darker side. ■



自由交流

本地规则

“本地采购”是个动听的口号，但往往造成误入歧途且代价高昂的政策

伊利诺伊州的商人兰迪·库尔（Randy Kull）销售交通标志牌。他的产品相当国际化，“停止”标志既有英语的“STOP”，也有西班牙语的“ALTO”，还有叫停马匹的“WHOA”。但对部分客户，他必须保持本地化。如果是美国交通部的订单，他就必须使用美国制造的安装支架，并填写表格确认这些部件的来源。库尔在阿肯色州的供货商对此很高兴，但他本人则心存疑虑。“我们可是活在全球化经济中啊。”他不无讥诮地说。有充分的证据支持他这种本能的怀疑。

在许多人看来，本地采购似乎合情合理，甚至是正义的行为。保持资金在本地流动应该能促进社区繁荣，创造就业机会。在特朗普政府看来，这是国家强大的源泉。在世界各地，这种观点日益流行。自2008年11月以来，监督组织全球贸易预警（Global Trade Alert）发现了343例新实施的本地化要求。据该组织估计，自2009年以来，美国有可能受本地化限制影响的进口份额已经上升到原来的五倍。11月24日，有关进一步加强政府采购既有限制的提案已提交给特朗普。

这可能是因为鼓励但不强制本地采购的“软性措施”不奏效。例如，要求“提供更多信息”的措施就有可能适得其反。1887年，为保护本国生产者，英国颁布新法令要求来自德国的产品贴上“德国制造”的标签。后来，这个标签成了品质的象征。标签也许会影响到一些爱国人士，但对于政府机构、精明实际的投资者和手头不宽裕的消费者而言，单单提供信息是不够的。“大家都是看价格办事。”库尔说。

各国政府会以不同的方式为自己的干预手段正名。阿根廷规定当地电台播放的音乐必须有30%为本地制作，并认为这是在捍卫本地文化。在中国，贯彻数据本地化法规的理由是保护国家安全。政府往往还会以保护环境为由，设置支持本地清洁能源的法规，并提供补贴。

更多时候，推行本地化措施其实就是为了争抢就业岗位和生意。理论上，本地化要求可以解决市场失灵的问题。企业可能没考虑到身处集群的好处，因而会太过热衷外包或使用外国供应链。通过克服协调失灵的问题，本地化法规能迫使本地企业“边做边学”，促进创新。

实际上，这些都是保护主义政策，为世贸组织所明令禁止。这些政策把外国竞争者挡在门外，庇护了本地供应商使其免受竞争，同时也妨碍它们利用全球价值链。彼得森国际经济研究所（以下简称PIIE）的加里·胡夫鲍尔（Gary Hufbauer）、杰弗里·斯科特（Jeffrey Schott）、凯瑟琳·西敏诺（Cathleen Cimino）、马丁·维埃罗（Martin Vieiro）、艾瑞卡·华达（Erika Wada）在2013年估计，这些政策导致全球贸易额每年减少930亿美元。

这些政策似乎并没有培育出强者，反而娇惯了弱者。PIIE、经合组织（OECD）和联合国的调查没有发现它们能激励创新的证据。在所谓的成功案例中，如中国的太阳能电池产业，并不能确定本地化政策是否带动了产业成功，也不清楚外国公司撤离是否阻碍了创新。PIIE的分析还显示，本地化要求导致巴西的医疗行业在采用新设备和新药物方面动作迟缓。保护主义还导致美国一度引以为豪的造船业逐渐萎缩。

本地化限制滋生出诸多麻烦。美国政府机构有一份豁免清单，据此进口无法从本国采购的产品，包括刺山柑、山羊皮和羔羊皮、眼镜蛇毒液、奎宁。想向美国政府出售车辆的美国公司必须详读一本83页厚的规则手册。然而，最大的代价是金钱支出。PIIE的几位作者估计，从2009年至2011年，奥巴马政府因钢铁本地采购的规定约花费了57亿美元。加拿大政府限制外购风力发电机，安大略省和魁北克省的电力公司因而必须在本地采购，相比购买美国产品，成本增加了五亿美元。

“本地采购”政策的支持者往往思路狭隘。高价购买本地材料，能花在其他方面的资金就减少了。在一篇新论文中，加拿大维多利亚大学（Victoria University）的彼得·迪克森（Peter Dixon）、莫林·里梅（Maureen Rimmer）、罗伯特·瓦舍克（Robert Waschik）指出，如果放弃本地化要

求，美国经济可获得的短期利益是大约30万个工作岗位。他们发现，钢铁行业不会有多大损失，因为政府只占整体需求的一小部分。但购买廉价材料节省的资金可令政府有财力推行减税。

| 不欢迎派对

本地化措施往往是在孤立地考虑问题。但如果这些政策导致报复，那么各方都会蒙受损失。据称，美国威胁限制墨西哥出口商进入美国的政府采购市场后，墨西哥贸易谈判人员提出将施以类似的限制作为报复，这就可以说明问题。即便是在同一经济体内，本地化要求也可能造成隐蔽的伤害。这些政策偏袒特定行业，影响则波及经济体内的其他部门。经合组织在全球范围对各类贸易限制的调查发现，在美国，这些规定导致非政策目标的行业出口下降略超过0.5%，在巴西和印度下降得更多。

“本地采购”的漂亮口号不会带来明智的经济政策。把资金输送给一个群体，另一群体就会被拒之门外。在一处钦点胜者，别处就有人沦为输家，而且这个输家也许并不像你以为的都在别处。这些政策还会造成险恶的政治暗流。呼吁本地采购无可避免地会形成排斥外来者的行动，催生“我们”与“他们”之分。貌似正义的政策有更阴暗的一面。 ■



Economic and financial indicators

Life insurance

Premiums in China will rise by 23% this year

Global life-insurance premiums came to \$2.6trn last year and are set to rise by 3% in 2017, more than double the average annual growth rate of the previous five years. Countries with booming middle-class populations account for most of this: premiums in China will rise by 23% this year. In America, the world's largest market, premiums will fall by 2%. A fall in annuity sales helps explain the drop, owing to uncertainty about the impact of a new fiduciary rule that requires financial advisers to put clients' interests first. Profits in the life-insurance industry have been dragged down by low interest rates. At the end of 2016 the industry's return on equity was 8.1%, well below the pre-crisis level of 14.4%. ■



经济与金融指标

人寿保险

中国今年的保费将增加23%

去年全球人寿保险保费达到2.6万亿美元，预计2017年将增长3%，是之前五年平均年增长率的两倍有余。那些中产阶级日益壮大的国家对增长的贡献最大：中国今年的保费将增加23%。然而在世界最大的保险市场美国，保费将下降2%。保费下降和年金保险销售额的减少有关。一项新的信托规定要求理财顾问将客户利益放在首位，由于不能确定这会带来怎样的影响，年金保险销量减少。低利率拉低了人寿保险行业的利润。2016年年底，该行业的股本回报率为8.1%，远低于金融危机前14.4%的水平。■



Buttonwood

A lot of zeros

Investors are piling into an illiquid asset. What can possibly go wrong?

MOST money these days is electronic—a series of ones and zeros on a computer. So it is rather neat that bitcoin, a privately created electronic currency, has lurched from \$1,000 to above \$10,000 this year (see chart), an epic journey to add an extra zero.

On the way, the currency has been controversial. Jamie Dimon, the boss of JPMorgan Chase, has called it a fraud. Nouriel Roubini, an economist, plumped for “gigantic speculative bubble”. Ordinary investors are being tempted into bitcoin by its rapid rise—a phenomenon dubbed FOMO (fear of missing out). Both the Chicago Mercantile Exchange, America’s largest futures market, and the NASDAQ stock exchange have seemingly added their imprimaturs by planning to offer bitcoin-futures contracts.

It is easy to muddle two separate issues. One is whether the “blockchain” technology that underpins bitcoin becomes more widely adopted. Blockchains, distributed ledgers that record transactions securely, may prove very useful in some areas of finance, and beyond. The second is whether bitcoin will become a widely adopted currency in everyday life. Here the evidence is weak.

Bitcoin can be used to buy a few things. But a currency has three main functions: store of value; means of exchange; and unit of account. Bitcoin’s volatility, seen when it fell 20% within minutes on November 29th before rebounding, makes it both a nerve-racking store of value and a poor means of exchange. Imagine buying an iPhone X with bitcoin in January. You would by now be cursing as the same coin could buy ten phones—Christmas gifts for the whole family.

A currency is also a unit of account for debt. Paul Mortimer-Lee of BNP Paribas, a French bank, tartly remarks: “Imagine if you had financed your house with a bitcoin mortgage.” This year your debt would have risen tenfold. Your salary, paid in dollars, euros or whatever, would not have kept pace. Put another way, had bitcoin been widely used, the last year might have been massively deflationary.

Such issues will be of minor concern to those who managed to buy bitcoin earlier in the year. They will just be delighted with the profits. But why has the price risen so fast? One justification for the existence of bitcoin is that central banks, via quantitative easing (QE), are debasing fiat money and laying the path to hyperinflation. But this seems a very odd moment for that view to gain adherents. Inflation remains low and the Federal Reserve is pushing up interest rates and unwinding QE.

A more likely explanation is that as new and easier ways to trade in bitcoin become available, more investors are willing to take the plunge. As the supply of bitcoin is limited by design, that drives up the price.

But it is worth remembering that the cost of using bitcoin is going up. Each transaction has to be verified by “miners” who need a lot of computing power to do so, and a lot of energy: 275kWh for every transaction, according to Digiconomist, a website. In total, bitcoin uses as much electricity a year as Morocco, or enough to power 2.8m American households. All this costs much more than processing credit-card transactions via Visa or MasterCard.

The miners are rewarded for their efforts by being paid in bitcoin; they are delighted by the rise in the currency’s price. But some are finding ingenious ways to cut back on their energy costs; one even put computers in his Tesla car so he could mine bitcoins using its free charging stations. Much mining is done in parts of China where electricity is cheap.

There are two ways of thinking about this. One is that the eventual price of bitcoin will equal the marginal cost of mining, which may be rising but is well below the current price. The second is that institutions will not want to use the technology if it relies on such a “Wild West” process; banks are already looking at cheaper forms of blockchain technology.

Whether the investors driving the price higher are pondering all this is open to doubt. It looks like a re-run of the dotcom craze. Adverts for trading digital currencies are appearing on the London tube and celebrities have piled onto the bandwagon. As seen many times before, when lots of investors buy an illiquid asset, the price can rise exponentially.

The top is hard to call. At some point, the urge to turn all those digital zeros into cars and iPhones will prove too great. Getting out of an illiquid asset—as this week, when exchanges struggled to cope with trading volumes—can be harder than getting into it. Some remember Nathan Rothschild’s remark about the secret of his wealth: “I always sold too soon.” ■



梧桐

长长一串0

投资者争相投资于一种缺乏流动性的资产。可能出什么问题呢？

如今大部分货币都是电子的，也就是计算机上的一串0和1。对比特币这一私人创建的电子货币来说，其价格今年从1000美元一路跌跌撞撞涨到10000美元以上（见图），又添上了一个0，可谓史诗般的旅程。

这种货币一直以来都是争议的焦点。摩根大通（JPMorgan Chase）的老板杰米·戴蒙（Jamie Dimon）曾斥之为骗局。经济学家努里埃尔·鲁比尼（Nouriel Roubini）认定它是“巨大的投机泡沫”。越来越多的普通投资者被其迅速上涨的价格吸引入场——这种现象被称为FOMO（fear of missing out，害怕踏空）。美国最大的期货市场芝加哥商业交易所以及纳斯达克证券交易所都计划提供比特币期货合约，似乎是在为比特币背书。

人们很容易把两个不同的问题混淆起来。一个问题是支撑比特币的“区块链”技术是否应用日益广泛。区块链是一种安全记录交易的分布式分类账，它可能在某些金融或其他领域非常有用。第二个问题是比特币是否会成为日常生活中广泛采用的货币。这方面的证据则很薄弱。

比特币可以用来买一些东西。但是货币有三个主要职能：价值储备、流通手段和计价单位。11月29日，比特币在几分钟内下跌20%之后又反弹，这种波动性使得比特币若充当价值储备会让人神经紧绷，作为流通手段也十分糟糕。想象一下，如果你在1月份用比特币买了一个iPhone X，现在肯定会想骂人，因为同一个币如今可以买十台手机，够全家人的圣诞礼物了。

货币也是债务的计量单位。法国银行法国巴黎银行（BNP Paribas）的保罗·莫蒂默-李（Paul Mortimer-Lee）尖锐地评论道：“想象一下，要是你的住房贷款是用比特币来还，会是什么样子。”今年你的债务可能已经涨了十倍。无论你拿的是美元、欧元或其他什么货币的工资，都跟不上它的步

伐。换句话说，要是比特币已得到广泛使用，过去一年可能已经出现了大规模通货紧缩。

对于那些在今年早些时候购买比特币的人来说，这些问题根本不重要。他们只会为利润感到高兴。但为什么价格上涨这么快？比特币存在的一个理由，是中央银行正在通过量化宽松（QE）让法定货币贬值，为恶性通货膨胀铺路。但是，现在也不像是这种观点能吸引追随者的时候。通货膨胀率仍然很低，美联储正在推高利率并逐步退出QE。

更可能的解释是，随着比特币出现更新、更容易的交易方式，更多的投资者愿意冒险。由于比特币在设计上就限制了供应，这会推高价格。

但同时也应该记得，使用比特币的成本正在上升。由于每笔交易都必须经由“矿工”验证，这需要大量计算能力。根据Digiconomist网站的数据，每笔交易需要275度电。比特币每年的总用电量与摩洛哥持平，或者足够为280万户美国家庭供电。所有这些都比通过Visa或万事达处理信用卡交易的成本高得多。

矿工们会获得比特币作为工作酬劳，他们为比特币价格的上涨感到高兴。但有些人正在寻找巧妙的方法来削减能源成本。有人甚至把电脑放在自己的特斯拉车上，这样就可以使用免费充电站来挖掘比特币。很多挖矿工作是在中国电价便宜的地方完成的。

对此有两种思考方式。一是比特币的最终价格将等于挖矿的边际成本，这一成本可能在上涨，但远低于现在的价格。第二，如果这种技术依赖于这样一个如“狂野西部”般的进程，机构就不会希望使用它；银行已经在研究更廉价的区块链技术形式。

推高价格的投资者是否考虑了这一切不得而知。这看起来像是互联网泡沫的重演。交易数字货币的广告出现在伦敦地铁上，名人也争相上车。正如历史上多次出现的，如果很多投资者购买一种缺乏流动性的资产，价格就可能呈指数级上涨。

什么时候到顶很难说。总有一天，将所有这些虚拟的o变成汽车和iPhone的冲动将变得太过强烈。逃出流动性不足的资产——就像本周交易所难以应付交易量时那样——可能要比进场困难。一些人记得纳森·罗斯柴尔德（Nathan Rothschild）谈及自己财富秘诀时的说法：“我总是卖得太早。”■



Energy management

Tripping out

Revamped fuse boxes could become the hearts of energy-efficient homes

IN THE future, homes will use electricity much more sensibly than they do now: turning the lights off automatically when no one is around; adjusting the heating regularly to suit a householder's daily routine; making sure the electric car is charged up using off-peak rates; even drawing power from the car's battery in the event of a grid outage. A variety of plug-in devices can already do some of these things. Yet lurking in every home, usually in a dark cupboard or down in the basement, is a humble piece of equipment that, with a bit of tweaking, could replace them all with a single command centre.

The equipment concerned is often referred to as a fuse box, although nowadays it is unlikely to use actual fuses—strands of wire that cut off the current by melting in the event of a power surge. Instead, such boxes contain a panel of electromechanical switches called circuit breakers. Typically, a breaker contains an electromagnet through which the current flows. If that flow exceeds a set level, the electromagnet becomes sufficiently energised to throw a mechanical switch, which breaks the circuit. A circuit breaker responds faster than a fuse, and can also be reset manually instead of having to be replaced.

Circuit breakers are thus essential to help prevent electrical fires and stop people from being electrocuted. But they also serve as a distribution point for all the wires in a house, with breakers monitoring the lights and power sockets in different rooms, and separate breakers regulating some individual appliances, such as cookers and water heaters. This makes the breaker box an ideal place from which to manage energy use.

To make such management work, though, the breakers need to become “smart”. One way to do that is to add electronics to them. This is what Eaton, a multinational, is attempting in a trial taking place in America with a dozen utilities and the Electric Power Research Institute, an industry body. Eaton’s modified breakers have been installed in about 80 buildings, where they are monitoring and controlling power supplies remotely. The breakers, which use encrypted internet connections, can also meter each circuit separately. That permits a much broader analysis to be made of a building’s power consumption and might in the future allow utilities to offer different tariffs for circuits powering different things, says Ron Thompson, one of the project’s leaders. A second phase of the trial will begin next year, to develop more applications. So far, the most popular ones control heating, air conditioning, water heaters and recharging electric cars.

Manetos Labs, a Swedish firm, is going even further than this, by developing a digital circuit-breaker. That has been made possible by advances in high-power semiconductors, which allow “solid-state” circuit breakers, with no moving parts, to be built. These would act as direct replacements for electromechanical ones.

| *Breaker dancing*

A digital breaker has several advantages. Its lack of mechanical parts should make it both safer and more reliable. It can cut a circuit in just 250 nanoseconds, which is substantially faster than a mechanical version, says Trued Holmquist, a Swedish information-technology entrepreneur who helped found Manetos. The programs it uses to control, measure and communicate with appliances could be updated over the internet, letting new features be added as they are developed. And, as with most smart-energy services, these could be controlled by a smartphone app.

The level of detail smart breakers look at is impressive. Mr Holmquist says

that his can, for example, measure the revolutions-per-minute of the compressor in a refrigerator. Not only would this let an app monitor how hard the appliance is working, it could also give warning if that appliance was about to break down.

A useful innovation, then, but one only likely to be taken up if the price is right. To this end Manetos has teamed up with Flex, an American firm that is one of the world's largest contract manufacturers, to work out how to make solid-state breakers as cheaply as possible. The plan is to consolidate the electronic circuits into a single chip that can be mass-produced for a few dollars. Breakers using such chips should, Mr Holmquist reckons, be competitive with mechanical ones.

Other firms are taking a different approach to the question of price, by seeking customers willing to pay a premium for a solid-state breaker's virtues. Atom Power, in North Carolina, is aiming the digital breakers it is developing at commercial and industrial buildings, where it thinks their benefits will be higher than in homes.

One of the advantages of a solid-state breaker is that it removes the risk of arc flashes—electrical discharges that can run through the air when a switch is thrown. Such sparks are particularly hazardous if there are combustible materials around, which is more likely in an industrial than a domestic setting.

Siemens, a German electricals giant, reckons digital breakers show “great promise” and has taken a stake in the company. Atom's engineers have not given up on the domestic market, though. They hope residential versions will be practical once production volumes grow. Eaton also thinks that, at some point, the time for digital breakers will come.

There is, however, one other obstacle besides price to the uptake of

domestic digital breakers: the regulators. These people, naturally and sensibly conservative, tend to be more in tune with mechanical than digital breaker systems. Their certification is necessary before products can go on sale. To deal with that problem, Manetos has a trick up its sleeve. Its first digital breakers will also incorporate an old-fashioned fuse. With this as a backup, the system should pass existing tests with flying colours. Mr Holmquist is confident, though, that the fuse will never be needed. Manetos will offer a lifetime guarantee it will not blow. ■



节能管理

跳闸

新式保险丝盒也许将成为家庭节能的核心

未来，家庭用电将比现在智能得多：没人时电灯会自动熄灭；暖气会根据住户的日常起居有规律地调节；确保只在用电波谷时段为电动车充电；甚至在停电时用电动车的电池供电。如今五花八门的插入式设备已能胜任一部分这样的工作。不过每家每户都藏着一个不起眼的装置——通常是在橱柜深处或地下室里，只要稍加改动就能成为一个指挥中心，替代上述所有设备。

这个设备常被叫做保险丝盒，一旦电流骤增，里面的保险丝就会熔断，切断电流。不过现在已经不大使用真正的保险丝了。如今的盒子里装着一组叫作断路器的机电开关。断路器内通常会有一个电磁体供电流通过，如果电流超过限定标准，电磁体就会产生足够大的磁力拉动机械开关，从而切断电路。断路器比保险丝反应更快，并且能手动重置，无需更换。

因此，在预防电气火灾及人员触电伤亡方面，断路器不可或缺。除此之外，它还起到分配家中所有电线的作用：有的断路器负责各个房间的电灯和插座，有的控制电炊具、热水器等家电。这使得这个盒子成为用电管理的理想指挥所。

不过，要实现这一管理功能，断路器需要变得“智能”起来。方法之一是在其中加入电子器件。在美国，跨国公司伊顿电气集团（Eaton）正联合12家电力公司以及行业机构美国电力研究院（Electric Power Research Institute）展开试验。伊顿在大约80座建筑物中安装了改良的断路器，远程监控供电。这些使用加密网络连接的断路器还能够分别测量每一条电路。这样就可以对一座建筑的耗电情况做出更广泛的分析，而未来电力公司或许也可以根据用电设备的不同，对各条电路实行区别收费，项目负责人之一罗恩·汤普森（Ron Thompson）如此说道。明年将开始试验的第二阶段，开发更多应用。目前控制暖气、空调、热水器以及电动汽车充电

等方面的应用最热门。

瑞典公司Manetos Labs则更进一步，正在研制数字式断路器。大功率半导体的进步使得制造无活动部件的“固态”断路器成为可能。固态断路器将会直接替代机电断路器。

| 小断路器的大舞台

数字式断路器有多项优点。这种断路器没有机械零件，因而更加安全可靠。协助创办了Manetos的瑞典信息技术创业者特鲁德·霍尔姆奎斯特（Trued Holmquist）说，数字式断路器在短短250纳秒之内就能切断电路，比机械式断路器快得多。另外，它用以控制、测量以及连接家电的程序可以在线更新，增加新开发的功能。而且与大多数智能能源服务一样，这些程序可以通过智能手机应用来控制。

智能断路器对细节的关注程度令人叹服。霍尔姆奎斯特举例说，他们的断路器能够测量冰箱压缩机每分钟的转速。这不仅能让应用程序监控家电的工作强度，还会在家电即将出故障时发出警告。

如此看来，这确实是一项有用的创新，但只有价格合适才可能被市场接受。为此，Manetos已经和全球最大的代工企业之一、美国的伟创力（Flex）合作，探索如何尽可能地降低固态断路器成本。它们计划将电子电路并入一个单芯片内，这样的芯片能够以几美元的价格批量生产。霍尔姆奎斯特认为，使用这种芯片的断路器应该能与机械式断路器竞争。

其他公司则另辟蹊径以解决价格问题，寻找愿意为固态断路器的优点出高价的顾客。北卡罗来纳州的Atom Power正在研制的数字式断路器面向商用和工业建筑。该公司认为数字式断路器在这些地方的收益比家用的要高。

固态断路器的优点之一是消除了危险的电弧闪光，即推动开关时电流通过空气产生的电火花。如果周围有易燃物，这样的火花尤其危险。而比起家庭环境，工业环境里更有可能堆积易燃物。

德国电气设备巨头西门子认为数字式断路器“大有前途”，并入股了Atom

Power。不过Atom的工程师们没有放弃家用市场。他们希望一旦产量增长，数字式断路器将能够进入家庭。伊顿也认为数字式断路器的时代终将到来。

然而，除了价格，还有一个因素阻碍了家用数字式断路器为市场所接受：监管者。可以想见，他们非常保守，更符合他们口味的是机械式而不是数字式断路系统。产品要想上市销售，必须先通过他们的认证。对于这个问题，Manetos自有妙招。它的首批数字式断路器会加入老式的保险丝，有了这个后备，系统应该就能大摇大摆地通过现行的认证检测。不过，霍尔姆奎斯特确信保险丝绝不会有有用武之地。Manetos将提供保险丝永不熔断的终身保证。■



Aviation

Winning the slottery

The allocation of airport capacity is skewed towards legacy carriers. It is time to break their grip

YOU may think that an airline's most valuable asset is its planes. But with Monarch, Britain's fifth-biggest carrier, which went bust in October, creditors were keenest to claim slices of airspace at particular times of day. Monarch's landing and take-off slots at British airports are a big enough prize to have caused a court battle. That is a sign of how much the system for allocating them harms competition and consumers.

Slots have been sought-after since the 1960s, when airports began to fill up. In response IATA, an airline-industry body, developed a set of guidelines which state that an airline can keep a slot from the previous year if it has been used at least 80% of the time. Those that are not are put into a pool and reallocated; half are supposed to go to new entrants. Over 190 congested airports—103 of them in Europe—follow rules that IATA describes as “fair, neutral and transparent”.

Hogwash. To comply with the “use it or lose it” rule, many airlines resort to artifice—flying smaller planes than necessary in order to spread capacity across their slots, for example, and even running empty “ghost” flights to ensure that the runways are busy at the appointed time. So instead of slots being recycled from established carriers to new ones, they are clung to. One analysis showed that only 0.4% of London Heathrow's total slots and 0.7% of Paris Charles de Gaulle's were allocated to new entrants during the period under study.

Incumbents have good reason to hoard the best spots on the schedule. They are allocated according to IATA's guidelines at no cost, but the money they

generate goes to the carrier. A shortage of landing slots in Europe inflates the fares passengers pay at busy times by €2.1bn (\$2.5bn) a year, according to SEO Amsterdam Economics, a consultancy, and Cranfield University. That extra money flows straight to the lucky airlines. Carriers can also sell some slots. The money on offer for slots with genuine scarcity value is astonishing, especially among hub airlines that rely on a central airport to transfer connecting passengers. Last year Air France-KLM, a legacy carrier, sold a single daily landing and take-off slot at London Heathrow, Europe's most congested airport, to Oman Air for \$75m. The slots owned by Monarch are worth an estimated £60m (\$79m).

None of this is fair, neutral or transparent. Legacy carriers can pocket the proceeds from plum slots they did not pay for. Upstarts are kept at a distance, unable to compete for the services that consumers prize most. The value of slots is obscure.

A better solution would be slot auctions, in which carriers bid to hold slots for staggered periods of five or ten years. Regulators in America and China have thought about this sort of approach. An alternative would be to adopt a congestion-pricing model for runways, in which airlines pay more to land or take off at busier times of the day than quieter ones. Facing higher costs for using prized early-morning slots, airlines would have a greater incentive to fill planes to capacity and to get rid of slots they cannot use. The extra money could be put into a central infrastructure pot to build more airport capacity.

| *Air fair*

No system is perfect. The sums of money needed to be paid upfront to win an auction, given the necessity of doing so for hub carriers, may be too high for new firms. The burden of making payments could destabilise the finances of some carriers. If congestion charges truly reflect the scarcity value of a runway slot at a crowded airport, fares could rise. Airlines' share

prices would certainly fall. But the case for change is nonetheless clear. Frequent flyers are among the world's richest people; the global airline industry just had its three most profitable years ever; the market share of the big three airline alliances is rising. The aviation industry should pay for the infrastructure it uses, not make hay from it. ■



航空

赢取航班时段

机场运力分配偏袒老牌航空公司，是时候打破这种垄断了

你也许会觉得航空公司最有价值的资产是飞机。但对于今年10月破产的英国第五大航空公司君主航空（Monarch），债权人最想索要的是它在每天指定时间段可用的空域资源。君主航空在英国机场的航班起降时段弥足珍贵，足以引发一场诉讼大战。从中可以窥见目前分配这些资源的系统对竞争及消费者的损害之深。

自上世纪60年代各地机场开始满负荷运转以来，航班起降时段一直是航空公司争夺的资源。面对这种局面，行业组织国际航空运输协会（IATA）制定了一套准则，规定航空公司对当年获得的某个航班起降时段的使用率须至少达到80%，才能在下一年保留这个时段。使用率未达标的起降时段将归集起来重新分配，其中一半应分配给新航空公司。全球超过190个拥挤的机场（其中103个在欧洲）遵守这套国际航协称之为“公平、中立、透明”的规则。

实属一派胡言。为了应付这一套“不用就收回”的规则，许多航空公司耍了花招，例如使用机位少于实际需求的较小型飞机来填满航班起降时段，甚至还动用无人搭乘的“幽灵”航班，确保在指定时间占用机场跑道。如此一来，航班时段并未从老牌航空公司回收转配给新航空公司，而是被前者牢牢掌握。一项分析显示，在研究期间，伦敦希思罗机场的全部航班起降时段中仅有0.4%分配给了新航空公司，巴黎戴高乐机场的数字是0.7%。

既有航空公司有充分理由囤积机场的最佳时段资源。这些时段是按国际航协的准则免费分配得来，而带来的收入则归航空公司所有。SEO阿姆斯特丹经济咨询公司（SEO Amsterdam Economics）和克兰菲尔德大学

（Cranfield University）的数据显示，欧洲机场航班降落时段短缺，导致繁忙时段机票销售额每年上涨21亿欧元（25亿美元）。这一额外收益直接流向了那些幸运的航空公司。航空公司也可以出售部分航班起降时段。其

他航空公司为获得真正有稀缺价值的时段出价惊人，尤其是那些要依靠某个中心机场来让乘客转机的枢纽航空公司。去年，老牌航空公司法荷航集团（Air France-KLM）把它在欧洲最拥挤的机场伦敦希思罗机场的一个每日航班起降时段卖给了阿曼航空（Oman Air），售价高达7500万美元。而君主航空拥有的航班起降时段价值估计达6000万英镑（7900万美元）。

这一切并无公平、中立、透明可言。老牌航空公司不花一文就能得到人人渴求的航班时段并以此获利。新航空公司则被隔离在外，无法参与竞争以改善消费者最看重的服务。航班起降时段的价值模糊而隐晦。

一个更好的解决方案是公开拍卖起降时段：航空公司出价竞投，交错持有起降时段五年或十年。美国和中国的监管机构已经在考虑这类做法。另一个办法是采用跑道拥堵收费模式，航空公司在每天较繁忙的时段起降要比在其他时间支付更多的费用。航空公司要使用珍贵的早班机起降时段就得支付更高的费用，因而更有动力充分使用机位并放弃无法利用的时段。由此得到的额外资金可拨入基础设施中央资金池，用于机场的扩容建设。

| 公道机票

没有任何系统是完美的。考虑到枢纽航空公司赢得竞标的必要性，竞投起降时段需要投入的资金也许会很高，新公司可能难以承受。这一资金负担也许会令一些航空公司财务状况不稳。假如拥堵费真实反映了繁忙机场中起降时段的稀缺价值，那么机票价格可能会上升。航空公司的股价肯定会下跌。然而变革的理由很清楚。飞行常客位列世界上最富裕的人群；最近三年全球航空业的盈利创历史新高；三大航空联盟的市场份额正在上升。航空业应为所用的基础设施付费，而不是利用它来占便宜。■



Trade deals

Repair job

America damaged the Trans-Pacific Partnership. Others are fixing it

REVIVING the original Trans-Pacific Partnership (TPP), a trade deal between 12 countries around the Pacific Rim, is technically impossible. To go into force, members making up at least 85% of their combined GDP had to ratify it. Three days into his presidency, Donald Trump announced that America was out. With 60% of members' GDP gone, that deal was doomed.

But on November 11th, another began to rise in its place, crowned with a tongue-twisting new name: the Comprehensive and Progressive Agreement for the Trans-Pacific Partnership (CPTPP). Ministers from its 11 members issued a joint statement saying that they had agreed on its core elements, and that it demonstrated their "firm commitment to open markets". The political symbolism was powerful. As America retreats, others will lead instead.

The CPTPP is still far from finished, however. This inconvenient truth is unsurprising. Resuscitating the deal without its biggest member was always going to be hard. Without America, uncomfortable concessions made in the old TPP can seem less worthwhile. But any attempt at a full renegotiation risked the entire deal unravelling. If countries used the opportunity to grab new concessions in their pet areas, others could make counterclaims and talks could descend into a protectionist mess.

The few unresolved areas reflect these challenges. Malaysia wants more time to adjust to rules governing its state-owned enterprises. Brunei wants a more lenient approach to its coal industry. And Vietnam, which stood to gain most from extra access to the American clothing market, wants more time before it could face sanctions for violating the pact's labour laws.

Trade ministers from Mexico and Canada had a particularly tricky task, given their involvement in trade negotiations with the Americans about the North-American Free Trade Agreement (NAFTA). Anything Mexico and Canada conceded in the TPP could then be unusable as a bargaining chip in separate talks with Mr Trump. The talks took a dramatic turn on November 10th when it seemed as though agreement had been reached, only for the Canadians to backtrack. (According to Wendy Cutler, an American negotiator of the TPP, such tactics are not unusual.) The Canucks want better access to the Japanese vehicle market and worry that a CPTPP agreement on cars will complicate the politics of NAFTA negotiations; they also want more freedom to force companies to develop Canadian cultural content.

For their part, Japanese negotiators were keen to create an incentive for America to join the CPTPP in the future. Some of the original rules could benefit America even outside the pact, blunting its incentive to rejoin. But ditching too many of them might cause the benefits of the original to be lost.

Aside from the areas still under discussion, the ministerial statement listed 20 carve-outs from the original pact. Rules that gave special treatment to express shipments, a sop to American companies like DHL and Federal Express, will be suspended. So will protection for intellectual property, also fought for fiercely by American negotiators. (If America did want to rejoin, then in theory it could negotiate these clauses back into force.) Contentious rules allowing investors to take governments to court have been narrowed in scope. States can force investors to sign agreements waiving their right to sue under the CPTPP.

Despite these difficulties, so far the CPTPP looks impressively similar to its parent. It seems the new deal will preserve the market access agreed upon in the TPP. And although differences remain, they do not seem like show-

stoppers. America's absence reduces the economic gains from the agreement but does not eliminate them (see chart). Giving up on the pact would squander years of talks as well as the opportunity to upgrade existing trade deals and spur economic reforms. The plan is to finalise a CPTPP deal in the first quarter of 2018. Even if America has rejected its own rules, others still see value in them. ■



贸易协定

修复工作

美国破坏了《跨太平洋伙伴关系协定》。其他国家正在补救

要重启原来的《跨太平洋伙伴关系协定》（TPP，环太平洋12国之间的一个贸易协定）在技术上已无可能。该协定要生效，必须得到至少占GDP总量85%的成员国的批准。特朗普在就任总统的第三天就宣布美国退出TPP。没有了占TPP成员国GDP60%的美国，协定注定要失败。

但11月11日，另一个协定在原来的基础上横空出世，并被冠以一个拗口的新名称——《跨太平洋伙伴关系全面进展协定》（CPTPP）。11个成员国的贸易部长发表联合声明，表示他们已就协定的核心内容达成一致，并称该协定表明了他们“对开放市场的坚定承诺”。这具有很强的政治象征意义：美国退出了，将会有其他国家来主导协定。

然而，CPTPP还远未完成。这个难堪的真相并不奇怪。缺少了最大的成员国，要重启这个协定总是很难的。没有了美国，原先在TPP中做出的不愉快的让步似乎也就不那么合算了。但任何全面重启谈判的尝试都有可能瓦解整个协定。假如一些国家利用这个机会在自己重视的领域抢占新特许权，其他国家便可以反诉，谈判也许就会陷入贸易保护主义的乱局。

少数未解决的领域反映了这些挑战。马来西亚希望有更多时间来适应管理国有企业的规则。文莱希望其煤炭工业能得到更宽松的对待。越南本可能因为更多地进入美国服装市场而获益最多，如今则希望争取更多时间，以免因违反该协定的劳工法而受到制裁。

墨西哥和加拿大的贸易部长面临一项特别棘手的任务，因为他们在和美国就《北美自由贸易协定》（NAFTA）进行谈判。两国在TPP谈判中作出的任何让步也许都无法再用作与特朗普单独谈判的筹码。11月10日，谈判出现戏剧性转折：协定眼看将要达成，不料加拿大人变了卦。（美国的TPP谈判代表温迪·卡特勒[Wendy Cutler]认为，这种策略并不少见。）加拿

大人想要更好地进入日本汽车市场，并担心CPTPP的汽车协议会使NAFTA谈判的政治角力复杂化。他们还想要更多的自由来迫使企业发展加拿大文化。

日本的谈判代表则渴望动员美国在未来加入CPTPP。即使美国不加入协定，也能从原来的一些规定中受益，而这会削弱美国重返协定的动力。但是，废除太多原有规定可能导致最初协定的好处付诸东流。

除了仍在讨论的领域，部长声明还另外冻结了原协定中的20项内容。给予快递业特殊待遇的规定（给DHL和联邦快递等美国公司的小甜头）将被中止；之前美国谈判代表大力争取的关于知识产权保护的规定也将中止。

（如果美国确实想重新加入，那么理论上它可以通过谈判让这些条款重新生效。）允许投资者将政府告上法庭的争议性规定缩窄了范围。在CPTPP中，政府可以迫使投资者签署协议，放弃诉讼权。

尽管有这些困难，从目前来看CPTPP与TPP非常接近。新协定似乎将维持在TPP中达成一致的市场准入。尽管差异依然存在，但似乎并不会阻碍协定的进程。美国的缺席减少了协定的经济收益，但并未完全消除这些收益（见图表）。放弃这项协定将浪费多年谈判的努力，而且会错过升级现有贸易协议、刺激经济改革的机会。CPTPP协定拟于2018年第一季度敲定。即使美国拒绝了自己制定的规则，其他国家仍看到了其中的价值。■



Military drones

Back to the unicopter

Why design an unmanned helicopter from scratch, when you can adapt an existing, manned one?

IN THE future, the skies of cities may belong to aerial drones. These are spiderlike devices with four or more propellers (thus often known as quadcopters, hexacopters, octocopters and so on) that provide both lift and thrust. The hope is that autonomous, self-guided versions of these will deliver anything from pizzas to passengers from door to door without being held up by terrestrial traffic jams.

Delivering goods, and particularly people, to and from a battlefield is, though, a bit different. Aircraft have to be hardened against enemy action, and also need the capacity to transport large payloads. A flying spider is unlikely to cut the mustard. Instead, Lockheed Martin, the maker of one of the world's best-known military helicopters, the Black Hawk, is working on a drone with those specifications—made from a Black Hawk helicopter.

Turning existing helicopters into drones is not a new idea. Northrop Grumman's RQ-8 Fire Scout, used for reconnaissance in Afghanistan by America's navy, and now being developed for mine hunting and fighting off swarms of small boats, is a modification of the Schweizer 330SP light-utility helicopter. The Kaman K-MAX, a heavy-lifting drone which the country's marine corps tested in Afghanistan for delivering cargo, is a modified version of the Kaman K-1200. A civilian version is now available, for firefighting. And since 2004 Boeing has been flying an unmanned demonstrator version of its H-6 Little Bird, a military-reconnaissance helicopter.

All these aircraft, however, are controlled by ground-based pilots.

Lockheed's intention is to build an autonomous craft—one that can sense and avoid obstacles and identify safe landing sites without human assistance. The project, sponsored by DARPA, America's main military-research agency, is known as Matrix. So far, Matrix has been used only as a co-pilot. But, if all goes well, the first helicopter able, in theory, to fly by itself will take off early next year. Though it will not be put to such a test immediately, the intention is that Matrix will eventually take over everything.

Matrix includes several sorts of sensor, so the helicopter can see for itself. It has what Lockheed describes as a supercomputer to interpret input from these sensors and to make decisions based on that input. It also has servo-controlled devices which operate the machine's flight controls.

The main sensor is a form of LIDAR, the laser equivalent of radar. LIDAR is part of the equipment of driverless cars, but the Matrix version is more powerful. It can detect objects hundreds of metres away. Also, as Chris Van Buiten, vice-president of Sikorsky Innovations, the part of Lockheed running the project, observes, a helicopter must deal with three dimensions, not two, and is likely to be travelling faster than a car. It may, for instance, be flying at over 250kph at low level in what he terms "obstacle-rich terrain", with trees, power lines and buildings, as well as other aircraft to avoid—not to mention enemy fire.

| *Black Hawk up*

Mr Van Buiten is cagey about the other sensors Matrix uses, but says they include various cameras and conventional radars. Presumably, the system will also have digitised terrain maps that will both assist navigation and permit it to spot changes in geographical features that may be the result of enemy activities. As to the flight-controlling servos, these are built into the aircraft itself. Matrix is not like PIBOT, a humanoid robotic flight-control system being designed by engineers in South Korea, which sits in an

unmodified pilot's seat and manipulates unmodified controls.

The sensors' rapid reactions—milliseconds rather than the two seconds or so a human pilot takes to assess and respond to an unexpected hazard—should make the unmanned system safer than such a pilot. It will take time to reach that level, but Matrix should, almost from the beginning, be able to take the aircraft over and fly it solo in case of an emergency. If the engine were to fail, for example, it would scan the ground below for the best landing spot and touch down there without human assistance. It will also be able to detect whether the pilot has fallen unconscious and, if so, fly the helicopter safely.

The plan is to expand these sorts of features, moving steadily from assisting the pilot to flying the aircraft autonomously. And though there are what Mr Van Buiten calls “gnarly technical problems” to be overcome, he says the biggest challenge is building trust. Not only passengers, but also pilots and regulators need to have confidence in the safety of Matrix before it can be fully autonomised.

Mr Van Buiten cites a precedent for such trust-building—a recovery system which Lockheed installed in F-16 fighter jets. If an F-16 pilot passes out during a violent manoeuvre, this automatically brings the aircraft into a straight and level flight path. That has already prevented several crashes, shifting pilots' attitudes from indifference to “I want that on board my fighter”.

The airframe being used for the first tests is one of the oldest models of Black Hawk, a UH-60A from 1980. This was chosen to demonstrate the ease with which an aircraft can be upgraded. Once the modified aircraft is airborne, it will be a matter of accumulating thousands of hours of reliable operation while steadily expanding the range of tasks that the automated controls can carry out unaided in increasingly challenging environments.

Then, from Lockheed's point of view, it will be ready for testing by the armed forces.

Warfare, however, is not the only potential market for Matrix. Mr Van Buiten says the technology may also see early use servicing offshore oil and gas platforms, permitting them to be resupplied in all weather conditions, without risking pilots. Fortunately for those who find even quadcopters noisy and irritating, pizza delivery is not on Lockheed's menu. ■



军用无人机

回到单旋翼直升机

既然可以改造现有的有人驾驶直升机，为什么还要从头设计无人直升机？

未来，城市的天空可能属于无人机。这些蜘蛛形的飞行设备有四个或更多螺旋桨（因此常被称为四旋翼、六旋翼、八旋翼飞行器等），这些螺旋桨同时提供升力和推力。人们希望，未来自动飞行、自我导航的无人机将会提供从外卖披萨到运送乘客的各种门到门运输服务，不受地面交通拥堵的阻碍。

不过，往返战场运输物资，尤其是运送人员，则不尽相同。飞机必须加固以经受敌方攻击，还要有运送大载重物资的能力。飞行蜘蛛不太可能符合要求。然而，世界上最知名的军用直升机之一“黑鹰”的制造商洛克希德·马丁公司（Lockheed Martin）正在研发一种由黑鹰直升机改造而来、能满足以上要求的无人机。

将现有直升机改造成无人机并非新鲜创意。诺斯罗普·格鲁曼公司

（Northrop Grumman）生产的RQ-8火力侦察无人机（Fire Scout）就是由施瓦泽（Schweizer）330SP轻型多用途直升机改造而来。该无人机曾在阿富汗被美国海军用于执行侦察任务，现在正被开发用于探雷和打击小船舰队。美国海军陆战队在阿富汗试用于物资运输的起重无人机卡曼K-MAX则是卡曼K-1200的改装版，用于消防的民用版也已出现。2004年以来，波音一直在试飞军用侦察直升机H-6“小鸟”的无人驾驶版验证机。

不过，目前所有这些飞行器都由地面的飞行员控制。洛克希德的目标是打造一个自主飞行器，可在无人协助的情况下感知并躲避障碍物，并确定安全着陆点。这个项目名为Matrix，由美国主要军事研究机构美国国防高级研究计划局（DARPA）资助。到目前为止，Matrix技术只用于辅助驾驶。不过如果一切顺利，首架理论上能够自主飞行的直升机将在明年初升空。最终的目标是完全由Matrix技术控制飞机，尽管还不会马上测试这一可行性。

Matrix技术包括几类传感器，让直升机可以自己感知环境。它具有被洛克希德称作超级计算机的设备，可以解读传感器输入的数据，并据此做出决策。Matrix还具有伺服控制装置，操作飞机的飞行控制。

Matrix的主传感器是一种激光雷达。激光雷达是无人驾驶汽车设备的一部分，但Matrix使用的版本更强大，可以探测到数百米外的物体。另外，洛克希德负责该项目的西科斯基创新公司（Sikorsky Innovations）的副总裁克里斯·范·布顿（Chris Van Buiten）指出，直升机必须处理三维而不是二维数据，而且可能比汽车的行驶速度更快。例如，它可能会以超过250公里的时速在布顿所谓的“障碍物繁多的环境”中低空飞行，要躲避树木、电线和建筑物以及其他飞机，更不必说敌方火力了。

| 黑鹰升空

布顿对Matrix所使用的其他传感器讳莫如深，但称其中包括各种摄像头和传统雷达装置。想必该系统还会配有数字化地形图，既可以辅助导航，又可以让系统发现可能因敌方活动而形成的地形特征变化。飞行控制伺服系统也与飞机整合为一体。Matrix和PIBOT不一样，后者是由韩国工程师设计的人形飞行控制机器人系统，放置在未经改造的飞行员座位上，操纵未经改造的飞行控制系统。

人类飞行员大约需要两秒钟评估和应对意外危险，而传感器的反应速度则是以毫秒计，所以无人机系统应该比人类飞行员更安全。要达到这个水平还需要时间，但Matrix几乎从一开始就应该能够在发生紧急情况时接管飞机，独自操作飞行。例如，在发动机发生故障时，它可以扫描地面以寻找最佳降落点，并在无人工协助的情况下降落。它还将能感测飞行员是否已失去知觉，在必要时接管直升机安全飞行。

该项目的计划是逐步扩展上述功能，让系统从协助飞行员稳步推进到自主飞行。尽管需要克服布顿口中的“拧巴的技术难题”，但他认为最大的挑战是建立信任。在完全实现自主飞行之前，除了乘客，飞行员和监管机构也需要对Matrix的安全性有信心。

布顿提到了一个建立信任的例子——洛克希德公司在F-16战斗机上安装的恢复系统。如果F-16的飞行员在激烈的操作中失去意识，飞机便会自动进入水平直线飞行状态，这已经防止了几起坠机事故，飞行员的态度从不感兴趣转变成“我的战斗机上也要装”。

Matrix系统第一次测试时使用的飞机是黑鹰直升机最老的型号之一——一架1980年的UH-60A。这样的选择是为了证明给飞机升级十分简便。改装后的飞机升空后，剩下的事就是积累数千小时的安全飞行时间，同时稳步扩大自动化控制在日益复杂的环境中能够独立完成的任务范围。在洛克希德看来，在这之后它就可以接受军方的测试了。

不过，战争并不是Matrix唯一的潜在市场。布顿说，这项技术也可能会先用于为海上石油和天然气平台提供服务，在任何天气条件下为平台提供补给，而无需飞行员冒险。幸运的是，对于那些连四旋翼无人机都嫌吵嫌烦的人来说，洛克希德的服务菜单上并没有披萨外卖。 ■



Economic and financial indicators

Natural gas

Global natural-gas production is set to increase by 46% in the years to 2040

Global natural-gas production is set to increase by 46% in the years to 2040, according to the International Energy Agency. Oversupply in the market is likely to continue as 140bn cubic metres of liquefaction capacity that is under construction comes onstream, mostly in America and Australia. Conventional gas currently makes up 80% of global gas production; unconventional sources, such as shale, should account for more than half of the addition to output. America's natural-gas output should increase by 41% over the forecast period; shale production should grow by 80%. The rise in shale production from 2008-23 is likely to represent the biggest jump by a single source in the history of gas markets. ■



经济与金融指标

天然气

从现在到2040年，全球天然气产量预计将增加46%

据国际能源署估算，从现在到2040年，全球天然气产量预计会增加46%。随着正在建设中的1400亿立方米的液化气产能（主要位于美国及澳大利亚）投产，天然气市场供应过剩的情况很可能会继续。目前，常规天然气占全球产量的80%，页岩气等非常规气源应该贡献了新增产量的一半以上。在预测期内，美国的天然气产量应该会增加41%，页岩气产量应会增长80%。2008年到2023年页岩气产量的增加可能会是天然气市场历史上单一气源发生的最大增幅。 ■



Competition

Silent dogs

Annual reports tell a significant tale

What explains the remarkable strength of corporate profits and the sluggish growth of real wages in recent years? One explanation is that industries are getting less competitive. Work by *The Economist* found that two-thirds of American industries were more concentrated in the hands of a few firms in 2012 than in 1997.

Research by AXA Investment Managers Rosenberg Equities into the language used in American annual reports points in the same direction. Sherlock Holmes famously talked of the significance of the dog that did not bark in the night. It may be similarly important that companies refer to rivals much less than they did; usage of the word “competition” in annual reports has declined by three-quarters since the turn of the century. Business is less cut-throat than it used to be. ■



竞争

不叫的狗

公司年报透露出重要信息

为什么近些年会出现企业盈利涨势强劲，实际工资却增长缓慢的局面？一种解释是各行业竞争减少。《经济学人》的研究发现，比起1997年，2012年美国有三分之二的行业更加集中，为少数几家公司掌控。

安盛投资（AXA Investment Managers）旗下从事量化投资的Rosenberg Equities研究了美国企业年报的用语，发现了相同的趋势。福尔摩斯有个著名的推理：那天夜里那只狗没叫，其中必有蹊跷。公司提及竞争对手的次数较之前大大减少，这一点也许同样意义重大。自世纪之交，各公司年报中“竞争”一词的使用频率已下降了四分之三。做生意已经不似从前那样要斗个你死我活了。■



Health care

No guts, no glory

Enhanced understanding of the human microbiome is opening up new possibilities for medicine

WHEN, at the turn of the century, the first human genomes were sequenced, many biologists felt they had had delivered into their hands the keys to unlocking numerous puzzles about disease. Since then there has indeed been a fruitful effort to understand how the thousands of human genes which control hormones, enzymes and other molecules of the body serve to regulate health. But, in an unexpected turn of events, it is also now apparent that the human genome is not the only one to which attention should be paid. Human guts contain microbes, lots of them. Added together, the genes in these bugs' genomes amount to perhaps 150 times the number in the human genome alone. If the bacteria in question were doing little more than swimming around digesting lettuce, this would be of small consequence. But they are doing much more than that.

The members of the microbiome, as this community is known, are, to a surprising extent, partners of humanity. And when that partnership goes wrong, the results can be dreadful. Inflammatory bowel disease, autism, multiple sclerosis, obesity, diabetes and chronic-fatigue syndrome all seem to have links with dysbiosis, as an imbalance in the microbiome is known. Only this month, there was news that human gut microbes influence the way patients respond to a popular new type of cancer treatment called immunotherapy. Certain sorts of bacteria are abundant in patients who respond well. Antibiotics that kill these bacteria render immunotherapy less effective.

That finding illustrates an important idea. In effect, the antibiotics are editing the collective bacterial genome by removing from it genes that

somehow assist immunotherapy. Much effort is now going into developing ways of editing the human genome, in order to improve human health. This is hard to do. But editing the microbial genome, by adding or subtracting particular species—and thus the genes they carry—is in principle far easier. That, too, could lead to improvements in human health. And many hopeful firms are now pursuing this idea.

| *Gut instincts*

Much of the recent interest in microbiome medicine can be traced to a growing awareness of the usefulness of transplanting faeces, with their natural cargo of bacteria, from healthy people into sick ones. It is an idea that goes back at least 1,700 years, which was when Chinese doctors began to use what was euphemistically called “yellow soup” to treat patients with severe diarrhoea. In a similar vein, warm camel dung has been employed in some parts of the world to treat dysentery.

These days, such faecal microbial transplants (FMTs) are used mainly to deal with the rampant multiplication of a diarrhoea-causing bug called *Clostridium difficile* in patients who have been heavily treated with antibiotics. The transplant alters the composition of the recipient’s microbiome in ways that make it hostile to *C. difficile*. A great deal of work has been directed to refining FMTs, both for use in *C. difficile* infections and, potentially, for treating other diseases tied to dysbiosis. New, encapsulated versions of FMTs are known colloquially as “crapsules”.

Transplanting whole microbiomes in this way is, though, a bit crude. Rebiotix, a firm based in Roseville, Minnesota, is developing a more refined approach: a standardised liquid suspension of healthy gut bacteria. Its most clinically advanced treatment is, as might be expected, for the prevention of recurring infections of *C. difficile*. But the firm is also searching for therapies for paediatric ulcerative colitis (a form of inflammatory bowel disease), multi-drug-resistant urinary tract infections,

infections of vancomycin-resistant *Enterococci*, and hepatic encephalopathy. This last illness is one of the most common complications of end-stage liver cirrhosis. Data suggest that part of its cause is ammonia generated by gut bacteria.

Other firms are focusing their efforts even more precisely, by selecting and delivering only the microbes they believe are beneficial. This is an approach sometimes known as “bugs as drugs”. Researchers at Seres Therapeutics, in Cambridge, Massachusetts, for example, think that suitable combinations of particular microbes can catalyse shifts in entire bacterial ecosystems—specifically, from ones that support disease to ones that support health. To this end, the firm is creating proprietary mixtures with particular purposes. One of its clinical trials, for the treatment of recurrent *C. difficile* infection, failed and is being re-run with an altered design. A second is for ulcerative colitis. A third is intended for first-time infections of *C. difficile*.

The opposite approach to adding such “good” bacteria (and thus their genes) to the mix is to subtract the bad ones. That is the strategy employed by C3J Therapeutics, in Marina del Rey, near Los Angeles. This firm is developing an antimicrobial peptide (a small protein molecule) aimed specifically at *Streptococcus mutans*, a bug that lives in the mouth and which is widely believed to be the microbe mainly responsible for dental caries. C3J’s drug, currently being tested for efficacy, is a non-specific antimicrobial peptide that has been joined with another peptide which binds only to *S. mutans*. Removing *S. mutans* leaves a vacant niche in the mouth. Although this is quickly filled by other species of *Streptococcus*, they are associated with a lack of cavities.

Another way to subtract components of the microbiome is to use viruses, known as bacteriophages, that attack particular bacterial species.

EpiBiome, in San Francisco, and Eligo Biosciences, in Paris, are both hoping

to deploy phages selectively against specific bacteria—something that would create an extremely refined form of antibiotic. EpiBiome is trying to isolate the phages which are most effective in killing harmful bacteria. Eligo is attempting to fit phages out with a form of gene-editing technology that will cut up a bacterium's DNA, thus killing the organism.

Editing bacterial genomes is also on the agenda of Blue Turtle Bio, in San Francisco, and Synlogic, in Cambridge, Massachusetts. Both companies want to engineer gut bacteria to deliver a constant supply of such things as the enzymes missing in genetic diseases like phenylketonuria (in which the absent enzyme means a chemical called phenylalanine can build up to toxic levels).

| *Only connect*

One last microbiome-related approach to medicine is to try to identify exactly which microbe-produced substances are affecting human health, whether for good or ill. This is of particular interest to established pharmaceutical firms. They hope such knowledge might lead to the sorts of products they are adept at making. A year ago, for example, Bristol-Myers Squibb, a leading immunotherapy firm, announced a tie-up with Enterome, a Parisian company. Their joint intention is to develop drugs and diagnostic techniques based on the gut microbiome. Meanwhile, Second Genome, in San Francisco, has started to investigate the apparent connection between dysbiosis and autism, with the hope that some sort of pharmaceutical intervention may be possible.

Isabelle de Cremoux, the boss of Seventure, a French venture-capital firm that has many microbiome-based investments, observes that the first bets in this area were generally connected with gastroenterology, because that is pertinent to the part of the body where the bugs actually live. But, she says, scientific publications about dysbiosis have turned increasingly to cancer. She expects biotech firms to follow. Indeed, two of those she has invested

in, Enterome, and also Vedanta Biosciences, in Cambridge, Massachusetts, have started to focus on oncology.

The idea that the gut's microbial passengers can influence the progression of cancers sounds, on first hearing it, an extraordinary one. But the multiplicity of microbial genes is such that some are almost bound to have side-effects of this sort. It is certainly a long way from yellow soup to immunotherapy. The journey, though, looks as if it will be a rewarding one. ■



医疗保健

无细菌，不健康

对人类微生物组更为深入的理解正在为医学开辟新的可能性

世纪之交，科学家对第一批人类基因组进行了测序。当时许多生物学家都觉得，一把能够解开有关疾病众多疑难问题的钥匙已经交到了他们的手中。从那时起，他们开始了解那些控制了人体激素、酶和其他分子的成千上万的人类基因是如何调节健康的，在这方面确实取得了累累硕果。然而，情势发生了出人意料的变化。如今已经明确的一点是，人类基因组并不是唯一应该关注的问题。人的肠胃中存在大量微生物，这些微生物的基因组中的基因总数可能是人类基因数量的150倍。如果这些细菌只是游来游去，消化些生菜，影响倒也不大，但它们的作用远不止于此。

微生物组（对微生物群落的称呼）的成员是人类的伙伴，联系程度之深令人惊讶。这种伙伴关系一旦出错，后果可能会很严重。炎症性肠道疾病、自闭症、多发性硬化症、肥胖症、糖尿病和慢性疲劳综合征似乎都与微生物生态失调（即微生物组失衡）有关。就在本月，有新闻称人类肠道微生物会影响患者对一种流行的抗癌新疗法——免疫疗法——的反应。体内存在大量某种细菌的患者对这种疗法反应良好，而杀死这些细菌的抗生素则会影响疗效。

这个发现揭示了一个重要的理念。抗生素移除了菌群基因组中辅助免疫疗法的基因，实际上是编辑了整个菌群的基因组。如今，研究人员正在努力开发编辑人类基因组的方法来改善人类健康，而这并不容易做到。但通过添加或筛除特定的菌种，也就是增减其所携带的基因来编辑微生物基因组从理论上说要容易得多，而这同样可以改善人类健康。许多对此抱有希望的公司正在这条道路上探索。

| 肠脏本能

最近微生物组医药引起了广泛的兴趣，是因为人们逐渐认识到把粪便中天然携带的细菌从健康人体移植到病患身上的疗效。这种做法至少可追溯到

1700年前，当时中国的医生开始使用美其名曰“黄龙汤”的方子治疗严重腹泻的病人。与此类似，世界上一些地方用温热的骆驼粪来治疗痢疾。

引发腹泻的艰难梭菌（*Clostridium difficile*）会在接受大剂量抗生素治疗的患者体内大量繁殖。粪便菌群移植（FMT）目前便主要用于抑制这种细菌的繁殖。移植改变了患者体内微生物组的构成，从而抑制艰难梭菌的繁殖。研究人员已做了大量工作改进FMT，不仅用它治疗艰难梭菌感染，还可能将其用于与微生态失调有关的其他疾病。新的胶囊版FMT俗称“粪囊”（crapsules）。

不过，用这种方法移植整个微生物群有点简单粗暴。位于明尼苏达州罗斯维尔（Roseville）的Rebiotix公司正在开发一种更精细的方法：健康肠道细菌的标准化液体悬浮液。正如人们可能预想的那样，它在临床上最先进的应用是预防艰难梭菌的复发性感染。但该公司也在寻找小儿溃疡性结肠炎（一种炎症性肠病）、多药耐药性尿路感染、耐万古霉素肠球菌感染和肝性脑病的治疗方法。肝性脑病是晚期肝硬化最常见的并发症之一，数据表明部分致病原因是肠道细菌产生的氨。

其他公司的研发目标更为精准，只选择和提供它们认为有益的微生物。这种方法有时被称为“细菌作药”（bugs as drugs）。例如，马萨诸塞州剑桥市的Seres Therapeutics生物制药公司的研究人员认为，特定微生物的恰当组合可以催化整个细菌生态系统的转变，具体来说就是从支持疾病的系统转变为支持健康的系统。为此，该公司正在研发特定用途的专利菌群配方。其中一个用于治疗复发性艰难梭菌感染的菌群配方在临床试验中失败，目前正以改进的配方重新试验。另一项临床试验针对溃疡性结肠炎，还有一项试验针对艰难梭菌的首次感染。

与这种将“好”细菌（及其基因）加入菌群相反的方法是去除不好的细菌。位于洛杉矶附近玛丽安德尔湾（Marina del Rey）的C3J Therapeutics公司采用的正是这种策略。该公司正在开发一种专门针对变异链球菌的抗菌肽（一种小分子蛋白）。变异链球菌存在于口腔中，被广泛认为是导致龋齿的主要细菌。C3J目前正在测试疗效的药物是一种非特异性抗菌肽，是和

另一种仅与变异链球菌结合的肽一起制成的。变异链球菌被去除后，在口中留出了“空生态位”，不过很快就被能减少龋洞的其他链球菌所占据。

去除微生物组中某些细菌的另一种方法是利用叫作噬菌体的病毒攻击特定的细菌种类。旧金山的EpiBiome和巴黎的Eligo Biosciences公司都希望能够利用有选择性地攻击特定细菌的噬菌体，这能产生极精细的抗生素。EpiBiome试图分离出能够最有效杀死有害菌的噬菌体，Eligo则在尝试用一种能切断细菌DNA的基因编辑技术来武装噬菌体，从而杀死有害菌。

旧金山的Blue Turtle Bio和马萨诸塞州剑桥市的Synlogic公司也将编辑细菌基因组提上了日程。这两家公司都希望能改造肠道细菌以持续供应患者体内缺少的物质，比如苯丙酮尿症这种遗传性疾病患者缺少的某种酶，这种缺失会导致名为苯丙氨酸的化学物质积累到毒性水平。

| 打通关联

最后一个与微生物组有关的医学方向是尝试准确识别微生物产生的哪些物质会影响人类健康，无论是有益的还是有害的。成熟的制药企业对此尤其感兴趣，它们希望在这种知识的引导下能够发现自己本来就擅长生产的产品。例如在一年前，领先的免疫治疗公司百时美施贵宝（Bristol-Myers Squibb）宣布与巴黎的Enterome公司合作，联合开发基于肠道微生物组的药物和诊断技术。与此同时，旧金山的Second Genome公司已经开始研究微生态失调和自闭症之间的显著关联，希望研制出某种药物干预。

法国风险投资公司Seventure有许多微生物组方面的投资，老板伊莎贝尔·德·克莱姆（Isabelle de Cremoux）注意到，最早投入这个领域的企业通常是在胃肠病治疗领域，这与菌群实际是在肠胃中生存有关。不过她说，关于微生态失调的科研论文主题越来越多地转向癌症治疗，预计生物技术公司也将转向这一领域。的确，她投资的两家公司Enterome和位于马萨诸塞州剑桥市的Vedanta Biosciences都已开始专注于抗癌。

肠道中来来往往的微生物可以影响癌症的发展，这样的说法乍听起来不可思议。但微生物基因极具多样性，其中一些几乎必然存在着这样的副作

用。从黄龙汤到免疫疗法确实还有很长的路要走，不过，这趟旅程看起来将会让人类受益匪浅。 ■



E-commerce

Briefs encounter

“Direct-to-consumer” startups are upending the consumer-goods industry

IN MANY ways, Tommy John, a startup based in Manhattan, resembles a tech company straight out of Silicon Valley. On its website the venture-backed firm touts its innovative materials and patented designs. When recruiting talent, it describes itself as “disruptive” and “revolutionary”. But Tommy John does not deal in computer hardware, software or any other kind of technology. It makes men’s underwear.

Following the example of successful e-commerce brands such as Warby Parker, a glasses firm, and Casper, a mattress-maker, a growing number of startups are reimagining everyday household items—from pants and socks to toothbrushes and cookware. These “direct-to-consumer” (DTC) companies bypass conventional retailers and bring their products straight to customers via their online stores. They began several years ago to catch the attention of venture-capital (VC) firms, which have poured in more than \$3bn since 2012. But the success of some DTC firms has attracted a lot of wannabes, making this a crowded market and leaving some wondering whether the boom has reached its limits.

The DTC business model first emerged in product areas dominated by slow-moving incumbents with hefty profit margins, such as spectacles and razor blades. In 2010 Gillette, the world’s largest razor-blade-maker, enjoyed 70% of the American market and gross margins as high as 60%. Since then, Dollar Shave Club and Harry’s, two subscription services that sell blades at a fraction of the price of big brands, have amassed more than 5m customers. Gillette’s market share has fallen to 54%.

Hubble Contacts, founded in 2016, wants to do the same to the \$8bn

contact-lens industry, which is dominated by giants such as Johnson & Johnson and Bausch + Lomb. Lenses are well-suited to the DTC model, being a commoditised product that customers purchase on a regular basis, says Jesse Horwitz, one of Hubble's founders. The startup is on track to generate \$20m in sales in 2017 and has attracted money from several VC firms.

Startups that cannot undercut incumbents on price must differentiate themselves in other ways. Casper won over many shoppers by getting rid of the worst bits of the bed-buying process, including choosing among dozens of similar products and haggling with pushy salesmen. Allbirds, a two-year-old San Francisco-based firm that makes all-wool trainers, has tweaked the design of its shoes 27 times based on feedback from customers.

Investors say branding and marketing are crucial if DTC startups are to make it. Sophie Bakalar of Collaborative Fund, a VC firm, says that brand is the first thing her team looks for in a consumer startup. Suitcases made by Away, a firm founded by two Warby Parker alumnae, have been featured in *Vogue* and endorsed by celebrities such as Karlie Kloss, a supermodel. But most customers learn about the brand on social media, where globe-trotting millennials share images of their bags, artfully displayed on hotel-room beds or rolling in front of iconic landmarks. Away's social-media team collects and redistributes these posts on its Instagram account, which boasts 140,000 followers. This year the firm expects to generate \$50m in sales.

For all the buzz surrounding such online brands, they face high hurdles. Investors worry about a glut of startups, which makes it difficult to stand out. "The challenge is rising above the noise," says Kirsten Green of Forerunner Ventures, an early investor in companies like Bonobos, a clothing retailer. Some DTC firms insist on focusing on a single item in the

bedroom, kitchen or bathroom, when they would do better to offer a stable of products.

Moreover, the giants of consumer goods and retailing, initially slow to respond to competition from these upstarts, have wised up. They are reacting in two ways. The first is to make it easier to buy their goods, both by expanding their own DTC distribution, as Procter & Gamble (which owns Gillette) does, and by working more closely with Amazon.

That may not be good news for the startups, but the big firms' second tactic is what the founders of every new DTC firm, and their VC backers, dream of: spending big to acquire young rivals. Unilever, for instance, paid \$1bn for Dollar Shave Club in 2016; Walmart spent \$310m to acquire Bonobos in June; and this week P&G said it was buying Native, a DTC deodorant brand, for an undisclosed sum.

This spending spree explains why optimism still abounds, even as more startups jostle to carve out a niche. The consumer-goods business remains gripped by a "DTC revolution", says Emily Heyward of Red Antler, a branding agency. A comforting thought for buyers of briefs. ■



电子商务

简短的邂逅

“直接面对消费者”的创业公司正在颠覆消费品行业

从很多方面看，曼哈顿的创业公司Tommy John都像是一家来自硅谷的科技公司。这家由风投支持的公司在其网站上推销着自己的创新材料和专利设计。招聘人才时，它自称是一家“颠覆性”和“革命性”的公司。但Tommy John经营的并不是电脑硬件、软件或其他技术，而是男士内衣。

越来越多的创业公司效仿有眼镜公司Warby Parker和床垫制造商Casper等成功电商品牌，它们正重新定义日常生活用品，例如裤子、袜子、牙刷、厨具等等。这些“直接面对消费者”（direct-to-consumer, DTC）的公司绕过传统零售商，通过网店直接把产品卖给消费者。它们在几年前起步，力图吸引风投公司的注意。自2012年起，注入这类公司的风投已超过30亿美元。但一些DTC公司的成功吸引了很多效仿者，令该市场变得非常拥挤，也让一些人怀疑这种繁荣是否已达到了极限。

DTC商业模式最初出现在由行动迟缓、利润极高的老牌企业主导的产品领域，比如眼镜和剃须刀片。2010年，全球最大的剃须刀片制造商吉列占据美国市场70%的份额，毛利润高达60%。在这之后，两大订购服务商Dollar Shave Club和Harry's以相当于大品牌售价很小一部分的价格销售刀片，已经积累了五百多万用户。吉列的市场份额已降至54%。

成立于2016年的哈勃隐形眼镜公司（Hubble Contacts）想在价值80亿美元的隐形眼镜行业做出同样的成绩，该行业由强生和博士伦等巨头主导。哈勃的创始人之一杰西·霍维茨（Jesse Horwitz）说，隐形眼镜是一种客户会定期购买的日用品，因而很适合DTC模式。这家创业公司2017年的营业额可能将达到2000万美元，并且已获得多家风投公司的投资。

那些无法以低价与传统企业竞争的创业公司必须用其他方式实现差异化。Casper消除了买床的过程中最糟糕的部分，比如在数十种类似的产品中挑

选、与咄咄逼人的推销员讨价还价，以此赢得了许多购物者的青睐。旧金山一家成立了两年的公司Allbirds生产纯羊毛运动鞋，公司根据客户的反馈，对鞋的设计做了27次调整。

投资者表示，DTC创业公司要获得成功，打造品牌和营销至关重要。风投公司Collaborative Fund的苏菲·巴喀勒（Sophie Bakalar）说，她的团队对消费品创业公司期望的第一样东西就是品牌。从Warby Parker离职的两位员工创立了行李箱公司Away，他们的产品登上了《Vogue》，超模卡莉·克劳斯（Karlie Kloss）等名人也为其做了宣传。但大多数客户是通过社交媒体了解这个品牌的。环游世界的千禧一代将自己箱包的照片发布在社交媒体上，在照片中，他们或是将行李箱精心地摆放在酒店房间的床上，或是拖着箱子经过各地标志性的景观。Away的社交媒体团队收集这些帖子，并用公司的Instagram账号（目前有14万粉丝）重新发布。这家公司今年的销售额预计将达到5000万美元。

虽然这些在线品牌备受追捧，但它们也面临很大的困难。投资者担心创业公司过多，很难脱颖而出。Forerunner Ventures的克斯汀·格林（Kirsten Green）说：“挑战在于如何突出重围。”这家公司是服装零售商Bonobos等公司的早期投资者。一些DTC公司坚持专注于卧室、厨房或浴室中的某件用品上，然而如果它们选择提供更多种类的产品，也许会发展得更好。

而且，消费品和零售业巨头一开始还对来自新兴企业的竞争反应迟缓，但现在已认清了现状。它们的应对方式有两种。一种是让消费者更容易买到自己的产品，具体方法就是像宝洁（旗下拥有吉列公司）那样拓展自己的DTC分销渠道，以及与亚马逊更紧密地合作。

这对创业公司来说可能不是好消息，但大公司的第二种策略却是所有DTC新公司及其风险投资人都梦寐以求的：花大价钱买下年轻对手。比如，2016年联合利华以10亿美元收购了Dollar Shave Club；沃尔玛今年6月斥资3.1亿美元收购了Bonobos；11月宝洁称正在收购DTC香体露品牌Native，具体金额未披露。

这一收购热潮解释了为什么你推我搡、争相闯出一片天地的创业公司越来越多，乐观情绪却依然盛行。品牌设计公司Red Antler的艾米丽·海沃德（Emily Heyward）说，消费品行业仍然深受“DTC革命”的影响。对内裤买家来说，这颇令人宽慰。■



Marriage

A more perfect union

Wedlock is more rewarding than ever—and also more upmarket. That is a problem

MARRIAGE idealises permanence, and yet it is changing more rapidly than at any time in its history. Almost everywhere it is becoming freer, more equal and more satisfying. As our special report this week explains, wedlock has become so good that it is causing trouble.

The most benign changes are taking place in poor and middle-income countries (where most people live). Child marriage, once rife, is ebbing. So is cousin marriage, with its attendant risk of genetic defects, though it is still fairly common in the Middle East and parts of Asia. Relations between husbands and wives have become more equal (though not equal enough). As women earn more and the stigma of divorce fades, more men are finding that they cannot treat their wives as servants (or, worse, punchbags), because women can credibly threaten to walk away.

In some regions change has been astoundingly quick. In India the share of women marrying by the age of 18 has dropped from 47% to 27% in a single decade. “Love marriages” remain disreputable in India, and arranged marriages the norm. But, as in many traditional societies, young people have more say. Some can veto the mates their families suggest; others choose their own, subject to a parental veto. Across the world, popular culture is raising expectations of what a good marriage is like, and dating websites are giving singletons vastly more options.

| *Ring the changes*

The worrying part is what is going on in rich countries. In the West marriage is in excellent shape, but only among the well-off. Elite couples delay tying the knot to allow time to get established in a career, but they

still tie it before having children. Working-class people, by contrast, are dramatically less likely to put a ring before a cradle than in previous generations. Among the college-educated in America, only 12% of births are to unmarried mothers; among those who dropped out of high school, the rate is 70%, up from 43% in the early 1980s. Similar trends can be seen across the wealthy world: the average out-of-wedlock birth rate for OECD countries is 40%.

If marriage were just a piece of paper this would not matter. However, it is much more than that. Although a wedding cannot turn a flimsy relationship into a strong one, it adds scaffolding that can save one that is in between. Making a public, lifelong commitment to another person is not the same as drifting into cohabitation to share the rent. And this matters a lot if children are involved. One study in America found that 18% of married couples broke up within five years of a birth, compared with 47% of cohabiting couples.

Children from stable backgrounds tend to do better in school and life—and are more likely to form stable unions of their own. Add the trend towards “assortative mating”, when high-achievers marry other high-achievers, and the gap between elite and working-class families yawns. Affluent parents intensively nurture their children for success; the offspring of less fortunate homes fall far behind before they ever set foot in a school. The marriage gap makes rich countries more unequal, and retards social mobility.

Improbable as it may seem, this pattern is likely to reach every corner of the globe. The forces that have shaken up marriage in rich countries—rising individualism, education, women’s economic emancipation—are spreading. It is not just a Western trend. For a long time Japan resisted it: highly educated women were less likely to marry than others. Now they are more likely to (and less likely to divorce).

The revolution in family life is largely beneficial, and there is not much that governments can do about its harmful side-effects. America has tried hard to promote wedlock among poor people since the 1990s, but failed utterly. Countries should try to ensure that their welfare systems do not penalise marriage among the poor. They should not, however, lurch in the other direction by providing tax benefits to the married. Given the growing social stratification of marriage, such measures are exceedingly regressive.

Working-class Westerners have not given up on marriage. On the contrary, many idealise it. Rather than seeing it as the start of a couple's journey together, as in the past, they often see it as something not to try until they arrive—with a good job, a house, financial stability and a lavish party. Many feel they are not “ready” to marry, even as they embark on parenthood. Helpfully, some European countries have begun to offer civil unions for heterosexuals. (Gay couples already had that option.) They confer nearly all the rights of marriage but entail less of the intimidating hoopla. These now account for a fifth of new formal unions in the Netherlands, and more in some working-class districts. They have not undermined marriage so far. It is a small fix for a huge problem, but it might help. ■



婚姻

更完美的结合

婚姻较以往有更多好处，但也更“高不可攀”。问题由此而生

婚姻以永恒为理想，但如今婚姻变化之快前所未有。在世界几乎所有地方，婚姻都正变得更自由、更平等，也更美满。本周的特别报道要剖析的是，婚姻愈趋美好，反而造成了问题。

最良性的改变发生在穷国和中等收入国家（世界大多数人口生活于此）。曾经盛行的童婚习俗正在消退。可能导致遗传缺陷的近亲联姻也在减少，不过这在中东和亚洲部分地区仍然相当普遍。夫妻关系已经变得更平等（尽管还不够平等）。随着女性收入的提高和离婚恶名的消减，越来越多男性发现自己不能把妻子当佣人（或者更糟糕地，拿她们做出气筒），因为女性可以放言走人，而且说到做到。

在某些地区，变化之快令人吃惊。在印度，18岁之前结婚的女性比例仅十年间就从47%下降到27%。“自由恋爱结婚”在印度依然是有损名声之举，父母包办婚姻仍是主流。但和许多传统社会一样，年轻人已经有了更大的自主权。一些人可以否决家人提议的婚配对象，也有的人自己选择对象，但父母保留否决权。在世界各地，流行文化正在提高人们对美好婚姻的期望值，而婚恋交友网站极大地增加了单身人士的选择。

| 婚姻变奏

令人担忧的变化发生在发达国家。在西方，婚姻状况非常好，但只限于富裕阶层。精英情侣为立业而推迟成家，不过还是会在生孩子前共结连理。相比之下，劳工阶层先结婚后生子的可能性要远低于前几代人。在受过大学教育的美国人中，未婚生育只占12%，而在高中辍学者中，该比例达70%，而上世纪80年代初时为43%。类似的趋势在富裕国家普遍可见：经合组织成员国的平均非婚生育率为40%。

婚姻如果只是一纸凭证，那么这种趋势无关紧要。但是婚姻远不止于此。

虽然一场婚礼不能把脆弱不堪的关系变得坚不可摧，但能为不那么牢固的关系提供支持，使之免于破裂。对另一个人公开承诺终身相伴有别于为分担房租而潦草地同居。如果涉及生儿育女，这一点就变得非常重要。美国一项研究发现，已婚夫妇在孩子出生后五年内分道扬镳的有18%，而在同居伴侣中这一比例达到47%。

来自稳定家庭的孩子往往在学习和生活上都有更好的表现，未来拥有稳定婚姻的可能性也更大。加上“门当户对”的婚配趋势，强强联姻令精英阶层和劳工阶层家庭之间的差距变得难以逾越。富裕的父母精心培育孩子，助其成功，而那些没那么幸运的家庭的子女还没踏入校门就已远远落后。这种“婚姻差异”使得富裕国家变得愈加不平等，也令社会流动性受阻。

虽然看上去不太现实，但这种趋势很可能扩展至全球每个角落。那些动摇了发达国家婚姻关系的力量正在蔓延——个人主义兴起、受教育程度提高、女性经济解放。这不仅是西方的潮流。长期以来，日本一直反其道而行：受过高等教育的女性结婚率低于其他人。但现在，她们比其他人更容易结婚，而且更不容易离婚。

家庭生活的革命大体上是件好事，至于其有害的副作用，政府能做的也很有限。自上世纪90年代以来，美国一直努力推动穷人结婚，但一败涂地。各国政府应努力确保它们的福利制度不会不利于选择结婚的穷人，但也不应倒向另一个方向，给予已婚人士税收优惠。鉴于婚姻的社会分层日渐加深，这些措施是极为倒退的。

在西方国家，劳动阶层并没有放弃婚姻。相反，许多人以之为理想。有别于过往，人们不再视婚姻为二人携手同行的开端，而是等一切就绪之后才去尝试的事情——要有好工作、房子、稳定的收入，还要有一场盛大的庆典。许多人就算已为人父母，还觉得自己没“准备好”结婚。好在一些欧洲国家已经开始向异性恋者提供“民事结合”的选择。（同性恋伴侣早有这一待遇。）这种做法赋予伴侣们婚姻中的几乎所有权利，但没有那么多令人敬畏的大张旗鼓。在荷兰，新近正式结合的伴侣中有五分之一选择了“民事结合”，在一些劳动阶层聚集区比例更高。目前来看，民事结合并没有

破坏婚姻制度。这只是个解决重大问题的小小举措，但也许真的会有帮助。■



Japan

The slow-grilled economy

What five years of Abenomics has and has not achieved

IN TOKYO'S Iidabashi district, north of the Imperial Palace, young salarymen and women gather after work to enjoy grilled chicken and a drink at Torikizoku, a chain of budget restaurants. They tap out their orders on touch-screen terminals, which the company has installed on many tables in an effort to economise on waiters, whose wages are hard to contain. Last month the company was forced to raise its price by over 6%, to ¥298 (about \$2.60) plus tax, for two skewers of locally reared chicken yakitori. It was the firm's first price increase in 28 years.

Chicken skewers are not commonly seen as a macroeconomic indicator. But Torikizoku's decision exemplifies the underlying logic of "Abenomics", a campaign to revive Japan's economy, named after Shinzo Abe, its prime minister. His economic strategy aimed to stimulate spending and investment through vigorous monetary easing. That would create jobs, driving up wages. Higher wages, in turn, would push up prices. Success would be measured by the defeat of deflation, which had depressed prices for the best part of 20 years, and the fulfilment of a new inflation target of 2%.

Mr Abe's experiment began even before he won power. Five years ago, on November 16th 2012, his predecessor dissolved Japan's parliament, prompting an election Mr Abe was sure to win. The yen immediately began to fall and the stockmarket started to rise in anticipation of the expansionary policies his victory would bring. Those expectations were, if anything, exceeded in April 2013 when Haruhiko Kuroda, the Bank of Japan's new governor, greatly expanded the scale and scope of the central bank's asset purchases. Five years later, Japan's currency is now about 30%

cheaper in dollar terms than it was in November 2012 and the Nikkei 225 stockmarket index is up by more than 150%.

That has provided some of the intended stimulus to the economy. Japan's GDP has now risen for seven quarters in a row, its longest spell of uninterrupted growth for 16 years. The expansion of nominal GDP, which makes no adjustment for inflation, is even more striking. It was almost 11% higher in the third quarter of 2017 than it was five years earlier (see chart), the fastest pace of growth for over two decades.

Exports contributed a big chunk of that increase. Thanks to the currency drop, every dollar spent on Japanese goods translated into a higher yen amount. But private investment has also gathered momentum, growing by more than 18% in nominal terms over the past five years and by almost 15% at constant prices. Torikizoku, for example, plans to add 80 new restaurants from August 2017 to September 2018.

Abenomics has also created more jobs than even its proponents could have hoped. Employment has increased by more than 2.7m in the past five years, even as Japan's working-age population has shrunk by over 4m. As a consequence, unemployment is below 3% and Japan has over 1.5 job openings for every applicant.

But despite this progress, Abenomics has fallen short of the most prominent target that it set for itself: 2% inflation. Consumer prices (excluding fresh food) rose by only 0.7% in the year to September. If energy prices are excluded from the calculation, inflation was even weaker.

Why has inflation lagged behind—and does it matter? One reason is that wages have not risen as fast as expected. The pay of workers in cyclical, insecure positions, such as yakitori waiters, has risen fairly quickly. But the same is not true of Japan's "core" workers, who account for the bulk of the

country's wage income.

These permanent workers cannot be readily fired, but nor can they easily quit, without enormous loss of status. As a result, their bargaining power does not ebb and flow as the labour market softens or strengthens. Their wage settlements mostly just keep pace with the cost of living. Mr Abe's team had hoped that workers would be "forward-looking", demanding more generous wages in anticipation of the higher inflation promised by the central bank. But pay deals have instead reflected price pressures in the here and now. The government, it turns out, expected far too much of expectations.

Another cause of slow wage growth is more encouraging: Japan has found more labour than it knew it had. Large numbers of women and elderly men have been drawn into the labour market. And the number of foreign workers exceeded 1m for the first time last year. Torikizoku, for example, has filled many of its positions with immigrants from Vietnam.

Moreover, where the cost of labour has risen, some firms have found ways to make better use of it, raising productivity rather than prices. Firms have invested in labour-saving technologies, such as Torikizoku's touchscreen terminals. Small companies, which face particularly severe labour shortages, plan to increase their software spending by over 22% this fiscal year, which ends in March 2018, according to the Tankan, a business survey.

The failure to raise inflation is also, of course, good news for Japan's consumers, who must sometimes wonder why their government is trying to make everything more expensive. Even Torikizoku's long-delayed price rise has been criticised by some of the chain's stingier customers. But among the skewer-eaters in Iidabashi on a recent Monday evening, the sentiment was more forgiving. One pair of students felt the previous ¥280 price was unsustainable. They had worried that the restaurant would have

to close branches if it had kept its price so low.

Their anxiety may illustrate another obstacle in the fight against deflation: the lugubrious disposition of many Japanese. They worry if prices are rising. And they worry if they are not. ■



日本

细火慢烤的经济

安倍经济学五年来的成果与未竟之业

在东京皇居以北的饭田桥地区，下了班的年轻工薪族男女聚集在平价连锁居酒屋鸟贵族（Torikizoku）里，享用烤鸡肉串和酒水。他们在触屏终端机上点餐。鸟贵族在很多餐桌上安装了这样的终端机以精简服务人员，减少难以维持的工资开销。10月，公司不得已提价了6%以上：以本地鸡肉制作的“烧鸟”售价涨至298日元（约2.6美元）两串，不含税。这是该公司28年来首次提价。

虽然烤鸡肉串通常并不被视作一个宏观经济指标，但从鸟贵族的提价可以看出“安倍经济学”背后的思路。得名于首相安倍晋三的“安倍经济学”是一场重振日本经济的运动。安倍的经济策略力争通过积极的货币宽松政策来刺激消费及投资。这将创造更多的就业机会，同时推高工资。而工资增加反过来又会推高物价。在过去20年的大部分时间里，通货紧缩抑制了价格。能否战胜通缩并实现2%的通胀新目标是衡量安倍经济学成功与否的标准。

安倍的实验早在他当政之前就已开始。五年前，也就是2012年的11月16日，他的前任解散了日本国会，继而启动了安倍稳操胜券的大选。由于市场预期安倍当选将会带来扩张性经济政策，日元随即下跌，股市开始上涨。2013年4月，日本央行新行长黑田东彦（Haruhiko Kuroda）大幅扩大央行资产购买的规模和范围，这一举措倒是有可能超出了市场对安倍经济扩张政策的预期。五年后的今天，日元兑美元汇率比2012年11月时下降了约30%，日经225股指上升超过150%。

这对经济产生了某些预期中的刺激作用。日本GDP已连续七个季度实现增长，是16年来为期最长的一次不间断增长。而未考虑通胀因素的名义GDP的增长更是引人注目。2017年第三季度，日本的名义GDP比五年前几乎高出11%（见图表），是20多年来最快的增长

出口对名义GDP的增长贡献良多。由于日元贬值，购买日本商品的每一美元都可以换为更多的日元。但私人投资同样势头强劲，在过去五年里，投资额名义增长率超过18%，按不变价格计算增长了近15%。例如，鸟贵族计划从2017年8月到2018年9月开设80家新店。

安倍经济学还创造了更多的就业岗位，甚至超出其支持者原本的预期。过去五年增加了270多万个职位，加上日本适龄劳动人口减少了400多万，失业率因此降至3%以下。日本每个求职者对应的职位空缺超过1.5个。

然而，尽管取得了这些进展，安倍经济学仍未达到自己设定的最重要的目标——2%的通胀率。截至今年9月的一年中，消费价格（除生鲜食品）只增长了0.7%。如果不将能源价格计算在内，则通胀还要更低。

通胀为何落后？这是否重要？其中一个原因是工资上涨没有预期那么快。在类似鸟贵族服务员这样周期性的、不稳定的职位上，工资上涨得相当快。但对于占国家工资收入大多数的日本“核心”员工来说，情况却并非如此。

这些正式员工不能被轻易解雇，却也不能轻易离职，除非他们不在乎社会地位会断崖式下降。因此，他们的议价能力并不随劳动力市场的松紧而消长。这些员工的薪资协议通常只能跟得上生活成本的上涨。安倍内阁原本希望工人们能“向前看”，考虑到央行承诺实现更高的通胀而要求多多加薪。结果工资协议却只反映了当下的物价压力。由此看来，政府之前的预期过高了。

工资增长缓慢的另一个原因让人稍感欣慰：日本的实际劳动力数量超出原先预计。大量妇女和老人被吸引进入劳动力市场，去年，外国劳工人数也首次超过100万。比如鸟贵族的很多工作就是由越南移民承担。

此外，一些公司在劳动力成本上升的领域找到了更好的解决之道，即提高生产率而不是价格。公司投资于节省劳力的科技，比如鸟贵族的触屏终端。根据商业调查公司短观（Tankan）的统计，一些劳动力尤为短缺的小公司计划本财年（截至2018年3月）将软件开支提高22%以上。

对日本消费者来说，提高通胀未果当然不失为好消息。消费者有时一定也会疑惑，为什么政府试图让每样东西都变得更贵。鸟贵族的涨价已经是一再推迟，却仍然遭到部分吝啬的顾客批评。不过，最近一个周一的晚上，鸟贵族饭田桥店的烤串食客对于此次涨价倒是表现出了比较宽容的态度。有两名学生认为之前280日元的价格已经难以为继。他们曾担心，如果这家居酒屋一直保持这样的低价，会不得不关掉很多分店。

他们的焦虑也许表明，很多日本人忧郁的性格是这场通货紧缩攻坚战中的另一个绊脚石。物价上涨了他们担心，物价不上涨他们也担心。 ■



Free exchange

Who is my neighbour?

When disputes over redistribution fuel separatism, thorny issues arise

POPULISM is the weapon not just of the downtrodden. As the crisis in Catalonia demonstrates, the rich have economic anxieties of their own. Catalonia has an identity distinct, in important ways, from that of the rest of Spain. But the recent drive for independence has been energised by anger over the flow of fiscal redistribution from rich Catalans to their countrymen: people seen, in parts of the restless north-east, as thankless and lazy as well as alien. Paradoxically, globalisation has inflamed separatism around the world by raising the question Catalans now confront: to whom, exactly, do we owe a sense of social responsibility?

Every country or restive region has its own idiosyncratic history. Yet over the long run national borders are surprisingly malleable. Some circumstances offer better prospects for the small and newly independent than others. The smaller the country, the more easily its government can satisfy its people's political preferences. A broadly satisfying compromise is easier among 300,000 people than 300m. But as Alberto Alesina and Enrico Spolaore note in their book, "The Size of Nations", smaller countries also face hardships. They sacrifice economies of scale—they need, for example, to operate their own state agencies, rather than spread the expense of government across a larger population. Borders are bound to add to trading costs, leaving countries with smaller internal markets at an economic disadvantage. At times of foreign-policy tension, smaller countries, with correspondingly constrained armies and defence budgets, are easier to bully.

So the world is more likely to sprout new countries when it is relatively peaceful, and when technology and global co-operation reduce

international barriers to trade. Although moves towards independence in East Timor, Kosovo and South Sudan were accompanied by appalling bloodshed, it is no coincidence that over the past half-century the number of sovereign states has increased in tandem with a decline in global violence and an increase in trade. For Catalonia's residents, membership of the Kingdom of Spain brings sacrifices, like the need to share decision-making on some matters with millions of other Spaniards. Were Catalonia able to secede from Spain yet keep its existing trade relationships, leaving would look quite attractive.

Smaller regions' motives for seeking independence are not always high-minded. In rich economies, the better-off subsidise the poor through an array of welfare programmes. That means richer regions support poorer ones financially. Geographical redistribution is not always a source of tension. Residents of Massachusetts rarely moan about the flow of their federal-tax dollars to Mississippi. Wealth divisions that coincide with stark cultural differences, however, can be more contentious. The financial crisis and its aftermath, by swelling the ranks of the unemployed (and thus of those dependent on government help), was ammunition for politicians in regions keen to cut ties with their national economies. Catalans bridle at the fiscal drag placed on them by the rest of Spain, but they are not alone; just last month, Italians in the richer north also voted to demand greater autonomy.

Fearing dismemberment, national governments often use fiscal decentralisation to reduce separatist pressures. Nationalist sentiment lies along a spectrum, and giving unhappy regions more say over their taxing and spending can deflect moderates from a pro-secession stance. Decentralisation has been a part of Britain's (so far successful) strategy for managing Scottish separatism, for example.

Delegating greater authority to regions, however, brings risks. As the

capacity of regional governments grows, citizens might become more confident in their prospects as truly independent countries. So governments will sometimes instead tighten the screws on the disgruntled region in order to limit its ability to govern itself. Madrid has used such tactics at times, most recently in 2010, when Spain's right-leaning Popular Party succeeded in rolling back rights previously granted to Catalonia. Similarly, the EU has said that seceding regions will have to reapply for membership—implying a damaging period of economic impairment.

Decentralisation is not a costless concession by the national government. In the short run, it clearly exacerbates inequality within the affected country, since fewer resources flow to poorer people and places. Some economists, like Jason Sorens of Dartmouth College, argue that, over longer periods, by encouraging regional competition for mobile people and capital, decentralisation leads to better economic performance. But if rich places tend to stay rich, because productive firms and people benefit from proximity to other such firms and people, then decentralisation can create lasting hardship for poorer places. Rich regions can support high-quality public goods at low cost because a larger tax base can be tapped to manage fewer of the social ills associated with poverty. In poorer ones the reverse is true, as more health, education and other needs must be met from a smaller tax base. It is just that the alternative—the abrupt, possibly extra-legal secession of the unhappy region—often looks worse.

| *Closer and closer*

For liberals, it is hard to know how to view separatism. Democratic self-determination seems a laudable principle. The threat of secession may even act as a check on the temptation among a poorer majority to saddle a richer minority with economically stifling levels of taxation. But cultural identity is a fuzzy, mutable thing. When it becomes an excuse for dodging responsibilities while enjoying the benefits of open markets, it endangers

both social harmony and openness. The geographical scope of redistribution will inevitably be limited by popular ideas about who truly belongs within the national fold. But it is better for everyone if that circle expands over time, rather than shrinks. ■



自由交流

谁是我的邻舍呢？

当围绕再分配的争议引发分离主义，棘手的问题就出现了

民粹主义并不只是被压迫者的武器。正如加泰罗尼亚的危机所示，富人也有经济上的焦虑。加泰罗尼亚人的身份认同在一些重要方面有别于西班牙其他地区，但他们近来寻求独立的运动却是由另一个问题所激发：财政再分配使得他们自身的财富流向了其他西班牙国民，这让他们感到愤怒。在躁动不安的加泰罗尼亚的部分地区看来，其他国民是不知感恩、懒惰散漫的异族人。一个悖论是，全球化实际上加剧了世界各地的分离主义，因为它引发了这样一个问题：我们究竟对哪些人负有社会责任？加泰罗尼亚人目前面临的正是这一问题。

每个国家或动荡的地区都有其独特的历史，但从长期看，国境线的延展性令人惊讶。在有些情况下，新独立的小国家会有更好的前景。国家越小，政府就越容易顺应人民的政治倾向。在30万人中比在3亿人中更容易达成大体令人满意的折衷方案。然而正如阿尔贝托·阿莱西纳（Alberto Alesina）和恩里克·斯波劳雷（Enrico Spolaore）在他们的著作《国家规模》（The Size of Nations）中所指出的，小国也面临着艰难困苦。它们牺牲了规模经济，比方说，它们需要自行运营国家机构，而不能将政府的花费分摊到更多的人口上。边境必然会增加交易成本，令国内市场规模较小的国家处于经济劣势。在外交政策紧张的时候，因其军队和国防预算相应受限，较小的国家更容易受到欺凌。

因此，在相对和平的时期以及技术和全球合作降低了国际贸易壁垒的情况下，世界上更有可能萌生新的国家。尽管在东帝汶、科索沃和南苏丹的独立运动伴随着骇人的流血冲突，但在过去的半个世纪里，随着全球暴力减少和贸易增加，主权国家越来越多，这一点并非巧合。对于加泰罗尼亚的居民来说，作为西班牙王国的一份子带来的是牺牲，比如他们要和其他千百万西班牙人分享对某些事情的决策权。假如加泰罗尼亚脱离西班牙后还能保持现有的贸易关系，那么独立看起来会很有吸引力。

较小的地区寻求独立的动机并不总是高尚的。在富裕经济体中，富人通过一系列的福利计划来补贴穷人，也就是说较富裕的地区要给予较贫困的地区财政资助。地理上的再分配并非一直是冲突的根源，就像马萨诸塞州的居民很少会抱怨他们的联邦税收流向了密西西比州。然而，与鲜明的文化差异并存的财富分割可能更容易引起争议。金融危机及其余波扩大了失业人员的队伍（依赖政府救助的人群也因此扩大），在那些迫切想和本国经济切断联系的地区成了政客的弹药。加泰罗尼亚人对西班牙其他地区施加给他们的财政负累甚为不满，但并非只有他们是这样：就在上个月，较富裕的意大利北部地区也投票要求更大的自治权。

由于担心解体，各国政府经常利用财政分权减轻分离主义的压力。民族主义情绪维持在一个范围内，而给予不满的地区更多对自身税收和支出的控制权，可以让温和派不再倾向于分裂。例如，权力下放已成为英国应对苏格兰分离主义战略的一部分（目前来看是成功的）。

不过，把更大的权力下放给地区会带来风险。随着地方政府能力增强，公民可能对成为真正独立国家后的前景更加自信。因此，政府有时反而会加强对不满地区的控制，限制其自治能力。西班牙政府曾数次采用这种策略，最近一次是在2010年，当时西班牙右倾党派人民党成功削弱了之前授予加泰罗尼亚的权利。同样，欧盟曾表示，脱欧国家必须重新申请成员国资格，这意味着会有一段破坏性的经济损害期。

国家政府做出权力下放的让步并非没有代价。从短期看，这显然加剧了国家内部的不平等，因为流向穷人和较贫困地区的资源减少了。一些经济学家，比如达特茅斯学院的詹森·索尔斯（Jason Sorens）认为，从更长的时期来看，权力下放会促进各地区争夺流动人口和流动资本，从而带来更好的经济效益。但是，如果生产力高的公司和人群因邻近同类公司和人群而受益，令富裕的地方始终富裕，那么权力下放会给贫困地区带来持久的困难。富裕地区可以以低成本负担高质量的公共利益，因为可以利用更大的税基解决更少的与贫困相关的社会问题。而在较贫穷的地区，情况正好相反，因为必须要以较小的税基满足更多健康、教育和其他方面的需求。只不过另一种选择往往看起来更糟，即不满的地区突然、且可能是非法地

宣布独立。

| 越来越近

对于自由主义者来说，很难明白该如何看待分离主义。民主化的独立自决似乎是一个值得称道的原则。独立的威胁甚至可能会抑制较贫穷的大多数这样一种念头——把经济上令人窒息的税收包袱强加在富裕的少数人身上。但文化认同模糊而可变。当它成为逃避责任却又享受开放市场好处的借口时，就会危及社会的和谐和开放。人们对哪些人真正属于本民族认同圈的普遍观念不可避免地会限制再分配的地理范围。但是如果随着时间的推移，这个圈子是扩大而不是缩小了，那么对每个人都会更有益。■



The digital world

Reality check

An illuminating memoir about virtual reality reflects on the hubris of Silicon Valley

WHAT is virtual reality (VR)? Over 21 chapters and three appendices, Jaron Lanier, a tech pioneer, puts forward 52 definitions. Some are geeky: “a media technology for which measurement is more important than display”. Others are poetic: “the technology of noticing experience itself”. And a few are terrifying: “a training simulator for information-age warfare”. VR is all of these things and more besides. Yet at a time when the malign influence of social media is grabbing headlines, it is the last of these that seems most urgent.

Mr Lanier is a Silicon Valley grandee. In 1984 he started the first VR firm, VPL Research, which sold early headsets and accessories, and is widely credited with popularising the term “virtual reality”. He has seen the tech industry go from being a bunch of start-ups run by counterculture idealists to global companies. He now works at Microsoft.

Mr Lanier is also a critic of his industry. His first book, “You Are Not a Gadget” (2010), argued that the web was creating “digital serfs”—users who gave up their data and privacy for no monetary reward or say in the system. “Who Owns the Future” (2013) railed against the monopolistic power of big tech firms. His new book is a memoir about virtual reality and a history of how the utopian thinking of Silicon Valley has brought dysfunction and division. It will be essential reading, not just for VR-watchers but for anyone interested in how society came to be how it is, and what it might yet become.

Many books about the early days of Silicon Valley play up the hippie-meets-techie culture that shaped it. Few define that better than the dreadlocked

Mr Lanier, who was raised in El Paso and educated across the border in Ciudad Juárez. After his mother died, Mr Lanier and his father moved to New Mexico and lived in tents for over two years before moving into a DIY geodesic dome. Mr Lanier skipped the end of high school and went straight to university, but did not graduate. After drifting in semi-poverty and trying various careers, he found himself in Silicon Valley.

This was not an uncommon trajectory in the Bay Area in the 1980s. Mr Lanier describes one associate as a “hippie physicist musician”, another as a Wyoming rancher and rock lyricist. In those days techie culture was a subset of hippie culture. The first advice Mr Lanier was given when he moved there was: “Don’t trust the suits.”

Silicon Valley believed everything would improve once coders were in charge. “We better find a way to constrain people more or the world will never get more efficient,” he remembers being told. “We’re creating a kind of power that is much more important than money.” Software, like air or sex, was meant to be “free”.

Today the world’s three most valuable companies are tech firms. The web is less wild and more structured. But the shortcomings of techie ideology have been exposed. The obsession with “free” nearly destroyed the music industry and continues to wreak havoc on the media. Tech firms still believe that they do not need to follow the rules—witness Uber’s bruising battles with municipal authorities around the world. And the biggest, most influential firms resist any regulation that would make them responsible for the content on their platforms. Web platforms care more about the amount of time their users spend on their sites than the quality of the experience or what they consume.

Mr Lanier remains optimistic that things can be fixed, perhaps by instituting a system of small payments to users for their data or by

ensuring that artists and writers are recognised and paid for their work. Human beings, not algorithms, should be at the centre of the internet economy, he says. These ideas will be familiar to anyone who has read his previous books. The business models of big tech firms are, however, too successful and too lucrative to change, so Mr Lanier's views are unlikely to prevail.

What does this mean for VR? Virtual reality will never be as widespread as the smartphone, but it will be influential. Its promise is to make experiences in computer-generated environments feel as visceral as those in the real world. It has philanthropic potential and may improve medicine and aid education. But it can also be dangerous if virtual worlds are designed to manipulate users. Mr Lanier worries that VR may go down the same route as social networks, becoming, as in another of his definitions, "the ultimate way to capture someone inside an advertisement".

But that is not a given. Although VR has flourished of late, and headsets are now available for a few hundred dollars, the industry is still in its infancy. VR is unlikely to be widely adopted for some time. Meanwhile, Western democracies are debating the merits and dangers of tech, and the need for big companies to police their platforms better. When VR goes mainstream, that debate will have intensified—and perhaps ended well.

By the time VR matures, it will be used by people who have grown up with smartphones and social media. They, Mr Lanier argues, will be more sophisticated than today's internet users, for whom it was a new technology. The next generation will see through the manipulation. It is not much of a hope to cling to, but it is something.

Perhaps the most fitting of Mr Lanier's 52 definitions of VR is that it is "a preview of what reality might be like when technology gets better". Technology is improving. Whether reality does too depends on the

technologists in charge and the power of society to shape their vision. ■



数字世界

认清现实

一本关于虚拟现实的回忆录反思了硅谷的傲慢自大，颇给人以启迪

虚拟现实（VR）是什么？技术先锋杰伦·拉尼尔（Jaron Lanier）在21个章节、三个附录中给出了52个定义。有些颇有极客色彩：“一种媒体技术，对该技术而言测量比显示更重要”。有些则很诗意：“一种让人注意到体验本身的技术。”还有一些很骇人：“适用于信息时代战争的训练模拟器”。以上均是虚拟现实的特征，但其涵义远不止于此。然而，在社交媒体的不良影响成为媒体关注焦点的时刻，最后一个定义带来的挑战似乎最为紧迫。

拉尼尔是硅谷的一位大人物。1984年，他成立了售卖早期头显和配件的首家虚拟现实公司VPL Research，人们普遍认为这是他普及了“虚拟现实”一词。他目睹了科技行业如何从众多由反主流文化的理想主义者经营的创业公司发展成为一家家全球企业。他现在在微软工作。

拉尼尔也是科技行业的批评者。他在2010年出版的首部著作《你不是个玩意儿》（You Are Not a Gadget）中指出，互联网正在制造出一批批“数字农奴”——用户白白放弃了自己的数据和隐私，却没有换来金钱报偿或发言权。在2013年出版的《谁拥有未来》（Who Owns the Future）一书中，他谴责了大科技公司的垄断势力。他的新书是一本关于虚拟现实的回忆录，同时也记述了硅谷不切实际的想法如何引发了混乱和割裂。对虚拟现实领域的观察者来说，这是本必读书，凡是有兴趣了解社会如何发展成如今的模样、未来又将如何变化的人也应该看看这本书。

“嬉皮士加技术控”的文化塑造了硅谷，许多讲述硅谷早期时光的著作也对此大书特书，不过没有谁比满头脏辫的拉尼尔做出了更好的阐述。他在德克萨斯州的艾尔帕索（El Paso）长大，在墨西哥的华雷斯城（Ciudad Juárez）读书。母亲去世后，他和父亲移居新墨西哥州，二人在帐篷里住了两年后搬进了一个自己设计建造的网格穹顶装置里。拉尼尔高中快读完

时跳级进入大学，不过未能毕业。在几乎穷困潦倒的状况下，他漂泊数年，尝试了多种职业，最后在硅谷找到了自我。

这在上世纪80年代的湾区并不算什么不寻常的人生轨迹，拉尼尔就将一位同事描述为“嬉皮士物理学家音乐家”，称另一位为“怀俄明农场主兼摇滚诗人”。那时候，技术控文化是嬉皮士文化的一个子集。拉尼尔到了湾区后得到的第一个忠告就是：“不要相信那些西装革履的人。”

硅谷相信，一旦程序员成为掌控者，一切都会改善。“我们最好想办法增强对人们的约束力，否则这个世界永远也不会变得更高效，”拉尼尔记得有人曾这样告诉他，“我们正在创造一股力量，它的重要性远远超过金钱。”软件就像空气或性一样，就是要“免费”才对。

如今，世界三大最具价值的公司都是科技公司。互联网已不再那么野蛮无章，而是更加有序。不过科技专家们观念上的缺点也显露出来。他们对“免费”的痴迷曾差点摧毁音乐产业，如今仍在危害媒体。科技公司仍然认为自己无需遵守规则——与世界各地市政部门展开激烈斗争的优步便是证明。而规模和影响力最大的公司则抗拒任何要求它们为平台内容负责的监管条例。比起用户体验的质量或消费的内容，互联网平台更在乎用户在自己网站上花了多少时间。

拉尼尔仍旧乐观，认为问题总会解决——也许是通过设立一个制度，规定平台向提供数据的用户支付小额报酬，或者确保艺术家和作家因其作品得到认可和报酬。他指出，互联网经济的核心应该是人类，而不是算法。读过他之前几部作品的人会很熟悉这样的观点。然而，大科技公司的商业模式太成功、太赚钱，难以有所改变。因此，拉尼尔的观点不太可能会大行其道。

这对虚拟现实来说意味着什么？这项技术永远不会像智能手机一样普及，不过仍将具有影响力。虚拟现实有望令计算机合成的环境中的体验如同在真实世界中一般真切。该技术有可能应用于慈善，推动医学进步，或辅助教育工作。然而如果打造虚拟世界的目的是为了操纵用户，那么它也可能

会很危险。拉尼尔担心虚拟现实也许会步社交网络的后尘，成为他在另一个定义中描述的事物：“将人锁在广告囚笼之中的终极方法”。

然而这并非既定事实。尽管近来虚拟现实蓬勃发展，而且现在花几百美元就可以买到一个头显，但这个行业仍处于起步阶段。短期内虚拟现实不大可能会得到广泛应用。与此同时，西方民主国家正积极探讨科技的价值与危险，以及大公司加强自身平台监管的必要性。虚拟现实成为主流之时，这场讨论将会更加激烈——也有可能完满收场。

等到虚拟现实发展成熟，其用户将会是用着智能手机和社交媒体长大的一代人。拉尼尔认为，这些人将比今天的互联网用户更精明老练——曾经互联网对后者来说还是项新技术。下一代人会看透虚拟世界是否正在操控自己。我们不能把希望寄托于此，但他说的不无道理。

拉尼尔为虚拟现实给出的52个定义中，最恰当的也许是“让人预先领略科技进步后的现实世界”。科技正在进步，而至于现实是否也在改善，就要取决于那些呼风唤雨的技术专家，以及能够影响这些专家视野的社会力量了。■



Schumpeter

Making Europe great again

Remember corporate Europe? It wants to be noticed again

WHEN Emmanuel Macron first started work as a mergers-and-acquisitions banker at Rothschild in Paris in 2008, technicians of the trade were not impressed. “He did not know what EBITDA was,” sniffed a former colleague, according to the *Financial Times* (it is a measure of company profits). Yet Mr Macron had ideas and made things happen, and four years later persuaded Nestlé to spend \$12bn buying Pfizer’s nutrition business.

Now that he is France’s president, Mr Macron is trying to revive the grandest idea of all in European business: creating continental champions capable of taking on American and Chinese firms. It is an ambitious mission that will prove highly frustrating.

Mr Macron laid out his vision at the Sorbonne in Paris in September, promising a “re-foundation of Europe”, and that he would bolster its “industrial and monetary power”. The same day Alstom, a French transport firm, agreed to merge with the transport arm of Siemens, a German rival. The combination will have \$18bn of sales, placing it second only to CRRC, a Chinese state-run monster that sells locomotives around the world. Joe Kaeser, Siemens’s boss, spoke of putting “the European idea to work” to create a “European champion”.

That label sounds corny but it used to make bosses tingle with excitement. A wave of intra-European deals followed the creation of the single market and the euro, accounting for 31% of global M&A activity between 2000 and 2005, according to Dealogic, a data provider. Some were orchestrated by governments—for example, the creation of EADS, a plane manufacturer (now Airbus) in 2000. Others were backed by investors—such as Vodafone’s

takeover of Mannesmann in the same year, which created a mobile-phone giant. But the common thread was that having a huge home market would give European firms the kind of economies of scale enjoyed by American companies.

Europe's long crisis, which began when European bond yields spiked in 2010 (and which, hopefully, ended with Mr Macron's election in May) paralysed this urge to consolidate. Pan-European deals were just 12% of global M&A last year. Worried about the euro's stability and enticed by faster growth in emerging economies, European companies have invested more elsewhere. Meanwhile, American and Chinese firms have used deals and organic expansion to get even bigger in their domestic markets.

It is bad enough that Europe does not have any technology giants on the scale of an Amazon or Alibaba, but these trends mean that even the region's bog-standard old-economy firms are relatively small. The median listed European company is 78% as big as the median American one (these figures are for the top 500 firms in each geographical area, and use a blend of profits, book value and market value to measure size, using Bloomberg data). If you exclude Switzerland and Britain, which have lots of large companies and which either are not, or soon will not be, in the European Union (EU), the median EU firm is just 48% of the size of the median American one. Chinese firms have almost caught up: the median company there is 94% as big as the median EU firm and within a couple more years will probably be larger.

Europe has a long tail of journeymen in some industries, including banking, media, defence and carmaking. For example, Peugeot produces one third of the cars that General Motors does. ProSiebenSat, a German broadcaster, has sales that are less than a tenth of Disney's. Ericsson is less than half the size of Huawei, a Chinese telecoms-equipment firm. Size is not everything. But a lack of scale, and the costs of operating in lots of

midsized countries, may help explain corporate Europe's weak return on equity, which at 9% lags behind America (13%) and China (10%).

With his aim to foster greater scale, Mr Macron should be pushing on an open door. Profits are rising, making managers bolder, and Chinese and American predators are sniffing around, giving a sense of urgency. And over time the EU may try to deepen the single market by harmonising corporate-tax rates and strengthening its banking union. All this will make pan-European deals more likely.

Yet there are two stumbling-blocks. First, prickly national sensitivities. The Alstom-Siemens combination will have a German controlling shareholder but its headquarters in France. Fingers crossed that this fudge works. Elsewhere, European unity appears scarce. A proposed \$34bn takeover of Abertis, a Spanish company, by Atlantia, an Italian firm, would create the world's largest toll-road operator. But a blocking counter-bid has been made by ACS, a Spanish firm, with the tacit backing of Spain's government. Meanwhile, Vincent Bolloré, a billionaire who controls Vivendi, a French media firm, wants to create a continental powerhouse and has tried to make inroads into Italy, buying stakes in Telecom Italia and Mediaset, a media business controlled by Silvio Berlusconi, a former prime minister. But Mr Bolloré has run into a wall of regulatory and political hostility.

| *Pleasing the people, and shareholders too*

The other stumbling-block is winning over shareholders. Pan-European deals are risky. Of the 100 largest bids, 30 have collapsed, often due to political rows. To justify paying a takeover premium, firms need to cut costs, but this can be hard for political reasons. The union of Finland's Nokia and France's Alcatel, two telecoms-equipment firms, backed by Mr Macron when he was finance minister in 2015, has since incurred his wrath by trying to cut jobs in France. Lax antitrust enforcement has let American firms form oligopolies and pass the gains to shareholders, not consumers.

But European regulators are, rightly, tougher, so deals that create windfalls for investors are harder to get approved.

Mr Macron's instinct is correct. European firms have lost their seat at the top table of global business. But if the aspiration of creating a new cohort of European corporate champions is desirable in theory, it is daunting in practice. ■



熊彼特

让欧洲再次伟大

还记得欧洲企业吗？它们想重获关注

二零零八年，埃马纽埃尔·马克龙（Emmanuel Macron）刚加入巴黎罗斯柴尔德银行（Rothschild）从事并购业务时，业内专业人士对他不以为然。据《金融时报》引述，其前同事曾不屑地说：“他连什么是EBITDA（息税折旧摊销前利润，衡量公司利润的一个指标）都不懂。”然而，马克龙富有想法，并做出了成绩。四年后，他成功说服雀巢公司斥资120亿美元收购辉瑞（Pfizer）的营养品业务。

如今成为法国总统的马克龙正努力复兴欧洲商界最宏伟的梦想：创造足以挑战美国和中国企业的欧洲领头羊企业。这一雄心壮志必将遭遇诸多艰辛。

今年9月，马克龙在巴黎索邦大学的演说中阐述了自己的构想，承诺“重建欧洲根基”，并壮大欧洲的“工业及财政力量”。同一天，法国运输公司阿尔斯通（Alstom）同意与德国竞争对手西门子公司的运输业务部门合并。两者合并后的销售额将达到180亿美元，仅次于在全球销售机车的中国国有巨头中国中车。西门子的老板凯飒（Joe Kaeser）表示要把“欧洲观念付诸实践”，打造一家“欧洲领军企业”。

这样的标签听来虽陈腐，却曾令企业老板们兴奋不已。数据供应商Dealogic的数据显示，欧洲成立单一市场并推出欧元后，曾兴起一轮欧洲内部的并购潮，占2000年至2005年间全球并购活动的31%。其中一些由政府策划，如2000年组建的飞机制造公司欧洲宇航防务集团公司（EADS，即如今的空客公司）。另一些则由投资者促成，比如同年沃达丰（Vodafone）收购曼内斯曼（Mannesmann），成为欧洲移动通讯巨头。然而这背后的共同思路是，只要拥有庞大的本土市场，欧洲企业便可获得美国公司享有的规模经济优势。

自2010年欧洲债券收益率飙升后，欧洲陷入长期危机（但愿已在5月随马克龙的当选而结束），企业并购势头全面衰退。去年，欧洲内部并购交易仅占全球并购活动的12%。欧洲企业担心欧元不稳，又受到新兴经济体增长加快的吸引，纷纷加大对外国的投资。同时，美国和中国企业利用并购及自身的有机扩张，在各自的国内市场上愈趋壮大。

欧洲没有任何规模堪比亚马逊和阿里巴巴的科技巨头，这已经够糟了，而上述种种趋势还意味着，该地区普通的传统经济企业规模也相对较小。欧洲上市公司中的中位企业规模仅为美国中位公司的78%（为欧美两地500强公司的数字，根据彭博数据，综合使用利润、账面价值及市场价值来衡量规模）。如果除去瑞士和英国（两国拥有大量大型企业，一个未加入欧盟，一个则快要脱离），中位欧洲企业的规模仅为美国中位企业的48%。中国企业已经快要赶上来：其中位企业规模已达欧洲中位企业的94%，而且说不定几年内就会超过欧洲。

欧洲在银行、媒体、军工和汽车制造等行业有一大批规模较小的公司。例如，标致公司的汽车产量为通用汽车的三分之一。德国广播公司ProSiebenSat的销售额不到迪士尼的十分之一。爱立信的规模够不上中国电信设备公司华为的一半。规模并非一切，但缺乏规模，加上在众多中型国家运营的成本，可能有助解释欧洲企业股本回报率低下的问题——9%的数字比美国（13%）和中国（10%）都低。

马克龙要扶持企业扩大规模，应该易如反掌。利润在上升，这令欧洲企业高层更加大胆，而中国和美国的并购大鳄也虎视眈眈，给人以紧迫感。今后，欧盟可能会通过协调企业税率、加强银行业联盟来深化欧洲单一市场。这一切都将促进欧洲内部的企业并购。

但还有两块绊脚石。一是敏感棘手的民族主义。阿尔斯通与西门子合并组建公司后，控股股东将是德国公司，但总部却设在法国。如此混搭要想行得通，真得靠上天庇佑。在欧洲其他地方，跨国合并案似乎也寥寥无几。意大利的亚特兰蒂亚公司（Atlantia）计划以340亿美元收购西班牙的阿伯特蒂斯公司（Abertis），创建世界最大的收费公路运营集团。但另一家西班牙

牙公司ACS已提出更高的收购报价，并得到西班牙政府的暗中支持。同时，法国媒体公司维旺迪（Vivendi）的控制者、亿万富翁文森特·博洛雷（Vincent Bolloré）意欲打造欧洲媒体帝国，他尝试进军意大利，入股意大利电信（Telecom Italia）和意大利前总理西尔维奥·贝卢斯科尼（Silvio Berlusconi）手下的媒体公司Mediaset。但博洛雷在监管壁垒和政治敌意面前碰了壁。

| 取悦民众，也取悦股东

另一块绊脚石是争取股东支持。欧洲内部的企业并购是有风险的。100宗最大提案中已有30宗谈崩——往往是由政治纷争所致。为应付高昂的收购费用，并购后企业需要削减成本，但受政治因素的限制，这可能难以实现。2015年，芬兰诺基亚和法国阿尔卡特这两家电信设备公司合并，得到时任法国经济部长的马克龙大力支持。但合并后公司试图削减在法国的职位，马克龙为之震怒。反垄断执法松懈令美国公司形成寡头垄断，把收益转给股东而非消费者。但欧洲监管机构更为严厉（理应如此），所以令投资者大发横财的并购案较难获批。

马克龙的直觉是对的。欧洲企业在全球商界的领导地位已经丧失。然而，如果说创立一批欧洲领军企业在理论上可取，那么实践起来则困难重重。





Social media and newspapers

Just the two of them

Publishers are wary of Facebook and Google's heft, but have no choice but to work with them. The second in our series on the future of journalism

IN RECENT months Google and Facebook have made changes that may escape the notice of most of their billions of users, but not of news organisations. Facebook began displaying the logos of publishers in some of its posts, so readers can identify the news source. And Google for the first time gave publishers the ability to control how many times the search engine's users can visit news sites free of charge. Both will directly help papers to sell subscriptions.

To critics of the social-media giants, that might look like wolves offering to help the sheep while still feasting on the herd. The business of both Facebook and Alphabet, parent of Google and YouTube, is to occupy people's time and attention with their free services and content, and to sell ads against those eyeballs. For them, quality journalism is just another hook.

Facebook calls its "News Feed" offering its most important product, but in recent years it has tweaked the feed in ways that de-emphasise actual news, instead prioritising updates from friends and family over those from publishers. The associated ad revenues for many publishers have been either nominal, in the case of Facebook's fast-loading "instant articles", or as yet mostly non-existent, in the case of videos they make for the social network. News sites have found they have no choice but to work with the two tech giants, however: Facebook, with its 2bn users, and Google, which directs 10bn clicks a month to publishers, are where their readers are.

So there is no confusion about where the power lies. That is unlikely to

change much in future, although publishers are fighting back a bit. In America a consortium of nearly 2,000 news organisations, the News Media Alliance, is asking Congress for an antitrust exemption to allow publishers to negotiate collectively with the two firms. David Chavern, the consortium's president, lists some of the demands: more ad revenue; the sharing of data about their audiences on the tech platforms; better branding for publishers, as the use of logos is very limited (people simply say, "I read that on Facebook", says Mr Chavern); and support for subscriptions.

That the tech giants are making concessions on some of these points may be because they sense that the political mood is turning against them in America and in Europe, or because of genuine concern for the media ecosystem. Recently Google News Lab, formed in 2015, helped fund "Report for America", which will put an initial 18 reporters in small-town newsrooms across the country, with more to come in future years. Facebook started a "Journalism Project" in January to help develop news products in collaboration with newspapers.

Several newspaper executives say Google's dealings with them seemed more sincere than Facebook's. But both firms' changes to click-through policies are significant. Google's old policy for users directed to make their first visit to a newspaper website was called "first click free", but it actually gave users three free clicks on a newspaper's site every day. As more publishers put up paywalls online, they lobbied Google to limit free access. Google prefers an entirely free, open web—the better for searching and for ad placements—but in the end it relented.

"We're pleased that the conversation has moved on from this ideological position that all content should be free," says an executive at the *Wall Street Journal*, which charges readers for digital access. Earlier this year the *Journal* opted out of "first click free" and experienced a 50% decline in

traffic from Google. It also saw a quadrupling of conversions to subscription among those who came to the site and hit the paywall. To the *Journal*, both data points confirmed the sheer power of tech platforms over publishers.

As for Facebook, users today get all instant articles free of charge. It has signed up ten publishers (including *The Economist*) for a trial that gives some users of Facebook's mobile app access to ten free instant articles per month but then sends them to a publisher's paywall. Even so, many readers are not likely to encounter one.

Media executives at firms that rely more on selling ads than subscriptions are more enthusiastic about Facebook and Google. "We see them as a friend," says Paul Zwillenberg, chief executive of Britain's Daily Mail and General Trust, owner of the *Daily Mail*. Mail Online has doubled daily visitors and engagement in part by making videos for Facebook and YouTube. That does not mean giving up on direct internet traffic (on which Mail Online can sell ads without sharing revenue with Facebook or Google). About 35% of Mail Online's traffic in America still comes directly to the news site's homepage, or "front door", according to SimilarWeb, an analytics firm, which is slightly higher than the rate for the homepages of the biggest American papers.

But selling digital ads on their own websites is a challenge for most news organisations, in part because of the competition from the duopoly. Facebook and Alphabet will take the majority of all digital-ad revenue globally this year, and, by some measures, have recently taken 80-90% of the growth in such revenue. Their data on users' browsing activities give them a huge advantage in micro-targeting users. Wherever journalism turns, Facebook and Google loom large. Their recent moves, although welcome to many publishers, are unlikely to alter the trajectory of the relationship. ■



社交媒体与报业

唯二之选

新闻业前景系列报道之二：报社警惕Facebook和谷歌的影响力，但除了与之合作外别无他选

近几个月，谷歌和Facebook有一些变化，也许它们数十亿用户中的大多数都不会注意到，但新闻机构都看在眼里。Facebook开始在部分帖子中显示出版商的logo，这样读者就能够识别新闻的来源。而谷歌则首次允许出版商决定谷歌用户免费访问新闻网站的次数。两项改变都将直接帮助报社提高订阅量。

在这两家社交媒体巨头的批评者的眼中，上述举动看起来就像饿狼一边在羊群中猎食，一边说愿意救它们一把。Facebook和Alphabet（谷歌及YouTube的母公司）的业务都是利用免费服务和内容抢占人们的时间和注意力，并对这些“眼球”销售广告。对它们而言，高质量的新闻只不过是又一个诱饵。

Facebook称“消息流”（News Feed）是其拳头产品，但近年来Facebook多次调整该产品，淡化新闻报道，以推送朋友和家人的动态为主，媒体信息为次。许多出版商的相关广告收入要么有名无实——例如从Facebook快速加载“即时文章”（instant articles），要么至今基本还没产生过——比如它们为Facebook制作的视频。然而，新闻网站发现自己别无选择，只能与这两大科技巨头合作，因为Facebook拥有20亿用户，谷歌每月引导100亿次点击进入出版商网站，这两者正是新闻网站读者的聚集之地。

所以，哪边是强势的一方一目了然。尽管出版商也做出了一些反击，但未来情况不会有多大变化。在美国，由近2000家新闻机构组成的团体“新闻媒体联盟”（News Media Alliance）正提请国会批准“反垄断豁免”，让新闻出版商能联合起来与这两家公司进行集体谈判。联盟主席大卫·查维恩（David Chavern）列出了部分诉求：提高广告收入分成、分享这些科技平台上其受众的数据、加强出版商品牌展示（目前出版商logo的使用非常

有限。查维恩指出，人们只会说“我是在Facebook上读到的”）、支持订阅服务。

两家科技巨头在其中一些问题上做出了让步，可能是感到美国和欧洲的政治氛围正朝向对自己不利的方向转变，或者是出于对媒体生态系统的真心关切。成立于2015年的谷歌新闻实验室（Google News Lab）最近为“美国报道”项目（Report for America）提供了资助，该项目将为全国多个小城镇的新闻编辑室配置首批18名记者，未来几年人数还将增加。Facebook在今年1月推出“新闻项目”（Journalism Project），联手报社开发新闻产品。

多位报业高管表示，谷歌与他们的合作似乎比Facebook更真诚。但两家公司都在“点击进入”的政策上做出了重大改变。以往，谷歌对首次点击链接进入某家报纸网站的用户实行名为“首次点击免费”的政策，但实际上它允许用户每天在一家报纸的网站上免费点击三次。随着越来越多出版商在自家网站上设置付费墙，它们纷纷游说谷歌限制用户免费访问。谷歌更倾向完全免费、开放的网络，这样更有利于搜索和投放广告，但最终还是让步了。

“我们很高兴看到讨论的立场得以改变，不再坚持‘所有内容都应免费’这一意识形态。”《华尔街日报》（其数字版内容需付费阅读）的一位高管表示。今年早前，该报退出“首次点击免费”计划，从谷歌搜索点击引来的流量随后减半。而访问网站并触及付费墙的读者转化为订阅用户的数量也翻了两番。对《华尔街日报》而言，这两个数据点都印证了技术平台对出版商的巨大影响力。

至于Facebook，用户现在可以免费阅读所有即时文章。在一项测试中，Facebook与十家出版商（包括《经济学人》）签约，让Facebook的部分移动应用用户每月免费阅读十篇即时文章，之后会面临出版商的付费墙。即便如此，许多读者还是不太会遇到付费墙。

更依赖广告销售而非付费订阅的媒体公司高管更追捧Facebook和谷歌。“我们把它们当做朋友。”英国每日邮报信托集团（Daily Mail and General

Trust，《每日邮报》的母公司）的首席执行官保罗·兹维伦伯格（Paul Zwillenberg）说。该公司旗下新闻网站Mail Online每日访客的数量和活跃度翻了一番，部分源于其为Facebook和YouTube制作的视频。这并不意味着公司对直接来自互联网的流量就不重视了（Mail Online可向这些直接访客销售广告，无需与Facebook或谷歌分成）。据分析公司SimilarWeb的数据，Mail Online在美国的流量中仍有约35%来自用户对网站主页的直接访问，即从“正门”进入，略高于美国一些最大报社的比例。

但对大多数新闻机构来说，在自家网站上销售数字广告是道难题，来自上述两大寡头的竞争是原因之一。Facebook和Alphabet将拿走今年全球数字广告收入的大头，而且以某些指标来衡量，它们近期还拿走了这项收入增长量中的八九成。因为掌握用户浏览活动的数据，两大巨头在精确定位受众方面有巨大优势。无论新闻业转向何方，Facebook和谷歌的庞大威胁总是如影随形。它们两家近期的行动虽然广受出版商欢迎，但不太可能改变双方关系的发展轨迹。 ■



The future of journalism

Funnel vision

The first in a three-part series on journalism's future examines how leading American newspapers got readers to pay for news in the internet era

SOMETIMES it feels like the 1970s in the *New York Times* and *Washington Post* newsrooms: reporters battling each other to break news about scandals that threaten to envelop the White House and the presidency of Donald Trump. Only now their scoops come not in the morning edition but in a tweet or iPhone alert near the end of the day.

It is like old times in another way: both newspapers are getting readers to pay, offsetting advertising revenue relinquished to the internet. After years of giving away scoops for nothing online, and cutting staff, the *Times* and *Post* are focusing on subscriptions—mostly digital ones—which now rake in more money than ads do.

Their experiences offer lessons for the industry in America, although only a handful of newspapers have a chance at matching their success. A subscription-first approach relies on tapping a national and international market of hundreds of millions of educated English-language readers and converting a fraction of those into paying customers. With enough digital subscribers—Mark Thompson, chief executive of the *New York Times*, believes his newspaper can get to 10m, from 2m today—the subscriptions-first model could (in theory) generate more profits than business models dependent on print advertising used to.

Such optimism is hard to summon after two decades of accelerating decline. In that period American newspapers lost nearly 40% of their daily circulation, which fell to 35m last year, estimates the Pew Research Centre. Annual ad revenues have shrunk by 63%, or \$30bn, just in the past ten years

(see chart). Newsrooms have shed 40% of reporters and editors since 2006. High returns on equity turned into single digits, losses or bankruptcy.

Like Detroit carmakers before the arrival of the Japanese, in pre-internet days newspapers flush with profits from a captive market grew lazy and complacent. Some big-city papers, like the *Philadelphia Inquirer* or the *Baltimore Sun*, splurged on foreign bureaus and fluffy suburban sections whether or not readers wanted them; classified ads alone covered these costs many times over. Now such newspapers are struggling to remain relevant to diminished readerships. A tier below, hundreds of local ones are dying or turning into advertiser sheets; newspaper chains, some managed by investment funds, have snapped up many of them, maintaining high profits by sacking journalists.

| *From the ashes of newsprint*

The *Times* and *Post* have been buffeted by the same forces. But now each is in turnaround. The *Times* has doubled its digital-only subscribers in less than two years; the *Post* has managed the feat in ten months, and now has more than 1m. Both have staunched losses. Revenue at the *Times* had fallen by more than 20% in three years to less than \$1.6bn in 2009; this year they are on pace to climb back above \$1.6bn, led by digital subscriptions. (Return on equity still fell, to 3% last year from 37% in 2001.)

The *Post* had also been losing millions before Jeff Bezos, boss of Amazon, bought it in 2013. The newspaper is now privately held and does not disclose revenues and profits, but Fred Ryan, the publisher, says both are growing and the newspaper is on track for its most profitable year in a decade. The *Wall Street Journal* added more than 300,000 digital subscriptions in the year to June, but a sharp fall in advertising crimped revenues by 6% at Dow Jones, the division of News Corp, Rupert Murdoch's media empire, that houses the newspaper.

How have they done it? Early attempts by newspapers to put up digital “paywalls” floundered, and met with derision from critics and competitors vaunting the internet’s ability to generate huge audiences for free content. How could anyone hope to attract paying digital customers when they could go elsewhere online for free?

The *Times* hit upon the answer in 2011, when it introduced a metered paywall, something the *Financial Times* was also trying. Visitors to the website could read a few free articles a month, after which they would be asked to pay. This approach is now standard across journalism (including at this newspaper), but it was controversial at the time. At News Corp Mr Murdoch erected a hard paywall at all his newspapers in the belief that giving away his product online would cripple the more profitable print editions. Those suffered anyway, and he later dropped the paywall at the *Sun*, a tabloid, and has allowed some flexibility at the *Journal*. Softer paywalls have created funnels to suck in customers.

On a whiteboard in Mr Thompson’s office at the *Times* is a diagram to illustrate the approach. At the top, where the funnel is widest, are all those who visit its digital site. (In September 104m people in America did so, according to comScore.) At the narrow end are its 2m paying digital-only subscribers (plus 1m print subscribers). Mr Thompson’s main preoccupation is to tweak the “geometry of the funnel” to shift more people from free to paid. At the *Post*, Mr Ryan is also busy funnelling.

The job of funnel mathematician did not exist at newspapers six years ago. Now it is one of the most important functions a digital site has. The *Times* and *Post* conduct numerous tests of different ways to trigger the paywall, for instance if a visitor returns to the same columnist. It is A/B testing like at a technology company, Mr Ryan says, except it is more like “A to Z testing”. The *Post* has settled on three site visits a month before hitting the paywall, which means 85% of visitors will not encounter it. The other 15%

are asked to subscribe at the introductory rate of 99 cents for the first four weeks.

Both newspapers sift through data about what visitors do just before stumping up. The *Post* looks at the “month zero” of a reader’s pre-subscription activity on the site. Mr Ryan credits the effort, which began a year ago, with helping to convert more visitors to subscribers this year.

Another factor has helped the two papers: Mr Trump. Since his election they have revived an old rivalry, vying for sensational scoops, sometimes several in a day. Mr Trump’s attacks on both newspapers—“the failing New York Times”, “more fake news from the Amazon Washington Post”—have almost certainly helped their bottom lines. His presidency has created an urgency around news that has made old-fashioned journalism more in vogue than it has been probably since Watergate. Fake news shared on social media has reinforced a feeling that real news costs money.

| *Trump bump*

The newspapers’ bosses agree Mr Trump has been good for business, but add they were ready for the moment. As Mr Bezos is fond of saying, “you can’t shrink your way to profitability”. He invested in the *Post* after buying it, hiring technologists to improve its digital presence. He has also added reporters (the *Post* now has 750 newsroom employees and counting). Marty Baron, editor of the *Post*, added a rapid-response investigative team of eight people this year. Dean Baquet, executive editor of the *Times*, has expanded the Washington bureau twice since the election. (The *Times* paid for new reporters in part by cutting dozens of other editorial jobs.)

The subscription-first approach justifies adding reporters. By increasing the quality of the product, newspapers hope to lure subscribers. But it is not clear others can replicate that virtuous circle so easily. Many regional papers are nurturing digital subscribers—they all have their funnels now,

too—but are doing so on a much smaller scale. They will have to come up with other ways to make money to survive. “They have to do everything,” says Jay Rosen, a professor of journalism at New York University.

By “everything” media experts like Mr Rosen mean ending a reliance on two traditional sources of revenue: ads and subscriptions. At regional papers, unlike the national ones, prospects for both are limited by the size of the metropolitan market. Savings from printing fewer copies are small—printing and distribution costs are mostly fixed—so they must either cut staff or find other ways to make money. This may include staging trade fairs, offering memberships with perks, even e-commerce partnerships. Such sidelines help to ward off staff cuts; to be a community hub, newspapers must also cover communities effectively. They may forgo costly (and wasteful) foreign and national bureaus. But to attract local readers, they must provide relevant coverage of city halls, courthouses, police precincts or schools.

Take the *Star Tribune* in Minneapolis, a privately owned newspaper which has managed to keep the newsroom humming along. Almost annually Mike Klingensmith, the publisher, and a few of his senior executives meet with their counterparts at the *Dallas Morning News*, *Boston Globe* and one or two other independently owned newspapers. They sign non-disclosure agreements and then share ideas about how to make money. In the past year Mr Klingensmith has adopted three of them, adding several million dollars in revenue: organising an advertiser fair to attract new clients; putting on a consumer travel show; and starting a glossy quarterly print magazine.

The *Star Tribune* now sells digital subscriptions (nearly 50,000) and advertises; delivers a thick Sunday paper full of features (which accounts for 54% of print ad revenue); and is expanding the Saturday print edition. It conducts in-depth investigations that wins awards, including the Pulitzer

Prize in 2013, and makes podcasts and daily videos. Several reporters cover city hall. In the past year an additional one was dispatched to Washington. Mr Klingensmith and Rene Sanchez, the editor, believe quality is key; nearly 20% of the budget goes to the newsroom, which has kept a headcount of 245 for seven years.

That gives the *Star Tribune's* funnel mathematician a product to sell. Patrick Johnston, a digital executive poached from Target, the retail store, and his boss Jim Bernard, a former executive at Marketwatch, a business-news website, explain how a local newspaper's funnel vision is different. They are, like the big papers, interested in the visitors who they call "intenders", people whose browsing behaviour suggests they may be ready to subscribe. But whereas many visitors to the *Times* and *Post* are potential intenders, the *Star Tribune* can dismiss about 50% of its online traffic—the "grazers" from outside Minnesota who clicked a link—and focus on the other half. Reducing friction is vital; they have got 25% more intenders to subscribe since installing PayPal as a payment option.

| *Hold the presses*

The downside to the ease of online subscriptions is the ease of cancelling them. Newspapers guard their rates of digital churn closely because they are so high—despite an all-out effort the *Star Tribune* keeps only one in two subscribers after 14 months (the *Times* and *Post* numbers are better, executives there say, without giving figures). A subscriber's early days are essential. Keeping a visitor engaged with the site is similar to getting a "guest" on Target's website to put another item in their basket, Mr Johnston says. It also means competing with ever more rivals for people's attention: bigger fish like the *Times* and *Post*, but also Netflix, Spotify or Candy Crush.

The virtue of digital subscriptions is that they build a deeper relationship between readers and newspapers than when distribution meant throwing broadsheets onto doorsteps. Newspapers nowadays know a lot more about

their customers' tastes. That lets them tailor the experience to readers individually, with the aim of keeping them around longer. It can be, as Mr Thompson says, an annuity for the newspaper. But the newspaper has to be worth the cover price. ■



新闻业前景

盯住漏斗

新闻业前景报道三部曲之第一部：在互联网时代，美国顶尖报社如何让读者付费订阅新闻

在《纽约时报》（New York Times）和《华盛顿邮报》（Washington Post）的编辑部，有时感觉像回到了上世纪70年代——记者们争抢着要揭露那些令白宫和特朗普总统之位岌岌可危的丑闻。只不过如今他们的独家消息并非通过晨报发布，而是在晚上用推特或iPhone通知发出。

还有一个方面也和过去相似：两家报纸都在争取让读者付费订阅内容，以弥补流向互联网的广告收入。多年来，它们都在网上免费提供独家新闻，并曾多次裁员，如今，它们正着力推动读者订阅内容（主要是数字版），这带来的收入比广告更多。

它们的经验给美国报业提供了借鉴，尽管只有少数报纸有可能取得可与之相匹敌的成功。“订阅主导”的方式有赖于在国内外市场上吸引几亿名受过良好教育的英语读者，并将其中的一部分转化为付费客户。《纽约时报》的首席执行官马克·汤普森（Mark Thompson）相信其数字版报纸的订阅量能从现在的200万增至1000万。只要有足够的数字版订户，“订阅主导”模式（理论上）就能比以往依赖印刷版广告的商业模式带来更多利润。

经历了20年的加速衰退后，这样的乐观态度实在难得。据皮尤研究中心（Pew Research Center）估计，过去20年里，美国报业的日发行量下跌近40%，去年降至3500万。仅过去十年间，广告年收入萎缩63%，减少了300亿美元（见图表）。自2006年以来，报社编辑部裁减了40%的记者和编辑。原本高企的股本回报率变为个位数，有的还遭受亏损甚至破产。

互联网时代到来之前，报业集团从垄断市场中赚取丰厚利润，变得懒散自满，颇像日系车打入美国市场前底特律的汽车公司。一些大城市的报纸，如《费城问询报》（Philadelphia Inquirer）或《巴尔的摩太阳

报》（Baltimore Sun），砸重金创办海外分社和空洞浅薄的郊区分版，不管读者是否有此需求，反正单靠分类广告收入就够抵消这些成本，还多出好几倍。但现在，这些报纸正苦苦挽留日益流失的读者。往下一层，数以百计的地方报纸或者奄奄一息，或者成了“广告主名录”。大型报业集团（有些由投资基金管理）收购了很多这样的小报社，通过裁减记者来维持高利润。

| 从新闻纸的灰烬之中重生

《纽约时报》和《华盛顿邮报》也受到同样的打击，但如今均见转机。在不到两年的时间里，《纽约时报》的纯数字版订户数量翻了一番，《华盛顿邮报》则在十个月内就取得了同样的成绩，如今已有超过100万纯数字用户。两家报社都已止损。《纽约时报》的收入曾在三年内下跌超过20%，2009年的收入不足16亿美元。在数字订阅的带动下，今年的收入有望回升到16亿美元以上。（股本回报率仍在下跌：2001年为37%，去年为3%。）

在2013年被亚马逊老板杰夫·贝佐斯（Jeff Bezos）收购之前，《华盛顿邮报》也是亏损数百万美元。该报现为私人持有，并不披露收入和利润数字，但发行人弗雷德·莱恩（Fred Ryan）表示，收入和利润均有增长，而今年可望成为十年来盈利最多的一年。《华尔街日报》（Wall Street Journal）在截至今年6月的一年里增加了30多万数字订户，但广告收入锐减，令母公司道琼斯公司（默多克的媒体王国新闻集团下属企业）收入下跌6%。

它们是怎么做到的？这些报纸早年刚设立数字“付费墙”时出师不利，遭到批评家和竞争对手的嘲讽——他们宣扬互联网上的免费内容会吸引到庞大受众。既然人们可在网上其他地方免费获取信息，怎能指望有人会付费阅读？

《纽约时报》在2011年找到了答案，推出了“咪表付费墙”，《金融时报》（Financial Times）当时也在做同样的尝试。《纽约时报》网站的访客每月可免费阅读几篇文章，想看更多就需付费。如今这已成为新闻业的

标准做法（包括本刊），在当时却颇具争议。默多克对新闻集团旗下所有报刊设下硬性付费墙，深信在线免费提供自己的产品会严重削弱盈利较佳的印刷版业务，但印刷版照样遭受重创，后来默多克取消了通俗小报《太阳报》（Sun）的付费墙，又让《华尔街日报》的付费墙增加了一定的灵活性。较灵活的付费墙形成了汇聚用户的漏斗。

在汤普森位于《纽约时报》总部的办公室里，白板上的一幅示意图阐释了这一方法。在最上端，即漏斗的最宽处，是该报数字版的所有访客。据 comScore 的统计，今年9月在美国有1.04亿人访问过该网站。而漏斗的窄处是纯数字版的200万付费订户（另外还有100万印刷版订户）。汤普森正全力调整“漏斗的形状”，把更多人从免费用户转变为付费用户。在《华盛顿邮报》，莱恩也在忙着打造他的漏斗。

六年前，报界并不存在“漏斗计算师”这一工作，如今这却成为报刊数字版最重要的职能之一。两家大报针对启动付费墙的各种方法进行了大量测试，例如，访客在多次阅读同一个专栏作者的文章时需要付费。莱恩表示，这与科技公司的A/B测试类似，只是更像是“A到Z测试”。《华盛顿邮报》确定下来的做法是，用户每月可免费访问网站三次，之后便需要付费，这意味着85%的访客都不会遇到付费墙。其余15%的访客可在前四周享受99美分的新用户优惠订阅价。

两家报纸都在分析访客在付费订阅前的活动数据。《华盛顿邮报》会研究读者成为订户前一个月在其网站上的活动。这项工作始于一年前，莱恩称在相关分析结果的助力下，今年有更多访客转化成为付费用户。

两家报纸的反弹还得益于另一个因素：特朗普。自从他当选总统以来，它们重新开始了老一套的竞争：争相报道轰动性的独家新闻，有时一天就发布好几则。几乎可以肯定的是，特朗普对它们的指责（“失败的《纽约时报》”、“亚马逊的《华盛顿邮报》又有假新闻”）提升了报纸的销量。特朗普上任后人们对新闻的需求增加了，旧式新闻报道自水门事件后再度风行。社交媒体上假新闻横行，也令人们愈发觉得获取真实报道是需要花钱的。

| 特朗普效应

两家报社的老板也认为特朗普帮助推动了业务，但补充说自己早为这一刻做好了准备。正如贝佐斯常说的那样，“总不能一直靠紧缩来实现盈利”。他收购《华盛顿邮报》后向该报注资，聘请技术人才提升数字业务，还增聘了记者（该报目前有采编人员750人，数目还在增加）。该报主编马蒂·巴龙（Marty Baron）今年增设了一个由八人组成的快速反应调查小组。《纽约时报》的执行主编迪恩·巴盖特（Dean Baquet）自美国大选以来已两度扩大华盛顿分社的规模。（该报聘请新记者的资金部分来自于削减几十个其他编辑职位。）

“订阅主导”模式确实需要增聘记者，因为报纸希望通过提高报道质量来吸引订户。但其他报社能否轻易复制这一良性循环尚不明朗。许多地区性报纸现在也都有了自己的漏斗——它们正在发展数字用户，但规模要小得多。这类报纸必须想出其他盈利方式才能生存。“它们得竭尽所能。”纽约大学新闻系教授杰伊·罗森（Jay Rosen）说。

罗森等媒体专家所说的“竭尽所能”是指结束对两种传统收入来源的依赖：广告和订阅。地方性报纸有别于全国性报纸，它们在这两项收入上的前景都受到区域市场规模的限制。减少印刷量能节省的成本不多——印刷和发行成本大多是固定的——所以它们必须裁员或寻求以其他方式盈利。这可能包括组织贸易展会，为订阅会员提供福利，甚至建立电子商务合作机会。这些副业有助于避免裁员。而要成为社区的信息枢纽，它们必须高效报道社区动态。它们可以放弃成本高昂（且浪费资源）的外国及全国分社。但要吸引本地读者，它们必须提供对市政厅、法院、警局或学校的重要报道。

以明尼阿波利斯的《明星论坛报》（Star Tribune）为例，这家私营地方报纸经营有方，编辑部门运转稳定。几乎每年，其发行人迈克尔·克林根史密斯（Michael Klingensmith）和多名高管都会与《达拉斯晨报》（Dallas Morning News）、《波士顿环球报》（Boston Globe）及其他一两家独立报刊的高层会面。他们签署不公开协议，分享赚钱的点子。去年，克林根史密斯采用了其中三个方案，增加了数百万美元的收入：组

织了一场广告商展来吸引新客户，举办了一场消费者旅游展，创办了一本季刊时尚杂志。

《明星论坛报》目前销售数字订阅（近五万用户）和广告、一份厚实的、有大量专题报道的周日版纸质报纸（占印刷版广告收入的54%），周六版报纸也在扩充改版中。该报的深度调查报道屡获奖项，包括2013年的普利策奖，还制作播客及每日视频。该报在市政厅派驻多名记者，去年又增派一名驻华盛顿记者。克林根史密斯和主编雷内·桑切斯（Rene Sanchez）相信质量是关键，把近20%的预算拨归编辑部，采编人员规模连续七年保持在245人。

这使得《明星论坛报》的“漏斗计算师”有货可售。该报的数字业务执行主管帕特里克·庄思顿（Patrick Johnstone）是从零售商场塔吉特（Target）挖来的，他的上司吉姆·伯纳德（Jim Bernard）则是财经新闻网站Marketwatch的前高管。两人解释了地方报纸的“漏斗视野”有所不同。虽然像大报那样，地方报纸也有意发掘出浏览行为显示可能订阅的“有意向访客”，但《纽约时报》和《华盛顿邮报》的很多网站访客都属于“有意向访客”，而《明星论坛报》网站却有约50%的流量可忽略不计（都是些从明尼苏达州之外点击链接进入的“过路客”），而只需专注剩下那一半。减少订阅路障至关重要：自从把PayPal纳入付款选项后，它们的订阅量增加了25%。

| 喊停印刷机

数字版订阅起来很轻松，缺点是要取消也很容易。报社紧盯数字订户流失率，因为它实在很高。即便全力挽留，《明星论坛报》每两个订户中就有一个会在14个月后流失（两大报的高管们称自己的情况好一点，但没透露具体数字）。用户订阅的前期是关键。庄思顿表示，吸引访客持续订阅《明星论坛报》的数字版，就跟设法让塔吉特网站的“客人”把又一件商品放进购物车一样。这也意味着要与更多对手争夺读者眼球，这些对手不单有两大报这样的巨头，还有Netflix、Spotify，或是网游Candy Crush。

数字订阅的优点是可以在读者和报纸之间建立更深层次的关系，而不是像

传统“发行”那样只是把报纸扔到你家门口。现在的报纸对顾客口味的了解大大增加，也就能为每个读者量身定制阅读体验，以便更长时间留住订户。正如汤普森所说的，这可以成为报社的“养老年金”。但报刊本身也必须值回“定价”。■



Economic and financial indicators

Maritime transport

Seaborne trade rose by 2.6% in 2016

Seaborne trade rose by 2.6% in 2016, or 260m tonnes, according to UNCTAD, and volumes are forecast to grow by 3.2% a year until 2022. The industry, which handles 80% of global trade by volume, has struggled with overcapacity in recent years, but improvement in the global economy has helped reverse the decline in freight rates. Despite five years of slowing capacity growth, supply still outstrips demand. In 2016 the container-shipping market's operating losses were \$3.5bn. A wave of "mega-alliances" (three groups now control 77% of global capacity) may help cut the excess supply, but concerns of an oligopolistic market are rising, placing greater pressure on regulators to ensure competition. ■



经济与金融指标

海上运输

2016年海运贸易增长2.6%

根据联合国贸易和发展会议（UNCTAD）的数字，2016年海运贸易增长2.6%，即2.6亿吨，预计在2022年前还将以每年3.2%的速率增长。该行业运送的货物占全球贸易量的80%，近年面对运力过剩的困境，但全球经济的改善帮助扭转了运价的下滑。尽管五年来运力增长缓慢，但仍供过于求。2016年，集装箱航运市场的营运损失为35亿美元。一股成立“大型联盟”的热潮（如今三大联盟控制了全球运力的77%）也许能帮助减少供应过剩，但人们对寡头垄断市场的担忧也日益加深。这给监管者带来了更大的压力，他们需要确保行业内有充分竞争。■



Free exchange

Too tight to mention

Firms should make more information about salaries public

SWEDES discuss their incomes with a frankness that would horrify Britons or Americans. They have little reason to be coy; in Sweden you can learn a stranger's salary simply by ringing the tax authorities and asking. Pay transparency can be a potent weapon against persistent inequities. When hackers published e-mails from executives at Sony Pictures, a film studio, the world learned that some of Hollywood's most bankable female stars earned less than their male co-stars. The revelation has since helped women in the industry drive harder bargains. Yet outside Nordic countries transparency faces fierce resistance. Donald Trump recently cancelled a rule set by Barack Obama requiring large firms to provide more pay data to anti-discrimination regulators. Even those less temperamentally averse to sunlight than Mr Trump balk at what can seem an intrusion into a private matter. That is a shame. Despite the discomfort that transparency can cause, it would be better to publish more information.

There is a straightforward economic argument for making pay public. A salary is a price—that of an individual worker's labour—and markets work best when prices are known. Public pay data should help people make better decisions about which skills to acquire and where to work. Yet experiments with transparency are motivated only rarely by a love of market efficiency, and more often by worry about inequality. In the early 1990s, it was outrage at soaring executive salaries which led American regulators to demand more disclosure of CEOs' pay. Such transparency does not always work as intended. Compensation exploded in the 1990s, as firms worried that markets would interpret skimpy pay-packets as an indicator of the quality of executive hires.

Despite this, bosses tend to oppose transparency, for understandable reasons. Firms have an easier time in pay negotiations when they know more about salaries than workers do. What is more, shining a light on pay gaps can poison morale, as some workers learn that they earn substantially less than their peers. A study of employees at the University of California, for instance, found that when workers were given access to a database listing the salary of every public employee, job satisfaction among those on relatively low wages fell. In industries in which competition for talented workers is intense, the pernicious effects on morale of unequal pay create an incentive to split the high-wage parts of the business from the rest. Research published in 2016 concluded that diverging pay between firms (as opposed to within them) could account for most of the increase in American inequality in recent decades. That divergence in turn resulted from increased segregation of workers into high- and low-wage firms.

Yet transparency increases dissatisfaction not because it introduces information where there was none before, but because it corrects misperceptions. Surveys routinely find that workers overestimate their performance and pay relative to their peers'. This is true across economies as well as within firms. In 2001, tax records in Norway were put online, allowing anyone to see easily what other Norwegians had earned and paid in tax. Reported happiness among the rich rose significantly, while the well-being of poorer people fell as they learned their true position on the economic ladder. Better information changes behaviour. Low-paid workers at the University of California became more likely to seek new jobs after salary data became public. In Norway the poor became more likely to support redistribution.

Transparency might threaten the function of capitalist economies if people were implacably opposed to pay gaps, but they are not. A study published in 2015 of factory workers in India, for instance, found that unequal pay worsened morale and led to reduced effort when workers could not see

others' contributions, but not when productivity differences were easily observable.

Yet in the modern economy, individual contributions are often devilishly hard to assess. Simple theory suggests that workers are paid according to their productivity. Were they to earn more, their employers would lose money; were they to earn less, other firms could profit by hiring away underpaid employees. But although it is easy enough to see how many shirts a textile worker stitches in an hour, it is much harder to evaluate the contribution of one member of a team that has spent years developing new software. When it is difficult to observe important parts of a job, economists believe that trying to link pay closely to narrow measures of performance can be misguided. Workers inevitably neglect murky but critical tasks in favour of those the boss can easily quantify. In the knowledge economy, therefore, the relationship between pay and productivity is often loose.

Pay gaps are often nonetheless justified. Workers with scarce and valuable skills can easily threaten to leave, and can therefore bargain for higher pay. Those fat pay-packets serve the economy by encouraging young workers to develop skills that are in short supply—provided, of course, that they know how much they can expect to earn. But the difficulty in observing productivity allows factors to influence pay, such as office politics, discrimination or a simple tendency to silence the squeakiest wheels with grease.

| *Open-plan offices*

Not every country will opt for radical transparency. Even Nordic governments continue to tweak their policies: in 2014 Norway banned anonymous searching of its tax database, so citizens could see who had nosed around their finances. But increased openness about pay could improve both the fairness and the functioning of the economy. When pay is

public, it is not the justifiable inequities that create the most discomfort, but those firms cannot defend.

Studies cited in this article can be found at economist.com/transparency2017 ■



自由交流

绝口不提

企业应将更多薪酬信息公之于众

瑞典人谈及个人收入时的坦率会吓到英国人或美国人。他们没有理由遮遮掩掩——在瑞典，直接打电话向税务机关询问，你就可以知道一个陌生人的工资收入。薪酬高度透明可以成为对抗持续不平等的有力武器。在黑客公布了索尼影业公司高管的邮件之后，全世界发现好莱坞一些最卖座的女明星比共同主演的男明星赚得少。此事揭露后，女演员开始为自己争取更多的报酬。然而，在北欧国家之外，薪酬透明化面临激烈的抵制。特朗普最近废除了奥巴马制定的一项规定，该规定要求大公司向反歧视监管机构提供更多薪酬数据。即使是那些秉性不像特朗普那样反感公开透明的人，对这么一件看似侵犯隐私的事情也会犹豫回避。太可惜了。尽管薪酬透明可能会带来不便，但公开更多的信息还是利大于弊。

公开薪酬信息有一个直截了当的经济学依据。工资是一个人的劳动力价格，而价格公开时市场运作得最好。公开的薪酬数据应该有助于人们更好地决定该掌握哪些技能、该去哪里工作。然而，关于薪酬透明化的实验很少是出于对市场效率的热爱，而更多是出于对不平等的担忧。上世纪90年代初，正是由于高管薪酬飙升引发了极大不满，才让美国监管机构要求企业披露更多有关CEO薪酬的信息。这种公开透明并不总能够取得预期的效果。相关报酬在90年代激增，因为企业担心，市场会把薪酬微薄解读为高管人选质量不佳。

尽管如此，企业老板们往往还是反对公开薪酬信息，原因也可以理解。如果企业比员工掌握的薪酬信息更多，在工资谈判中就会更占上风。另外，披露工资差距会让一些员工因得知自己比同事少赚许多而士气受损。例如，一项对加州大学雇员的研究发现，当员工可以查看一个列出每个公职人员薪水的数据库时，工资相对较低的员工的工作满意度会下降。在人才竞争激烈的行业中，鉴于薪资差异对士气的有害影响，会促使业内的高工资企业与其他企业区隔开来。2016年发表的一项研究得出结论，公司之间

的薪酬差异（而不是公司内部的差异）是近几十年来美国不平等加剧的主要原因。而这种差别反之又因为人们日益分化到高薪公司或低薪公司而加强。

然而，薪酬透明会加深不满并不是因为它公开了以前无法得知的信息，而是因为纠正了误解。调查一再发现，员工往往会高估自己相对于同事的表现以及应得的薪酬，在不同经济体和企业内部都是如此。2001年，挪威在网上公布税务记录，任何挪威人都能轻易看到其他国民的收入和纳税情况。据报道，富人的幸福指数因此显著上升，而收入较低的人群在得知自己在经济阶层中的真实地位后幸福指数有所下降。掌握更充分的信息会改变行为。薪资数据公布后，加州大学的低收入员工变得更有可能去找新工作。在挪威，穷人更有可能支持财富再分配。

如果人们完全无法接受薪酬差异，那么薪酬透明化可能会威胁到资本主义经济的运转，但人们并非如此。例如，2015年发表的一项关于印度工厂工人的研究发现，如果员工看不到别人的贡献，那么薪酬不平等就会打击员工士气，导致员工懈怠，但如果生产效率差异显而易见的话，就不会出现这种情况。

然而在现代经济中，个人贡献往往极难评估。简单的理论认为，员工的工资由其生产率决定。给员工多发工资，雇主就有损失；员工挣得少，其他公司就有机会挖墙脚，从中得利。然而，尽管很容易计算出一名纺织工人在一小时内缝了多少件衬衫，但在一个花费了数年时间开发新软件的团队中评估某个成员贡献几何却难得多。经济学家认为，当一份工作中重要的部分难以观察时，试图将薪酬与片面的绩效指标紧密挂钩的做法可能会适得其反。员工不可避免地会绕开一些复杂但关键的任务，而专注于那些可被老板轻易量化的任务。因此，在知识经济中，薪酬与生产率之间的关系往往较为松散。

不过，薪酬差异往往是合理的。拥有稀缺宝贵技能的员工有资本说走就走，因此能够争取到更高的报酬。丰厚的收入会鼓励年轻人发展短缺的技能，从而促进经济，当然，前提是他们知道自己大概能靠这些技能挣多少

钱。但是，难于观测生产率会让一些因素影响薪酬，如办公室政治、歧视，或者是干脆只给最会哭的孩子奶吃的做法。

| 开放式办公室

并不是每个国家都会选择彻底的公开透明。即使是北欧国家的政府也在不断调整政策：2014年开始，挪威禁止匿名搜索税务数据库，这样公民就可以知道谁曾窥探他们的财务状况。不过，提高工资收入透明度可以促进经济的公平和正常运转。一旦薪酬信息公开，让人心中不快的就不是合理的差别待遇，而是公司不能说明理由的不平等待遇。

文中引述的研究详情请见economist.com/transparency2017 ■



The internet of things

Bish bash Bosch

A conservative German hardware giant tries to turn itself into a new kind of ultra-secure technology platform

BOSCH is everywhere. It has 440 subsidiaries and employs 400,000 people in 60 countries. Its technology opens London's Tower Bridge and closes packets of crisps and biscuits in factories from India to Mexico. Analysts call it a car-parts maker: it is the world's largest, making everything from fuel-injection pumps to windscreen wipers. Consumers know it for white goods and power tools synonymous with "Made in Germany" solidity.

The company itself prefers to be called a "supplier of technology and services", or "the IoT [internet-of-things] company". On a hill overlooking Stuttgart, robotic lawnmowers whizz around its headquarters and a window displays dishwashers and blenders. Inside are signs of a company in transition: posters call on staff to rip off ties, celebrate "error-culture" and "just do it" opposite a quote from Robert Bosch, the founder: "Whatever is made in my name must be both first-class and faultless."

The 130-year-old giant's attempts to become more like a tech company reflect a world where value comes increasingly from software, services and data, not things. When software and hardware meet, as they do in the field of autonomous cars or the IoT's world of internet-connected objects, manufacturers risk becoming mere commodity suppliers. Part of Bosch's answer is to position itself as a trusted custodian of data. "Orwell's 1984 is kindergarten compared to the IoT-world. When it comes, and people re-evaluate privacy, Bosch will be prepared," says Peter Schnaebeler, its head of smart homes.

| *Soft power as well as hard*

Bosch is 92%-owned by a foundation, freeing it to invest in long-term innovation. In 2016 it spent nearly a tenth of its revenue of €73bn (\$85bn) on R&D. Recently it opened a glitzy research campus in Renningen. It also has a €420m venture fund and a startup incubator. In a converted warehouse in Ludwigsburg, north of Stuttgart, six teams of former employees work to turn more radical ideas into businesses.

Volkmar Denner, its CEO, says that he still sees Bosch's future as a product company, but one that is heavily involved in software and "middleware" and that provides services on top. It has invested in software; built a platform (on which it runs IoT services and apps and allows other firms to do the same), called Bosch IoT suite; and last year launched its own cloud and data centre. That is unusual; two other industrial giants, General Electric and Siemens, use Amazon's cloud to run their platforms. Bosch says it is seeking greater speed, flexibility and data security. It plans to open several more centres next year.

Bosch's mantra is to increase the value of hardware with a "3S" strategy: sensors, software and services. Over half of its electrical-product classes are web-enabled; by 2020 all should be. Among its more telling bets is a €1bn investment in a semiconductor plant in Dresden for chips and sensors, to act as the "eyes and ears" of the IoT.

The long-term prize will be to use the data to teach things to think—by, for example, training the lawnmowers to respond to unexpected objects. The company last year started an artificial-intelligence (AI) centre, with 100 employees in Bangalore, Palo Alto and Renningen.

Because machines will be only as smart as the data they are fed, Bosch—which already "hosts" over 100,000 terabytes annually (1 terabyte fills 1,428 CD-Roms)—is gathering as much as it can. It crunches data from

some British Gas customers to anticipate energy-maintenance needs, for example; data also pour in from factory floors and farmers' fields filled with sensors. "Today we sell products and practically don't have to care for them again because—being German-made—they'll last," says Christoph Peylo, Bosch's head of AI. But in future products may need updating every two weeks, so "perhaps we'll charge by volume of data, not hardware."

Coup, an electric-scooter sharing scheme in Berlin and Paris (pictured), has no Bosch hardware at all. The company just provides the platform and buys the scooters in from Taiwan. It is Bosch's first direct-to-consumer business in "mobility". This area—loosely, anything that involves getting people from point A to point B—is crucial to Bosch, generating over half its revenue. The firm invests €400m per year in "electro-mobility", or developing parts for electric cars, bikes, charging stations and so on. Some 3,000 developers work on driver-assistance systems. It holds nearly 1,000 patents for automated driving and by 2019 expects to make €2bn from driver assistance (double what it earned in 2016).

| *Sharing economy*

Whether it is cars or the IoT, partnerships have become an efficient way to innovate. It was not always in the company's culture to share with outsiders, says Lothar Baum, a data scientist at the firm. Indeed, Bosch is still seen by many as too conservative, cautious and cost-sensitive. But it is making connections with all sorts of other companies; from a map-building partnership with Apollo, a Chinese platform owned by Baidu, to working with Tesla on autonomous cars, to a deal with Amazon to use Alexa—its voice-controlled computer—to steer Bosch smart-home systems. "Especially in the pre-competitive stage, sharing makes sense," says Mr Baum.

The big unknown is what will happen in the competitive stage. The race among leading IoT platforms is wide open. Eric Lamarre of McKinsey, a

consultancy, divides the field into the horizontal tech platforms, such as Amazon; the more vertical manufacturers, such as Bosch and GE; and startup platforms. This is when questions around data become critical. Bosch thinks that customers will soon value data more than they do today. At the launch of the “Bosch IoT Cloud” Mr Denner noted that many companies and consumers say data-security concerns stop them using cloud technologies and connectivity products, offering its own cloud as an answer.

The firm hopes that manufacturing nous will still count for something, too. Even in a super-connected world “you don’t want to be surrounded by shoddy devices which are cheaply built,” says Mr Peylo. Last month Bosch’s smart security camera won the German Design Award; its white goods are selling like hot cakes in Asia. The company will continue to make non-shoddy products and to put its sensors into factories, homes and cars. It will almost certainly remain a big part of the “T” in IoT. The question is whether it can become far more than that. ■



物联网

干脆利落的博世

保守的德国硬件巨头力图转型成为新型超安全技术平台

博世无处不在。它拥有440家子公司或区域性公司，遍布60个国家，员工达40万人。伦敦塔桥的升起仰赖其技术；从印度到墨西哥，工厂为薯片和饼干包装袋封口时采用的也是博世的技术。分析人士将这家公司称作汽车配件制造商：它制造从喷油泵到雨刷等各种汽车零部件，是该行业的全球老大。消费者对它的了解则来自于白色家电和电动工具——这些产品已成为“德国制造”可靠品质的同义词。

博世本身更愿意被称作“技术及服务供应商”，或者“物联网公司”。在一座俯瞰斯图加特的山丘上，机器人割草机在其总部大楼外快速地奔忙，一面橱窗中展示着洗碗机和搅拌机。楼内种种迹象显示出公司正处于转型期：张贴的海报中，有的号召员工扯下领带，有的赞颂“试错”和“尽管去做”的文化，对面是公司创始人罗伯特·博世（Robert Bosch）的一则语录：“任何以我的名义生产的产品都必须一流且完美无缺。”

这个有着130年历史的巨头试着让自己变得更像一家科技公司，这反映出在如今的世界，价值日益来自软件、服务和数据，而不是物品。一旦软件与硬件交融——就像在自动驾驶汽车领域或物联网世界中所发生的那样，制造商就有可能沦为仅仅是普通日用品的供应商。博世的部分应对方法是将自身定位成值得信赖的数据保管人。公司智能家居部门负责人彼得·施耐伯勒（Peter Schnaebeler）说，“和物联网世界相比，奥威尔的《一九八四》描绘的世界就是个幼儿园。等物联网世界到来，而人们重新评估隐私的重要性时，博世将已有所准备。”

| 有硬实力，也有软实力

博世92%的股权由一家基金会持有，这让它可以放手投资长期的创新项目。2016年，博世从730亿欧元（850亿美元）的收入中抽出近十分之一用于研发。近期它还在雷宁根（Renningen）设立了一个炫目的研究园区。

它还拥有一个规模达4.2亿欧元的风投基金和一个创业公司孵化器。在斯图加特北部的路德维希堡（Ludwigsburg）有一间经改造的仓库，由博世前雇员组成的六个团队在那里将更激进的想法转变为业务。

博世CEO沃尔克马尔·邓纳尔（Volkmar Denner）表示，他仍旧认为未来的博世会是一家产品公司，只不过会深度涉及软件和“中间件”，并提供最优质的服务。博世已投资于软件，还打造了一个叫作“博世物联网套件”的平台，供自己及其他公司运行物联网服务及应用。去年，博世创建了自己的云和数据中心。这个做法不同寻常，毕竟另外两大工业巨头通用电气和西门子都是利用亚马逊的云服务来运行自己的平台。博世称自己正在追求更快的速度、更高的灵活性及数据安全性。公司计划明年再增开几个数据中心。

博世反复提及采用“3S”策略来提升硬件的价值：传感器（sensors）、软件（software）以及服务（services）。公司有超过一半的电子产品门类能联网，到2020年，所有产品门类都应该具备这一功能。有些赌注更能说明问题，比如斥资10亿欧元在德累斯顿成立了一家半导体工厂，生产的芯片和传感器可充当物联网的“眼睛和耳朵”。

长远来看，博世会有一项收获：用搜集来的数据教物品去思考，例如训练割草器对意外出现的物体做出反应。去年，博世设立了一个人工智能（AI）中心，在班加罗尔、帕洛阿尔托（Palo Alto）和雷宁根有100名员工。

机器能达到的智能程度取决于向其输入的数据，因此博世正在全力收集数据——如今其每年“存储”的数据已超过10万Tb（存储1Tb数据需要1428张光盘）。比如，它会分析英国天然气公司（British Gas）部分用户的数据，以此预测对能源维护的需求。安装在工厂车间和农户田地里的传感器也带来了大量数据。博世人工智能部门主管克里斯托弗·佩罗（Christoph Peylo）说，“今天我们只管卖产品，卖出以后几乎不用再操心——毕竟它们是德国制造，非常耐用。”但未来，产品也许每隔两周就要升级一次，因此，“我们也许会按数据量而不是硬件数量收费。”

在柏林和巴黎开展的共享电动踏板车项目Coup（见图）完全没用到博世的硬件。博世所做的仅仅是提供平台和从台湾买来电瓶车。该项目是博世在“出行”领域中首个直接面向消费者的业务。任何涉及将人从一处运送到另一处的活动大致都可称为“出行”。这一领域对博世至关重要，为其带来了超过一半的收入。公司每年向“电动出行”——即为电动汽车和自行车研发零配件、充电站等——投入四亿欧元。约有3000名开发人员从事驾驶辅助系统方面的工作。博世持有将近1000项自动驾驶相关专利，预计到2019年会从驾驶辅助业务中赚得20亿欧元（是2016年所得的两倍）。

| 共享经济

无论是在汽车还是物联网领域，合作都已成为创新的有效手段。博世的一位数据科学家洛塔尔·鲍姆（Lothar Baum）表示，与外部人士共享资源并非是公司贯有的文化。的确，仍有很多人认为博世太过保守和谨慎，对成本也过于敏感。不过博世正与各种各样的公司展开联系：它与中国百度旗下的平台阿波罗达成构建地图的合作协议，与特斯拉共同打造自动驾驶汽车，还与亚马逊达成协议，利用其声控电脑Alexa来控制自己的智能家居系统。“特别是在竞争前的阶段，共享是明智的。”鲍姆说。

至于到了竞争阶段会发生什么，则是个很大的未知数。一流物联网平台间的竞赛胜负难料。咨询公司麦肯锡的埃里克·拉玛尔（Eric Lamarre）将该领域划分为亚马逊等水平的技术平台、博世和通用电气等更偏向垂直的制造商，以及创业公司平台。到了这一阶段，与数据有关的问题变得十分重要。博世认为消费者很快就会比现在更加重视数据。邓纳尔在“博世物联网云”发布时指出，很多公司和消费者表示自己出于对数据安全的担忧而不使用云技术和联网产品。他提出博世的云服务可作为一个可靠的选择。

博世希望自己在产品制造上的智慧仍会有些用处。即使是在一个超级链接的世界里，“你也不想周围都是些粗制滥造的设备。”佩罗说。上个月，博世的智能安防摄像头获得了德国设计奖，其白色家电在亚洲的销路也非常好。这家公司将继续生产高质量的产品，也将不断在工厂、住房和汽车中安装传感器。几乎可以肯定，在物联网的“物”这一方面，博世仍将保有重

要的地位，有待揭晓的是它的成就是否会远远超出这一点。 ■



General Electric

The right mechanic?

GE's newish boss unveils his strategy to revive a struggling American icon

“NUMBER one, cash is king...number two, communicate...number three, buy or bury the competition.” These rules were laid out by Jack Welch, a brash but brilliant former boss of General Electric (GE). The American industrial conglomerate, founded by Thomas Edison, has operations ranging from health care and aviation to lighting and energy. During Mr Welch’s tenure, from 1981 to 2001, his company’s market value rose from about \$15bn to over \$400bn. Today, it barely tops \$150bn. Having fallen by more than two-fifths this year, GE is the worst-performing stock in the Dow Jones Industrial Average, a composite index that has risen by nearly a fifth since January 1st.

Jeffrey Immelt, Mr Welch’s amiable successor, violated all three rules. To be fair, he did steer GE through a sharp downturn in aviation following the September 11th 2001 terrorist attacks and unwound its risky financial arm after the global financial crisis. But on his watch GE’s core power business deteriorated to the point where the firm now cannot generate enough cash to pay its promised dividend (see charts). His reliance on multiple accounting standards and opaque long-term service contracts led financial analysts to complain about a lack of openness.

And rather than buying and burying the competition, Mr Immelt’s expensive and ill-timed acquisitions of big energy companies, which coincided with low oil and gas prices, instead nearly buried GE. The firm spent \$10.1bn to acquire France’s Alstom, which sells power-generation kit, and \$7.4bn to win control of America’s Baker Hughes, an oilfield-services group. Neither is performing as well as hoped.

| *A new narrative*

This is the mess inherited by John Flannery, a hard-nosed GE veteran who took over from Mr Immelt in August. He immediately began to unravel the tale told by his predecessor about GE's good health. On October 20th the firm announced abysmal third-quarter results, which saw profits in its power division decline by half from the same quarter a year earlier. Weak global markets, stiff competition and a challenge from renewables are part of the explanation, but Russell Stokes, the new head of the power division, accepts that GE should have run this business better.

It is "clear from our current results that we need to make some major changes with urgency", declared Mr Flannery. On November 13th, in front of scores of financial analysts and journalists gathered at the Wharton Forum in New York (the number-crunching boss holds an MBA from Wharton Business School), he unveiled his strategy to save GE. The plan has three main components: slash costs, sharpen the culture and shrink to the core.

Take costs first. To his credit, Mr Flannery clearly understands that GE is bloated. Even before this week's announcement, he had vowed to cut an additional \$1bn in annual spending, on top of the \$2bn annual cut Mr Immelt was forced to concede earlier this year. He also let it be known that he was grounding the firm's fleet of jets. (It surfaced recently that Mr Immelt sometimes travelled with two jets, just in case one broke down.)

This week Mr Flannery took the painful decision to cut GE's dividend by half, which will save over \$4bn. Only twice before in its 125-year history has the firm failed to pay its promised dividend. He will also save it money in coming years by borrowing \$6bn at today's low interest rates to prepay the next few years' worth of pension obligations. That will help, but the pension fund he inherited is currently underfunded by a staggering \$31bn.

The second pillar of Mr Flannery's strategy is to transform GE's culture. The

firm has been celebrated for its superior management and capital discipline. But insiders describe a company adrift under Mr Immelt, who often talked in lofty terms about GE's future and invested a lot in innovation but did not always hold people accountable or insist on tough targets. "Jeff was a visionary but he did not dig into the numbers the way John does," says a senior GE executive. Mr Flannery promises to be disciplined and data-driven in his decisions. "Capital allocation is a contact sport, and I expect vigorous debate," he says.

That is promising. So, too, is his vow this week to make GE's books more transparent. "Complexity has hurt us," he acknowledged. The firm has long used multiple non-standard measures for reporting its financial performance, juggling various business assumptions and costs. This has made it harder to understand its true financial picture. For example, it has in the past favoured "industrial cash flow from operating activities" (CFOA), an abstraction that Mr Flannery is ditching in favour of the widely used measure of free cash flow. GE's industrial CFOA is \$7bn; its equivalent free cash flow is only \$3bn.

The biggest cultural change will happen at the top. Mr Flannery plans to realign pay for top executives so that they are rewarded when the firm does better on free cash flow. He is also reforming the board of directors, an unwieldy collection of 18 grandees who failed to ask hard questions even as GE's performance deteriorated. In October he put Ed Garden, chief investment officer of Trian Partners, an activist investment fund, on the board. This week he said the board would be cut to 12 members, and that three new directors with experience relevant to GE would soon replace oldies.

| *Small is beautiful*

So far, so good. The problem arises with the third pillar of the strategy, which involves shrinking the firm. In October Mr Flannery promised to sell

off assets worth \$20bn over the next two years. This week he made it clear that the company's operations in transport (which make locomotives) and industrial lighting are up for sale. In addition, he indicated that the firm was willing to sell its majority stake in Baker Hughes, a separately traded entity born of the merger of GE's oil and gas division and the old Baker Hughes oilfield-services business.

That sounds like a lot, but for a goliath like GE, which had total assets of \$365bn last year, it is underwhelming, and investors are unimpressed. GE's shares fell by 12% in the two days following the plan's unveiling—though it probably didn't help that on November 14th a class-action lawsuit was announced against GE and its officers for allegedly misleading investors about the firm's weakening performance, especially in power.

Analysts had been divided on the firm before this week, but now the bulls are deserting it in droves. One of them, Deane Dray of RBC Capital Markets, wrote that the plan “fell short of the sweeping reset of the business model/ portfolio many had hoped for”. Joe Ritchie of Goldman Sachs, an investment bank, thinks GE should cut not \$3bn in annual costs by 2020, but \$4bn. He points out that the firm has spent \$10bn in restructuring over the past five years, with little to show for it in improved margins. He thinks that GE still has many assets that are earning sub-standard margins, and which could be run more profitably by more focused outsiders.

Scott Davis of Melius Research says it is not clear why a “bigger spin-off” was not part of the plan. He calculates that GE's health-care and aerospace divisions alone are now worth close to today's stockmarket value of the entire company. That suggests GE could release enormous trapped value through a more ambitious, but thoughtfully sequenced, series of spin-offs and divestments.

The intensity of the criticism from analysts might seem unfair. Mr Flannery

has, after all, only just begun to wrestle with the problems he has inherited. His instincts appear to be sound, and his principles of curbing costs, cultural clarity and cutting to the core are surely the right ones. He is being punished for his reluctance to wield the knife more aggressively.

In the end, however, it is worth reflecting on another of Mr Welch's musings: "Change before you have to." Mr Immelt was a thoughtful man, but his failure to deal with emerging threats for years allowed them to come to a head. Mr Flannery is now changing GE because he must. Sensible though his plan is, he may come to regret that he did not make further-reaching changes before he had to. ■



通用电气

对路的机修工？

GE新老板公布新战略，要重振陷于困境的美国标志性企业

“第一，现金为王.....第二，要沟通.....第三，收购或埋葬竞争对手。”定下这些原则的是杰克·韦尔奇（Jack Welch），通用电气（GE）那位盛气凌人但又才华横溢的前老板。这家美国工业集团由托马斯·爱迪生（Thomas Edison）创立，业务范围涵盖医疗、航空、照明和能源等领域。1981年至2001年韦尔奇在位期间，GE的市值从大约150亿美元一路攀升，直至突破4000亿美元。而目前GE的市值勉强超过1500亿美元。今年，GE是道琼斯工业平均指数（该综合指数自今年1月1日以来上涨近五分之一）中表现最差的股票，今年以来股价已下跌超过五分之二。

韦尔奇的继任者、和蔼可亲的杰弗里·伊梅尔特（Jeffrey Immelt）违背了上述全部三条原则。说句公道话，他确实带领GE度过了2001年911恐怖袭击后航空业务急转直下的难关，还在全球金融危机爆发后削减了旗下高风险的金融业务。但在其任内，GE核心的电力业务严重下滑，已经到了无法产生足够现金以支付承诺股息的地步（见图表）。伊梅尔特坚持采用多种会计准则及不透明的长期服务合同，被金融分析师们指摘缺乏公开性。

另外，伊梅尔特也没做到收购并埋葬竞争对手，反倒是在石油和天然气价格低迷之际不合时宜地高价收购了大型能源企业，几乎埋葬了GE自己的前程。当时GE花费101亿美元收购了销售发电机组的法国公司阿尔斯通（Alstom），又以74亿美元购得美国油田服务集团贝克休斯（Baker Hughes）的控制权。但两者目前表现都不如预期。

| 新腔调

这就是约翰·弗兰纳里（John Flannery）面对的烂摊子。今年8月，这位作风强硬的GE老将接替伊梅尔特，成为新任首席执行官。上任后，他立即揭穿了前任对公司健康状况的粉饰。10月20日，GE公布了第三季度低迷至极的业绩，显示电力业务的利润比去年同期下降了一半。全球市场疲弱，

竞争激烈，加上可再生能源带来的挑战，这些都在一定程度上影响了GE的业绩，但其发电集团新任总裁罗素·斯托克斯（Russell Stokes）承认，这一部分业务本可以做得更好。

弗兰纳里宣称，“从目前的结果来看，我们迫切需要做出一些重大改变”。11月13日，在纽约举行的沃顿论坛（Wharton Forum）上，这位拥有沃顿商学院MBA学位、擅长数字的新老板向一众金融分析师及记者公开了自己拯救GE的战略。该计划有三个主要组成部分：削减成本、明确公司文化、向核心业务收缩。

先看成本问题。弗兰纳里对GE的臃肿心知肚明，这一点值得称赞。甚至在本月宣布上述战略之前，他已立下誓言，除了今年早前伊梅尔特被迫接受每年要削减的20亿美元之外，还将另外减少10亿美元的年度开支。他还表明将停飞公司的公务飞机。（最近爆出消息称，伊梅尔特以往乘坐公司飞机出行时，为防出现故障，有时还要一架备用飞机随行。）

本月，弗兰纳里痛下决定，要将GE的股息减半，这将节省超过40亿美元。在GE125年的历史中，没兑现承诺股息的情况之前仅发生过两次。另外，他将当前的低利率借款60亿美元用以支付未来几年的员工养老金，籍此为未来节省开支。这有助于缓解问题，但他接手的养老金资金缺口惊人，高达310亿美元。

弗兰纳里的战略中第二个支柱是改造GE的企业文化。该公司一直以卓越的管理和资本纪律闻名。但内部人士指出，在伊梅尔特的领导下，GE偏离了这些价值。他经常用宏大的字眼谈论公司的未来，并在创新方面投入大量资金，但却没能充分实施问责机制或坚持硬性目标。“杰夫是个有远见的人，但他没能像约翰那样深入研究数字。”GE一位高级主管说道。弗兰纳里承诺会严守纪律、基于数据做出决策。“资本配置是一场贴身肉搏。我料想会产生激烈的讨论。”弗兰纳里说。

这是不错的做法。而本月他发誓要让GE的账目变得更透明，也是大有希望的改革。“过于复杂已对我们造成损害。”他承认。长期以来GE采用多种非

标准化指标报告财务业绩，业务假设和成本计算五花八门，让人难以了解其真实的财务状况。例如，GE曾乐于采用“工业经营活动现金流”（CFOA）来衡量业绩，现在弗兰纳里摒弃这一方式，转而采取业界广泛采用的“自由现金流”指标。GE的工业经营活动现金流为70亿美元，但对应的自由现金流仅为30亿美元。

文化上的最大转变将发生在公司高层。弗兰纳里计划调整顶层高管的薪酬机制，如果公司的自由现金流水平有所提高，他们就能得到回报。同时他也在改革董事会。这个由18位大人物组成的臃肿机构在GE业绩恶化时并没有提出有力的质疑。上月，弗兰纳里邀请维权投资基金特里安基金公司（Triun Partners）的首席投资官爱德华·加顿（Ed Garden）加入GE董事会。本月，弗兰纳里表示董事会成员将减至12人，而且即将有三位拥有GE相关经验的新董事取代旧成员。

| 小之美

说到这里一切都还好。问题在于战略中的第三个支柱，其中涉及公司业务的收缩。上月，弗兰纳里承诺在未来两年内出售价值200亿美元的资产。本月，他表明公司已准备好出售运输（机车制造）和工业照明业务。此外他还表示，GE愿意出售所持有的贝克休斯（Baker Hughes）的多数股权，贝克休斯是GE旗下油气业务与贝克休斯油田服务公司合并后形成的独立交易实体。

听起来似乎收缩了许多，但对于GE这样的巨头（去年总资产达3650亿美元）来说，这些举措影响不大，投资者也不为所动。在计划宣布后两天内，GE的股价下跌了12%。不过，11月14日传出消息，GE及其高层因涉嫌隐瞒公司业绩下滑（尤其是在电力业务上）、误导投资者而被提出集体诉讼，这可能也是影响其股价的一个不利因素。

本月以前，分析师们对于GE的看法还有分歧，但原本看好之人如今纷纷改变看法。加拿大皇家银行资本市场（RBC Capital Markets）的迪恩·德雷（Deane Dray）便是其中之一。他写道，该计划“没能像许多人期望的那样，彻底改变商业模式或大规模重组资产”。投资银行高盛的乔·里奇

(Joe Ritchie)认为，到2020年，GE每年削减的成本不应该只有30亿美元，而是要达到40亿美元。他指出，过去五年，GE在重组过程中已花费100亿美元，但对提高利润收效甚微。他认为，GE仍持有许多收益低下的资产，如果交给业务更为专注的外部机构来经营，盈利也许会更高。

研究公司Melius Research的斯科特·戴维斯 (Scott Davis) 表示，目前还不清楚为什么“更大规模的拆分”不是计划的一部分。据他计算，GE的医疗和航空航天业务现在的价值已接近整个公司当前的市值，这意味着GE有可能通过更庞大但精心铺排的一系列拆分和剥离来释放出巨大的被套牢的价值。

分析师们的炮轰看似不太公平。弗兰纳里毕竟只是刚刚着手解决前任留下的问题。他似乎有着敏锐的直觉，其提出的原则——控制成本、明确企业文化以及只保留核心业务——肯定是正确的，受到指责只是因为他不愿下手更狠。

然而，最终值得思考的是韦尔奇的另一句名言：“在不得不改变之前就先改变。”伊梅尔特是个思虑周全的人，但多年来他未能及早应对新威胁，导致问题恶化。弗兰纳里目前对GE的改革是不得不为之。虽然他的计划合理，但日后他也可能会后悔自己没有在被逼至绝境前做出一些更深远的改革。■



Economic and financial indicators

Doing business

Ease of doing business ranking

The World Bank calculates that in the 12 months to June 2017, 119 countries implemented at least one positive reform to make it easier for entrepreneurs to do business. In all, 264 regulatory reforms were carried out. The greatest number of reforms were designed to help people start a business and get credit. Asian countries have been particularly busy: Brunei, India and Thailand each implemented eight reforms. Among other things, Brunei and Thailand both strengthened the rights of borrowers and creditors by introducing new secured-transaction laws; India reduced border-compliance costs. Rwanda has implemented the most business-friendly reforms over the past 15 years: 52 in all. ■



经济与金融指标

营商环境

营商便利度排名

世界银行估算，截至2017年6月的12个月里，有119个国家为提高营商便利度实施了至少一项积极的改革。这一期间实施的监管改革共计264项，其中旨在帮助人们开办企业和获得贷款的改革数量最多。亚洲国家尤为忙碌：文莱、印度和泰国各自开展了八项改革。除其他一些改革外，文莱和泰国还推出了新的担保交易法，以巩固借款者及贷款方的权利。印度降低了边境合规的费用。卢旺达在过去15年中实施的有利于商业的改革数量最多，总共有52项。■



Free Exchange

The big squeeze

One hundred years after the Russian revolution, what remains of its economic ideas?

IN 1955 Jawaharlal Nehru, the prime minister of India, embarked on a 16-day tour of the Soviet Union. He was like a “kid in a candy store”, according to one editor of his letters. Besides the Bolshoi ballet and the embalmed corpse of Stalin, he visited a Stalingrad tractor works, a machinery-maker in Yekaterinburg and an iron-and-steel plant in Magnitogorsk. In a letter, he wondered if the Soviet Union’s economic approach, “shorn of violence and coercion”, could help the world achieve peace and prosperity.

The answer, of course, was “no”. But Nehru concluded otherwise, incorporating Soviet ideas into India’s five-year plans and welcoming Soviet aid, equipment and expertise. In the year of his visit, the Russians set up a steel factory in what is now the Indian state of Chhattisgarh. It became India’s main supplier of rails.

Nehru was not alone. The Soviet model impressed many leaders in the poorer parts of the world. Even today, according to Charles Robertson of Renaissance Capital, an investment bank, “more than a few suggest that a Stalin might be needed to kick-start industrialisation” in poor countries. The Soviet approach rested on a variety of arguments, notes Robert Allen of Oxford University, such as the need for a big push in industry, the abundance of rural labour and the superiority of collective farming.

The Soviets believed that industrialisation would succeed *en masse* or not at all. Those steel plants, tractor factories and machinery-makers needed to operate on a big enough scale to justify the heavy upfront cost of building them. And the success of any one industrial venture depended on

complementary investments in others. Upstream suppliers need downstream buyers and vice versa. Yevgeni Preobrazhensky, a Bolshevik economist, argued that a broad advance was needed across the whole industrial front, not an “unco-ordinated advance by the method of capitalist guerrilla warfare”.

The workers for this industrial advance could be found in abundance on the farms, the Soviets believed. Agriculture was so overmanned it could lose millions of field-hands without much damage to the harvest. That was just as well, because the remaining peasantry would have to feed the factory workers as well as themselves. One way or another, resources would have to be transferred from the countryside to the cities. By organising the peasantry into collective farms, the Soviets hoped to make them more productive—and easier to “tax”. A collective farm was, they believed, easier to collect from.

The Soviet approach succeeded in industrialising the economy. Between 1928 and 1940 its manufacturing output grew by over 170% (see left-hand chart), even as the rest of the world wallowed in the Depression. By the second world war, it was well on its way to becoming the industrial candy-store so admired by Nehru. This brute industrial expansion did not, however, validate the theories underlying the Soviet approach. To increase manufacturing output by 170%, the Bolsheviks had to increase inputs by even greater percentages: the non-agricultural workforce had to grow by almost 190% and the amount of capital in that sector by a phenomenal 336%, according to figures reported by Anton Cheremukhin of the Federal Reserve Bank of Dallas and co-authors. The Soviets, in other words, could move resources into the factories, but they could not maintain the efficiency with which they were used.

More importantly, the peasantry did not surrender “surplus” workers and grain without immense economic damage, bitter resistance and

widespread suffering. Stalin expropriated, expelled or exterminated many of the most prosperous and sophisticated farmers (the “kulaks”), requisitioned grain at low prices and tried to nationalise draught-animals. In response, aggrieved farmers simply slaughtered their horses and oxen or stopped feeding them. These efforts to extract resources from agriculture by force were a disastrous blunder as well as a crime. At its worst, agricultural output declined by over a quarter compared with 1928, leaving the planners with less to redistribute to the urban workforce.

| *Growth without grotesquery*

Could this violence and coercion be shorn from the Soviet approach as Nehru hoped? Mr Allen believes so: “The collectivisation of agriculture was not necessary for rapid growth,” he argues. Even Stalin eventually had to relent, requisitioning less grain, legalising private agricultural markets and permitting individual ownership of small plots of land.

Indeed, some economists believe that the broad outlines of the Soviet approach, minus the atrocities and the autarky, bear some resemblance to East Asia’s economic model. Paul Krugman, an American economist, made that comparison in 1994, arguing that the growth of the Asian tigers resulted from rapid accumulation of various kinds of capital, and not from the more efficient use of these resources. More recently, he has also argued that China’s high investment can be sustained only by the flow of surplus workers from overmanned farms. Now that China is “running out of peasants”, he warns, investment may collapse.

Mr Cheremukhin and his co-authors are more optimistic. Examining both China and the Soviet Union within the same analytical framework, they find notable differences. Most of China’s growth from 1978 to 2012 was because of increases in non-agricultural productivity, they find. And the migration of labour from field to factory was less important than the migration of resources from state-owned enterprises to private firms.

China may have exhausted its surplus peasantry, but the scope for reforming and retrenching its state-owned enterprises remains vast. The same is true of India. The Chhattisgarh steel plant set up with Russian help in 1955 is, for example, still going—part of India's giant, publicly owned Steel Authority of India. But it is not a great advertisement for the Soviet approach. It has failed to meet Indian Railways' requirement for new track. And its parent has lost money for nine quarters in a row. ■



自由交流

大压榨

俄国革命百年后，其经济思想还剩什么？

一九五五年，印度总理贾瓦哈拉尔·尼赫鲁（Jawaharlal Nehru）对苏联进行了为期16天的访问。整理其信件的一位编辑称，尼赫鲁当时如同“走进糖果店的小孩”一样欣喜。除了观看莫斯科芭蕾舞团表演，瞻仰经防腐处理的斯大林遗体，他还参观了斯大林格勒的一家拖拉机厂、叶卡捷琳堡的一家机械制造厂，以及马格尼托哥尔斯克的一家钢铁厂。尼赫鲁在一封信中思索到：如果“排除暴力和胁迫”，苏联的经济手段能否帮助世界实现和平与繁荣？

答案当然是“不能”。但尼赫鲁得出了相反的结论，他把苏联的思想融入印度的五年计划中，并欣然接受苏联的援助、设备及专业技术。在他访苏那一年，俄国人在如今的印度恰蒂斯加尔邦（Chhattisgarh）援建了一家钢铁厂，成了印度主要的铁轨供应商。

有如此想法的不止尼赫鲁一人。苏联模式打动了許多世界较贫困地区领导人。俄罗斯投行晋新资本（Renaissance Capital）的查尔斯·罗伯森（Charles Robertson）表示，即便是在今天，在贫穷国家还有“不少人认为可能需要一位斯大林式的人物来推动工业化进程”。牛津大学的罗伯特·艾伦（Robert Allen）指出，苏联模式有多种理据支撑，例如工业发展需要大力推动、农村劳动力充沛及集体农业的优势。

苏联认为工业化要全面开展才能成功，否则就会失败。那些钢铁厂、拖拉机厂、机械制造厂需以足够大的规模运作，才能使得建造这些工厂的昂贵前期成本合理化。而且，任何一家工业企业的成功都取决于对其他工业企业的互补性投资。上游供应商需要下游买家，反之亦然。苏共经济学家叶夫根尼·普列奥布拉任斯基（Yevgeni Preobrazhensky）认为，整个工业战线需要全面推进，而不是“资本主义游击战式的不协调进展”。

苏联相信，推动工业发展所需的工人可以从丰富的农业劳动力中得来。农业人口严重过剩，少几百万人耕种也不会对收成造成多少损害。而且农业产出也不会减少，毕竟剩下来的农民不仅要为自己还要给工厂工人提供口粮。不管怎样，资源需从农村转移到城市。苏联组织农民成立集体农庄，希望他们变得更高效，并更易“征税”。他们认为对集体农庄征税会更容易。

苏联的模式成功实现了工业化。1928年到1940年间，世界其他地区陷入大萧条，苏联的制造业产值却增长超过170%（见左图）。到第二次世界大战前，苏联正稳步成为尼赫鲁无比羡慕的工业“糖果店”。然而，这种粗暴的工业扩张并不能验证苏联模式背后的理论。达拉斯联邦储备银行的安东·切列穆什金（Anton Cheremukhin）及其报告的合著者提供的数据显示，制造业产值要增长170%，苏共政府就要以更大的比例增加投入：非农业劳动力必须增加近190%，而对工业的资本投入须增加惊人的336%。换句话说，苏联可以把资源转投工厂，但无法保持其原本的使用效率。

更重要的是，政府让农民交出“多余”的劳动力和粮食，结果给他们带来了巨大的经济损失和普遍的苦难，也引发了激烈的抗争。斯大林征用、驱逐、诛杀了许多最富裕能干的农民（即“富农”），以低廉的价格征收粮食，并试图把耕畜国有化。结果，愤愤不平的农民干脆把自己的牛马杀掉，或者不再喂养牲口。如此强行从农业抽取资源既是一种犯罪，也是灾难性的失误。最糟时，农业产值比1928年下降了超过四分之一，导致政府能重新调配给城市劳动力的资源减少。

| 非扭曲性增长

这种暴力和胁迫能否如尼赫鲁所愿，从苏联模式中除去？艾伦认为可以，他说：“农业集体化并不是快速增长所必需的。”斯大林最终也不得不让步，减少征收粮食，给予私营农业市场合法地位，并允许个人拥有小块土地。

事实上，一些经济学家认为，除去暴行和封闭性，苏联模式的总体框架与东亚的经济模式有几分相似。美国经济学家保罗·克鲁格曼（Paul

Krugman)就在1994年做了这样的比较。他指出，亚洲四小龙的崛起源于各种资本的迅速积累，而非这些资源的更有效利用。近些年，他又指出，中国的高投入只能通过转移农村过剩劳动力来维持。他警告说，如今在中国“农民变得紧缺”，投入可能崩溃。

切列穆什金及其报告合著者则较为乐观。在同样的分析框架下审视中国和苏联的情况后，他们发现两者存在显著的差异。从1978年到2012年，中国大部分经济增长来自非农业生产率的提高，而资源从国有企业向私营企业的转移，要比劳动力从农业转移到工业更重要。

中国也许已经耗尽了过剩的农村劳动力，但国有企业改革及精简的空间依然广阔。印度也一样。例如，1955年在俄方援助下建立的恰蒂斯加尔钢铁厂一直运作至今，从属于印度国营巨头印度钢铁管理局（Steel Authority of India），但它可不是苏联模式的典范。它没能达到印度铁路公司（Indian Railways）对新轨道的要求，而其母公司已经连续亏损了九个季度。■



American Express

Shuffle and deal

Competition in the credit-card business will only intensify

HE IS leaving with the share price rising and the announcement, on October 18th, of earnings that were largely well received. Better still, Kenneth Chenault, American Express's chief executive for 16 years, accomplished a feat rare in the upper reaches of American finance: to stand down without an obvious helping shove. No grandstanding senators hounded him out (see Wells Fargo). No boardroom coup hastened the end (Citigroup). The financial crisis left him untouched (take your pick). His successor, Stephen Squeri, promoted from within and apparently groomed for the job, takes over in February.

For all that, Mr Chenault's long tenure has not been an unequivocal triumph. Though generating strong returns on assets and equity, American Express has continued its slide within the fast-changing and competitive payments industry. According to Nilson, an industry bible, in 1974 the amount of money for purchases channelled through American Express was equivalent to 50% of what went through MasterCard and 70% of what went through Visa. By 2016, those ratios had shrunk to 30% and 14%.

American Express has grown nonetheless, as credit-card usage has surged. But the best days may be over. Its share price, revenues and profits all peaked in 2014. Buried in the details of its latest earnings release are hints that raise questions about how strong its numbers are, and suggestions that its strategy—which increasingly relies on lending to replace diminishing transaction fees—may be heading into more turbulent conditions.

| *Cutting the cards*

Competitive pressure looms on all sides. MasterCard's market

capitalisation is twice that of American Express; Visa's, three times as big. PayPal, spun off from eBay in 2015 and run by a former American Express executive, has a tiny fraction of Amex's revenues and profits but on the eve of the earnings announcement passed it in market value (see chart). Its sales and profits have grown much faster, and it was born online.

Rather than a card, PayPal provides a payments platform for individuals, on smartphones or computers, using accounts at their bank or tied to American Express, Visa or MasterCard. In the process it collects a fee. It also offers systems such as Venmo (intended for payments between individuals but sometimes used by small businesses, too), Braintree, a financial link used by Uber and Airbnb, and Xoom, a remittance service.

Competition abroad is just as keen. American Express entered Asia early and once had an enviable position there, but its presence has faded. In 2007 it sold (to Standard Chartered) a private bank created almost a century ago that had languished from inattention. Japan's JCB has issued almost as many cards (but still accounts for far less in transactions). China's UnionPay boasts the world's biggest transaction volume, eight times that of American Express, and 55% of cards issued globally.

These conventional competitors may matter less than electronic networks such as Alibaba's Alipay and Tencent's Tenpay and a profusion of still little-known startups. The entire mechanics of payments are being rethought, with cards being replaced by QR codes, biometrics and more.

In this noisy hothouse, Mr Chenault deserves respect for keeping American Express healthy. It has supported its market share through deals with banks and other financial institutions that can now issue American Express cards (and generate fees by transacting through Amex's systems). In the past decade the number of businesses accepting its cards has doubled. But these victories have come at a cost. Twenty-five years ago American Express

collected a 3.2% fee on every transaction, according to Sanford Bernstein, an investment research firm. Now, it makes less than 1.8%. Competitive pressure will squeeze this further.

In the past, merchants were willing to pay for American Express transactions because its cardholders were well-off and willing to spend. But now large banks are going after these customers. JPMorgan Chase and Citigroup, both with card businesses headed by ex-Amexers, have issued cards that provide benefits broadly regarded as better than those from American Express. Soon Bank of America will follow. Banks have also taken aim at lucrative co-branding deals carrying exclusive rewards for customers. In 2015 American Express lost one such deal with Costco, a large retailer that accounted for 10% of its transaction volume, to Citigroup. Another, with JetBlue, an airline, went to Barclays.

To rely less on revenue from transaction fees, American Express has become more banklike, lending more. Net interest income made up 18% of revenues in 2012 and should bring in 28% in 2018, predicts Nomura/Instinet, a brokerage. That has looked good lately, because funds have been cheap and credit quality high, but the environment may be changing. Citigroup and JPMorgan Chase, among others, began expanding their consumer-loan portfolios in 2015. Now quality may be worsening. In the two most recent quarters, analysts were surprised by the size of American Express's provisions for credit losses. Other banks also increased provisions.

Credit is cyclical and it would be a surprise if this time were different. A new concern is electronic fraud, notwithstanding companies' efforts to thwart it. Still, the business that American Express joined 60 years ago will continue to grow, and American Express may well be a beneficiary. But others may be better placed. Mr Chenault's tenure may thus be remembered merely as a pause before the end of an era. ■



美国运通

洗牌重来

信用卡业务的竞争只会愈演愈烈

肯尼斯·切诺尔特（Kenneth Chenault）担任美国运通CEO长达16年。在他即将卸任之际，公司股价上涨，10月18日公布的收益情况大体受到好评。更难得的是，他在美国金融业高管中取得了一个罕见的成就：卸任之时不用别人半推半送。没有哗众取宠的参议员赶他下台（对比富国银行CEO），没有董事会发动政变加速他引退（参见花旗集团总裁），金融危机中他岿然不动（无人出其右）。他的继任者斯蒂芬·萨克里（Stephen Squeri）由内部晋升，显然是专为继任而培养的，他将于明年2月份接掌公司。

尽管有这样的成就，但切诺尔特在运通的漫长任期仍算不上彻头彻尾的胜利。美国运通虽然取得了强劲资产和股本回报，但仍在快速变化和竞争激烈的支付行业中持续下滑。支付行业权威刊物《尼尔森报告》（Nilson）显示，1974年，通过美国运通完成的交易额相当于万事达的50%和Visa的70%，到2016年，这两个数字分别下降到30%和14%。

不过随着信用卡使用的激增，美国运通还是有所增长。但好日子可能已经到头了，其股价、收入和利润都在2014年达到顶峰。从最新公布的盈利报告细节中能看出一些问题的端倪，让人质疑其盈利数字所体现的公司实力，也显示其战略——越来越依赖发放贷款以弥补交易费用下滑——这可能会将公司带入更动荡的局面。

| 重新洗牌

来自各方的竞争压力都在逼近。万事达卡的市值是美国运通的两倍，Visa是运通的三倍。PayPal在2015年从eBay拆分出来，由美国运通一位前任高管管理，收入和利润只有美国运通的一小部分，但市值却在收益公告发布前夕超过了运通（见图表）。PayPal的销售和利润的增长都快得多，而且是一家纯网络公司。

PayPal不发行信用卡，而是通过银行账户或与美国运通、Visa或万事达绑定的账户，在智能手机或电脑上为个人提供支付平台，并收取费用。它还提供Venmo（用于个人用户之间的支付，但小企业用有时也会使用）、优步和爱彼迎所使用的支付链接Braintree、以及汇款服务Xoom这类系统。

海外竞争也同样激烈。美国运通较早进入亚洲市场，一度取得了令人羡慕的市场地位，但其影响力已逐渐丧失。2007年，它向渣打银行出售了一家私人银行，此银行成立已近百年，但市场认知度低，已失去活力。日本JCB的发卡数和美国运通相近（但交易笔数仍少得多）。中国银联的交易量为全球最高，是美国运通的八倍，发卡量占全球的55%。

相比阿里巴巴的支付宝和腾讯的财付通等电子网络，以及大量目前还鲜为人知的创业公司，这些传统竞争对手可能还不是主要威胁。随着银行卡被二维码、生物识别技术等逐渐取代，整个支付机制都要重新设计。

在这个竞争日益激烈的环境中，切诺尔特令美国运通保持了良好的运作，值得尊敬。美国运通与银行和其他金融机构达成协议，以此支持自身的市场份额，这些机构现在都可以发行美国运通卡，进而通过美国运通系统进行交易来产生费用。过去十年来，接受美国运通信用卡的商家数量翻了一番。但这些成绩是有代价的。投资研究公司盛博（Sanford Bernstein）的数据显示，25年前美国运通对每笔交易收取3.2%的手续费，而现在已经不到1.8%。竞争压力还将进一步挤压这项收入。

过去，商家愿意为运通卡交易付费，因为运通卡的持卡人都很富裕，且不吝花钱。但现在大银行都在追逐这类客户。摩根大通（JPMorgan Chase）和花旗集团（Citigroup）都有信用卡业务，而且都由前运通人士负责运营，用户广泛认为它们的信用卡提供的好处比运通更多。美国银行（Bank of America）很快也将加入战局。银行还瞄准了利润丰厚、能为客户提供独家奖励的联名卡业务。2015年，占美国运通交易额10%的大型零售商Costco终止了与运通的联名合作，转投花旗银行。另一项与捷蓝航空公司（JetBlue）的合作被巴克莱银行抢走。

为了减少对交易手续费收入的依赖，美国运通增加了贷款业务，越来越像一家银行。经纪公司野村极讯（Nomura/Instinet）预测，2012年，美国运通的利息净收入占总收入的18%，2018年将达到28%。由于资金成本低，信贷质量高，这一业务近期看来不错，但环境可能正在改变。2015年，花旗集团、摩根大通等银行开始扩大消费贷款组合。如今，借贷业务质量可能正在恶化。最近两个季度，分析师对美国运通信贷损失拨备的规模感到惊讶。其他银行也增加了准备金。

信贷具有周期性，这次应该也不会例外。新近让人担忧的是电子欺诈，尽管各家公司都在努力遏制这个问题。不论如何，美国运通在60年前开始的信用卡业务仍将继续增长，公司很可能会继续受益。不过其他公司可能处于更有利的位置。因此，今后人们回想起来，可能只会认为切诺尔特的任期不过是一个时代结束前的一次暂停。■



Schumpeter

Apple Capital LLC

Hey Siri. Should the world's biggest firm shrink its finance arm before it goes bananas?

IT IS fashionable to say that tech firms will conquer the financial services industry. Yet in the case of Apple, it seems that the opposite is happening and finance is taking over tech by stealth. Since the death of Steve Jobs, its co-founder, in 2011, the world's biggest firm by market value has sold hundreds of millions of phones with bionic chips and know-it-all digital assistants. But it has also grown a financial operation that is already, on some measures, roughly half the size of Goldman Sachs.

Apple does not organise its financial activities into one subsidiary, but Schumpeter has lumped them together. The result—call it “Apple Capital”—has \$262bn of assets, \$108bn of debt, and has traded \$1.6trn of securities since 2011. It appears to be run fairly cautiously and is part of a thriving firm, but it still deserves scrutiny. Companies have a history of being hurt by their financial arms; think General Electric (GE) or General Motors (GM).

Apple Capital has lots of responsibilities but three stand out. It invests the firm's mountain of surplus profits, mainly in “highly rated” instruments (this task seems to fall to Braeburn Capital, a subsidiary in Nevada, which uses some external fund managers). Apple Capital also uses derivatives in order to protect the firm against currency and interest-rate gyrations. And it manages America's fifth-biggest corporate-debt pile by issuing Apple bonds as part of an elaborate strategy to limit tax bills.

Apple Capital has become important to its parent. Since Jobs died, its assets have risen by 221%, twice as fast as the company's sales, reflecting Apple's huge build-up of profits. Its investments are worth 32% of Apple's market

value, and its profits (investment income, plus gains on derivatives, less interest costs) have been 7% of Apple's pre-tax profits so far this year. It is also sizeable compared with other financial firms. Consider four measures: assets, debt, credit exposure and profits. Depending on the yardstick, Apple Capital is 30-85% as big as Goldman Sachs. It is 22-42% as large as GE Capital was at its peak in 2007, just before things went down the tubes during the subprime crisis.

Apple Capital is different from these firms in important ways. It does not take deposits and has much lower leverage. In their prime Goldman and GE Capital were run by hard-charging financiers, and made lots of loans. By contrast, Apple Capital does not make loans, and is not meant to be a profit centre in its own right. Nonetheless, it has become riskier, in three ways.

First, Apple Capital is investing in racier assets, which involves taking credit risk. In 2011 a majority of its assets were "risk-free": cash or government bonds. Today 68% are invested in other kinds of securities, mainly corporate bonds, which Apple says are generally investment grade. The shift may explain why Apple's annual interest rate earned on its portfolio (2%) is now higher than that of the four other Silicon Valley firms with money mountains, Microsoft, Alphabet, Cisco and Oracle. In total, they still have 66% of their portfolios squirrelled away in risk-free assets.

Second, Apple's derivatives book has got much bigger. Since 2011 its notional size—the face value of its contracts—has risen by 425%, to \$124bn. This is still much smaller than big banks' positions, but is the third-largest book of any non-financial firm in America, after GE and Ford. For every dollar of foreign sales, Apple has 89 cents of derivatives, compared with 57 cents for the other four tech giants. At points these derivatives have yielded big rewards. In 2015 they contributed \$4bn, or 6% of Apple's profits. But they have dangers, too. Apple says that its "value-at-risk" (VAR), a statistical measure of the maximum likely loss in an average day, is \$434m. That is

huge: similar to the combined VAR of the world's top ten investment banks. In theory losses on derivatives would be offset by gains in the value of Apple's underlying business. But the sheer size of these positions gives pause for thought.

The last area of higher risk is Apple's divided geography. Its foreign operation swims in cash while its domestic one drowns in debt. Profits made abroad are kept in foreign subsidiaries. That way Apple does not pay the 35% levy America charges when earnings are repatriated. Some 94% of Apple Capital's assets are "offshore" and cannot be tapped for ordinary purposes. The domestic business must do the hard work of paying for dividends and buy-backs. Its profits are not big enough to cover these, so it borrows. Domestic net debts have risen to \$92bn, or five times domestic gross operating profits. Each year Apple must issue \$30bn of bonds (including refinancing), similar to the average of Wall Street's five largest firms.

Apple's core business is so profitable that it is—almost—inconceivable that a blow-up at Apple Capital could lead to it needing taxpayer or central-bank support, as was the case for GM and GE. Still, it is easy to imagine how Apple Capital could hurt its parent. A market shock could lead to losses on its portfolios. A two-percentage-point rise in interest rates would result in a loss of \$10bn. If bond markets dried up, Apple might struggle to issue so much debt and have to bring home funds, incurring a big tax bill. It might also become tricky to run such a big derivatives portfolio.

| *Don't upset the Apple cart*

Apple Capital has grown in a forgiving period for financial markets. That won't last. Over time, the risk of mission creep will rise, as will the temptation to invest in riskier assets. On the current trajectory, by 2022 its assets will reach \$400bn and debts \$250bn. By then financial regulators, who do not supervise Apple, will be grinding their teeth at night.

According to a former manager who left in 2012, Apple's financial gurus were careful because "nobody wanted that 3am call from Steve Jobs". But Jobs isn't there any more. In any case, a fear of rebuke is not enough. If the tax laws change Tim Cook, Apple's boss should wind down the structure that the firm has created. But even if the rules don't Apple Capital should be shrunk. Tech firms should seek to disrupt finance, not be seduced by it. ■



熊彼特

苹果资本有限责任公司

嘿，Siri。全球最大的公司应该在其金融部门失控前为它“瘦身”吗？

眼下时兴的说法是科技公司将夺取金融服务业的江山。然而在苹果公司，情形似乎正好相反——金融业务正悄然取代科技业务。自从2011年苹果联合创始人史蒂夫·乔布斯去世后，这家以市值衡量为全球最大的公司已售出数亿台搭载了仿生芯片和“万事通”数字助手的手机。除此之外，它还发展了金融业务，以某些标准衡量，这项业务已经差不多抵得上半个高盛。

苹果并没有将自己的金融活动放入一家子公司里，但本专栏将它们归并在一起，得到的结果是：这些业务（姑且称之为“苹果资本”）拥有2620亿美元的资产、1080亿美元的债务，并且自2011年起交易了1.6万亿美元的证券。虽然看上去它的经营相当谨慎，又隶属于一家生意兴隆的公司，但还是应对其加以仔细的审视，因为不乏企业受累于其金融部门的先例，比如通用电气或者通用汽车。

苹果资本职责众多，其中突出者有三。首先，它负责将公司巨额的剩余利润进行投资，主要是在“高评级”的金融工具上。这项任务似乎落在了苹果位于内华达州、雇用了一些外部基金经理的子公司Braeburn Capital的肩上。其次，苹果资本利用金融衍生品使公司免受货币及利率波动的影响。其三，作为苹果公司苦心设计的避税策略的一部分，它通过发行苹果债券，管理着美国第五大的公司债券。

苹果资本对其母公司来说已是举足轻重。自乔布斯去世后，苹果资本的资产已增长221%，增速是公司销售额的两倍，这反映出苹果累积的巨额利润。苹果资本的投资额相当于苹果市值的32%，今年截至目前，它的利润（投资收入加上衍生品收益，再减去利息成本）是苹果税前利润的7%。与其他金融公司相比，它的规模也相当可观。如果以资产、债务、信用风险以及利润等四个标准分别考量，苹果资本的规模相当于高盛的30%到85%，GE金融（GE Capital）在2007年鼎盛时（也就是次贷危机爆发、形

势急转直下之前)的22%到42%。

苹果资本在一些重要的方面与这两家公司不同。它不吸收存款而且杠杆率低得多。而高盛和GE金融在鼎盛期是由干劲十足的金融家管理，发放了很多贷款。相比之下，苹果资本没有放贷，也没有被设计为一个独立的利润中心。尽管如此，它的风险还是在加大，具体表现在以下三个方面。

首先，苹果资本现在投资的是更富活力的资产，这涉及信贷风险。2011年，它的主要资产还是“无风险的”现金或者政府债券。而现在，68%的投资是以企业债券为主的其他证券，苹果认为这些债券总体属于投资级。这种转变也许可以解释为什么苹果投资组合上的年收益率(2%)目前高于微软、Alphabet、思科以及甲骨文这四家同样家财万贯的硅谷公司。这四家公司总计仍有66%的投资组合被稳妥安置在无风险资产上。

其次，苹果的金融衍生品规模增长了很多。从2011年起，它的票面规模，即合约的票面价值已经增长了425%，达到1240亿美元。虽然这与大银行的头寸相比仍然相差甚远，但却在美国所有非金融公司中排名第三，仅次于GE和福特。苹果在国外每销售一美元，就有89美分的金融衍生品，而其他四家科技巨头是57美分。这些衍生品一度带来了丰厚回报。2015年它们为苹果贡献了40亿美元，占其利润的6%。但它们也存在诸多风险。苹果称自己的“风险价值”(VAR，一种统计指标，衡量正常一天内的最大可能损失)是4.34亿美元。这是个巨大的数字，相当于全世界十大投资银行的VAR总和。理论上说，衍生品上的损失会被苹果基础业务的收入抵消，但是其衍生品的庞大规模还是值得反思。

导致高风险的最后一个方面是苹果的“分而治之”。苹果的国外公司富甲一方，国内公司却是负债累累。其海外盈利被保留在国外的子公司里，以此逃避美国35%的海外收益汇回税。苹果资本大约94%的资产是“离岸的”，不能用于一般用途。国内公司必须辛苦支付股息和回购费用。但利润不足以支付这些开支，因此需要借债。其国内净债务已经上升到920亿美元，是国内经营毛利的五倍。苹果每年必须发行300亿美元的债券(包括再融资)，相当于华尔街五家最大公司的平均数。

苹果的核心业务利润如此丰厚，因此几乎无法想象苹果资本一旦出乱子会需要纳税人或者央行来出手相助，就像通用汽车和通用电气所经历的那样。尽管如此，还是不难想象苹果资本会给母公司带来怎样的损害。一次市场冲击就能导致它的投资组合遭受损失。利率上升两个百分点就会带来100亿美元的损失。如果债券市场萎缩，苹果可能会很难发行那么多债券，因而必须得让资金回流国内，这样就要承担大笔税费。而且，经营如此大规模的衍生品投资组合也许也会变得很棘手。

| 好端端的苹果，别摔烂了

苹果资本壮大于金融市场的宽松期。但好日子不会一直持续。久而久之，投资高风险资产的诱惑会加大，“任务蠕变”的风险也会增加。按照当前的发展趋势，到2022年苹果资本的资产将达到4000亿美元，债务将达到2500亿美元。到那时，现在不作为的金融监管者将会焦虑得夜不安寝。

据一名2012年离职的前经理说，苹果的金融专家们都很谨慎，因为“没有人想在凌晨三点接到乔布斯的电话”。但是乔布斯已经不在。无论如何，仅靠害怕被训斥是不够的。如果税法发生变化，苹果老板蒂姆·库克应该逐步缩减公司建立的金融部门。但即使法规没有变动，苹果资本也应该“瘦身”。科技公司应该设法革金融业的命，而不是被它诱入歧途。■



Initial coin offerings

Scam or substance?

There is an ICO bubble. But it holds out the promise of something important

MARKETS and manias go together. The latest frenzy is for all things crypto. The price of the best-known digital currency, bitcoin, has risen by nearly 700% this year and is now about \$7,500; one enterprising firm recently quadrupled its share price simply by adding the word “blockchain” to its name.

But nowhere do alarm bells ring more loudly than in the realm of “initial coin offerings” (ICOs), a form of crowdfunding in which firms issue digital “coins” or “tokens” in return for a payment (typically in ether, another crypto-currency). ICOs have raked in more than \$3.2bn this year, rivalling the money flowing to internet startups from early-stage venture capital. Although most of these tokens are supposed to be used in exchange for the companies’ products, as in a corporate loyalty scheme in the offline world, investors scent something different: the chance to be in at the birth of another bitcoin.

It is tempting to dismiss ICOs as nothing but a fraud’s charter. They are easy to pull off, requiring little more than a few enterprising souls and an ambitious-sounding plan. Unlike equity-owners, coinholders get no claim on an issuer’s earnings. Projects are being marketed to retail investors. In September America’s Securities and Exchange Commission (SEC) brought its first charges against a token-issuer, for allegedly promising hefty returns from firms that barely exist. China and South Korea have banned ICOs altogether.

Yet there is usually meaning in the madness of technology-driven bubbles. The British railway mania in the 1840s helped create a national network of

train lines; the dotcom boom spawned firms such as Amazon and eBay. So it is with ICOs.

They can provide a source of finance for serious software projects which otherwise have a hard time getting off the ground. As an analogy, imagine that in the early days of the internet domain names had been sold to finance the development of the network with the promise that their value would rise as online traffic grew.

ICOs may also give rise to new forms of firm: because founders, employees and users hold coins, everyone has an interest in seeing their network grow, as this will drive up the value of the token. One example of this is Filecoin, which in September raised \$257m and will allow token-holders to buy and sell digital storage on each other's computers. Enthusiasts say that these "crypto co-operatives" combine the advantages of a firm—lower transaction costs, aggregation of capital—with a decentralised structure that means no one controls it or the data it holds. Such hopes may prove unfounded, but there is a chance that organisations of this sort could offer an alternative to the monolithic tech giants of today.

| *The baby in the bathwater*

For these reasons, it is wrong for regulators to ban ICOs. Fortunately, most are more thoughtful. Some, like the financial-market authorities in Quebec, have invited ICOs into a regulatory "sandbox", where less strict rules apply. The SEC has issued a useful report giving guidance about when a token is a security, meaning that an ICO has to comply with registration requirements. This month it warned celebrities against making endorsements of an ICO (as Floyd Mayweather, a boxer, and Paris Hilton, a socialite, have done).

The big test of regulators will come when the ICO bubble pops, as it surely will, and people lose money. If the backlash is severe, ICOs and the

organisations they finance might fall out of favour for years to come. A lot of today's ICOs sound silly, and some are scams; most of the projects they finance will fail. But they might just contain the seed of a digital future that is not dominated by a few online giants. ■



首次代币发行

骗局还是大事件？

首次代币发行存在泡沫，但也可能带来重要的东西

市场与狂热并存。最新的热潮是对所有加密事物的疯狂。今年以来，最著名的数字货币比特币的价格已上涨近700%，目前约为7500美元。一家雄心勃勃的公司仅因在名字中加了“区块链”一词，最近股价就翻了两番。

然而没有哪个地方的警钟敲得比“首次代币发行”（ICO）领域更响。ICO是一种众筹融资：公司发行数字“货币”（即代币，通常是另一种加密货币以太币）作为一笔投资的回报。今年，ICO已筹得超过32亿美元，数额足以匹敌流向互联网创业公司的早期风险资本。虽然这些代币中的大部分本应用来交换公司的产品，就像线下世界中的企业忠诚度计划那样，但投资者却察觉到另外一种东西：参与另一个比特币诞生的机会。

人们容易想当然地认为ICO只不过是个诈骗的幌子。ICO很容易成功，只要有几个敢想敢做的人和一个听起来雄心勃勃的计划就差不多了。代币持有者与股权所有者不同，他们无权分享发行人的收益。项目针对散户投资者销售。今年9月，美国证券交易委员会（SEC）首次对一家代币发行商提出指控，称该公司承诺投资者将从某些企业获得巨额回报，然而这些公司几乎不存在。中国和韩国已经全面禁止ICO。

然而，在技术驱动的狂热泡沫中往往蕴藏着意义。19世纪40年代，英国的铁路建设狂潮推动建成了一个全国铁路网络；互联网热潮催生了亚马逊和eBay这样的企业。ICO也有其价值。

它们可以为正经的软件项目提供资金来源，否则这些项目会很难起步。打个比方，试想互联网发展的早期，人们靠出售域名获得资金来帮助网络发展：随着网络流量增长，域名的价值也有望上升。

ICO也许还会催生出新型公司：由于公司的创始人、员工和用户都持有代

币，因此每个人都希望看到自己的网络扩大，因为这会推高代币的价值。这方面的一个例子是Filecoin，它在9月融资2.57亿美元，并将允许代币持有者买卖彼此计算机上的数字存储。追捧者认为，这些“加密合作社”将公司这种组织形式的优点（降低交易成本和积聚资本）和去中心化的结构（意味着没有人控制它或它拥有的数据）结合了起来。这样的希望也许没什么根据，但这类组织有可能替代如今庞大稳固的科技巨头。

| 去芜存菁

鉴于上述原因，监管机构禁止ICO是错误的。幸运的是，大多数监管机构更为深思熟虑。魁北克金融市场监管部门等一些机构已经邀请ICO加入规则没那么严格的监管“沙箱”。美国证券交易委员会发布了一份有用的报告，对代币作为有价证券给出指引，这意味着ICO必须符合注册要求。本月，它对名人代言ICO发出了警告（拳击手弗洛伊德·梅威瑟和名媛帕丽斯·希尔顿已经做了代言）。

ICO泡沫必将破灭。等到泡沫破灭、人们赔钱之时，监管者将迎来重大考验。如果反弹严重，那么未来几年ICO及其资助的机构可能会失宠。目前许多ICO听起来都很愚蠢，有些则是骗局；它们资助的大部分项目都会失败。但它们可能恰恰蕴含着数字未来的种子，而这样的未来将不会由少数网络巨头所主宰。■



The world's largest tech deal

Welcome to the wild

Broadcom's \$130bn bid for Qualcomm shows how mature and how ruthless the chip business has become

AT FIRST glance the chip business and the Serengeti appear to have little in common. But both are arenas where large predators hungrily stalk big game. On November 6th Broadcom announced its intention to buy its rival, Qualcomm, for around \$130bn, including debt. If successful, it would be the largest deal in the history of the technology business (see table).

And like the African plains, the semiconductor industry supports a complex food chain with different species of chipmakers hunting each other. Qualcomm is already trying to swallow another chip firm, NXP, from the Netherlands, in a deal worth \$47bn. In 2015 NXP, which makes chips for automobiles and other markets, itself completed a merger with Freescale, another large chip company. Meanwhile, Broadcom has become the world's fifth-largest semiconductor firm by snapping up rivals. It has pulled off five big acquisitions since 2013 and is seeking approval for its \$5.9bn bid for Brocade, yet another semiconductor company. If it successfully ingests Qualcomm, the combined group would become the world's third-largest chipmaker, behind only Intel and Samsung Electronics, and a dominant supplier of many components in smartphones.

Consolidation in semiconductors is only speeding up, both in memory chips and, as with this proposed transaction, in microprocessors. Between 2006 and 2016 deals worth a total of \$556bn were struck as chipmakers sought to expand in a rapidly maturing industry. Previous sources of brisk growth, such as the spread of personal computers, tablets and smartphones, have dried up. Global sales of chips reached \$344bn in 2016, but in the past five years they have flattened.

It is against this backdrop that Hock Tan, chief executive of Broadcom, continues to hunt for new targets. His firm switched its name to Broadcom after the company he once ran, Avago, acquired it in 2015 for \$37bn. This month he stood next to President Donald Trump as he announced that he would move Broadcom's legal headquarters from Singapore to America, a move surely designed to encourage American regulators' approval both for his acquisition of Brocade and the subsequent bid for Qualcomm.

Mr Tan and his firm keep a low profile and are barely known outside the semiconductor industry, but his techniques have a following. In particular, he has connections to America's private-equity industry. Silver Lake, a prominent buy-out firm that owns a stake in Broadcom, is providing \$5bn in financing for the proposed takeover, alongside banks.

Most semiconductor firms are run by electrical engineers who see engineering as the solution to their problems, says Mr Tan, who was born in Malaysia, studied engineering at the Massachusetts Institute of Technology and then business at Harvard Business School. He tackles his industry more like a private-equity boss, finding firms that are bloated and cutting costs. "He ran through Broadcom with a machete," says Stacy Rasgon of Bernstein Research. According to Linley Gwennap of the Linley Group, a consultancy focused on semiconductors, Mr Tan eliminated an entire layer of management at Broadcom and now has around 20 business units reporting directly to him.

Scale helps semiconductor companies greatly because the business is so capital-intensive. Broadcom also sees benefits from Qualcomm's investments in areas such as 5G technology, where it falls short itself. If Qualcomm's purchase of NXP is approved, Mr Tan would also gain exposure to the automotive market and to self-driving cars, another area of promise for chipmakers.

Qualcomm has recently suffered legal wounds, which will have helped draw Broadcom in for a kill. It makes the majority of its revenue from patent licensing, but in January America's consumer watchdog, the Federal Trade Commission, sued it, alleging it was abusing its monopoly position in order to extract high licensing fees for baseband chips, used in smartphones. Regulatory bodies in China, South Korea and Taiwan have levied hefty fines on Qualcomm for anticompetitive behaviour. One of the semiconductor industry's most powerful customers, Apple, has also sued Qualcomm over its licensing terms, and iPhone manufacturers have started withholding royalty payments, depriving Qualcomm of billions in sales as the dispute rages on. There is no end in sight.

Mr Tan has suggested that new ownership could lead to a more amicable relationship between Qualcomm and customers such as Apple, although there is little evidence for that view. In a few areas, including connectivity chips that enable Wi-Fi and radio-frequency chips, Broadcom and Qualcomm compete; having a giant firm with more market power is not likely to please chip buyers. If they combined, with no divestments, Qualcomm and Broadcom would control between 50%-60% of the market for Wi-Fi chips and 27% of radio-frequency chips for mobile devices. According to Mr Gwennap, Broadcom has raised prices in some markets where it has a dominant share, such as Ethernet switches for data centres, and customers are unhappy.

| *Chip, chip, chip, chip hooray*

Qualcomm's board is said to be preparing to reject the offer, which it considers to be too low. Broadcom could raise its price to see through a deal, or pursue a hostile bid. But even if Broadcom wins the support of Qualcomm's bosses and shareholders, there are large risks, says Geoff Blaber of CCS Insight, a research group. With Qualcomm's pending purchase of NXP and Broadcom's of Brocade, what looks at first glance like

a merger between two giants is actually a four-sided deal. It would be difficult to unite so many different divisions and business units all at once.

A second risk is regulatory. The European Commission's ongoing investigation of Qualcomm's proposed acquisition of NXP is suggestive of the close scrutiny that another mega-deal in chips could receive in Europe, says Thomas Vinje, head of antitrust at Clifford Chance, a law firm, in Brussels. China's antitrust regulators could also prove difficult. They may want to protect their own, home-grown chipmakers.

Some have interpreted the bid as an attempt by Broadcom to enter future fast-growing areas, such as chips for connected devices, collectively called the "internet of things", and artificial intelligence, where Nvidia, another chipmaker, dominates. But the combined entity may actually be too focused on maturing semiconductor markets; by swallowing Qualcomm, Broadcom would be doubling down on smartphones rather than diversifying away from them.

Yet Mr Tan sees this as a good thing. "Focus is the key to success as the industry consolidates," he says. "We try to progress innovation in areas we are already good at." Perhaps he thinks that he can buy into new categories in the chip business when he is ready to roll them into his giant company. Skilled hunters learn never to reveal where they might be planning to attack next. ■



全球最大的科技业交易 欢迎来到野蛮之地

博通拟以1300亿美元收购高通，显示出芯片行业成熟和残酷的程度

乍一看去，芯片行业和非洲塞伦盖蒂平原（Serengeti）似乎风马牛不相及。但两者都是饥渴的巨兽伺机捕杀大型猎物的角斗场。11月6日，博通（Broadcom）宣布打算以约1300亿美元（含债务）收购竞争对手高通（Qualcomm）。如果并购成功，这将是科技业史上最大规模的交易（见表）。

和非洲平原一样，半导体行业也供养着一条复杂的食物链，不同种类的芯片制造商在其中相互捕杀。高通已在试图以470亿美元吞并荷兰芯片公司恩智浦（NXP）。恩智浦是汽车和其他市场的芯片制造商，它自己于2015年完成了与另一家大芯片公司飞思卡尔（Freescale）的合并。与此同时，通过抢购对手，博通已经晋身为世界第五大半导体公司。自2013年起，博通已经完成五起大型收购，目前其出价59亿美元对博科（Brocade，同样是一家半导体公司）的收购还有待批准。如果博通成功吞并高通，那么合并后的公司将成为仅次于英特尔和三星电子的世界第三大芯片制造商，以及智能手机中很多零部件的主导供应商。

半导体行业的合并只会加快，在存储芯片和此次意向交易涉及的微处理器两个领域都是如此。芯片制造商力图在一个正快速成熟的行业内扩张：2006至2016年间，合并交易总额达5560亿美元。然而先前芯片业快速增长的源泉，比如个人电脑、平板电脑及智能手机的普及，已经枯竭。尽管2016年芯片的全球销售额达到3440亿美元，但在过去的五年里销售增长已经趋于停滞。

正是在这样的背景下，博通的首席执行官陈福阳（Hock Tan）继续搜寻新的目标。2015年他掌管的安华高（Avago）以370亿美元购得博通后，公司更名为博通。本月，他站在特朗普身边，宣布将博通法定总部从新加坡迁至美国，此举无疑意在敦促美国监管部门，批准他对博科以及随后对高通

的收购。

陈福阳和他的公司颇为低调，在半导体行业以外鲜为人知，但他的并购手法使他拥有一批拥趸。特别是他在美国私募股权行业人脉广泛。以全面收购著称的银湖公司（Silver Lake）持有博通的股份，它出资50亿美元，与多家银行联手为博通的意向收购提供资金。

陈福阳说，大多数半导体公司都是由电气工程师管理，他们将工程技术视为解决问题的方法。陈福阳出生于马来西亚，先在麻省理工学院学习工程，而后在哈佛商学院研读商业。他在行业内的做派更像一个私募股权公司的老板：发现臃肿的公司，然后削减成本。伯恩斯坦研究公司

（Bernstein Research）的斯泰西·拉斯贡（Stacy Rasgon）说：“他对博通用了砍刀。”据半导体行业咨询公司林利集团（Linley Group）的林利·格温耐普（Linley Gwennap）说，陈福阳砍掉了博通一整个管理层，现在大约有20个业务部门直接向他汇报。

规模经营对半导体公司大有裨益，因为该行业属于高度资本密集型。博通还认为高通在5G技术等领域的投资将有利可图，而该领域正是博通自己的短板。如果高通收购恩智浦的计划获批，陈福阳还能进入汽车市场和自动驾驶领域，这也是芯片制造商有望大展拳脚的地方。

高通最近频遭法律诉讼之伤，这给了博通可乘之机。高通大部分收入来自专利授权，但在今年1月，美国的消费者权益保护部门联邦贸易委员会

（Federal Trade Commission）控告高通滥用垄断地位，靠智能手机中的基带芯片榨取高额专利使用费。中国大陆、韩国以及台湾的监管机构因反竞争行为对高通处以重罚。半导体行业最有影响力的客户之一苹果也因高通的专利授权条款对其发起了诉讼。iPhone的代工厂已经开始拒绝缴纳专利使用费，僵持不下的纠纷导致高通损失了数十亿美元的销售额。这样的情形还不知到哪天是个头。

陈福阳认为博通的并购可以让高通和苹果等客户建立更友好的关系，不过这种观点并无根据。博通与高通在包括Wi-Fi连接芯片以及射频芯片在内

的几个领域互为对手。出现一个拥有更大市场支配力的巨头公司也不见得能令芯片买家欢喜。如果两家公司在完全不做剥离的情况下合并，它们将会共同控制Wi-Fi芯片市场的50%至60%、移动射频芯片市场的27%。根据格温耐普的说法，博通已经在一些占有绝对份额的市场提高了价格，比如用于数据中心的以太网交换机，这引发了客户的不满。

| 芯片万岁万万岁

据说高通的董事会认为出价太低，准备拒绝此次收购。博通可能会提高收购价来达成交易，也可能启动恶意收购。研究机构CCS Insight的杰夫·布拉伯（Geoff Blaber）表示，即使博通赢得了高通老板及股东的支持，仍存在很大风险。高通对恩智浦以及博通对博科的收购都悬而未决，因此，初看上去这是两家巨头之间的合并，实际上却是一次四方交易。要一下子统合这么多不同的部门和业务单位不是一件容易的事。

第二个风险来自监管。高伟绅律师事务所（Clifford Chance）在布鲁塞尔的反垄断负责人托马斯·温耶（Thomas Vinje）说，欧盟委员会正在调查高通收购恩智浦的提案，这表明在欧洲，芯片行业再有巨额交易同样还会受到严密审查。另外，中国的反垄断监管部门也可能是只拦路虎，它们可能想要保护本土的芯片制造商。

一些人把这次收购理解为博通尝试进入那些将会快速发展的领域，例如统称为“物联网”的互联装置使用的芯片和人工智能芯片——后者由另一家芯片制造商英伟达（Nvidia）主导。但是合并后的公司实际上可能会太过专注于日趋成熟的半导体市场。另外，如果吞并高通，博通会加倍押注于智能手机，而不是在此之外实现多元化。

然而陈福阳认为这是件好事。“随着行业整合加剧，专注是成功的关键，”他表示，“我们试图在自己驾轻就熟的领域进一步创新。”也许他想的是，当他准备好将新型芯片公司收归旗下时，就可以进入新领域了。老练的猎手知道，决不能暴露自己下一个可能袭击的目标。■



Economic and financial indicators

Economic outlook

The Economist's latest poll of forecasters, November



经济与金融指标

经济前景

《经济学人》11月对各家预测机构的最新调查



Global inflation

Gone missing

The world economy is gathering momentum—but where's the inflation?

A FEW years ago, the news about the euro-zone economy was uniformly bad to the point of tedium. These days, it is the humdrum diet of benign data that prompts a yawn. Figures in November show that GDP rose by 0.6% in the three months to the end of September (an annualised rate of 2.4%). The European Commission's economic-sentiment index rose to its highest level in almost 17 years. Yet when the European Central Bank's governing council gathered on October 26th, it decided to keep interest rates unchanged, at close to zero, and to extend its bond-buying programme (known as quantitative easing, or QE) for a further nine months.

The central bank said it would slow down the pace of bond purchases each month, to €30bn (\$35bn) from January. But Mario Draghi, the bank's boss, declined to set an end-date for QE. A hefty dose of easy money will be necessary, he argued, until inflation durably converges on the ECB's target of just below 2%. It shows few signs of doing so, despite the economy's strength. Underlying, or core, inflation, which excludes the volatile prices of food and energy, fell from 1.1% to 0.9% in October, according to data published a few days after the ECB meeting. The euro zone's miseries of 2010-12 were unique. But in its present, happier state of vigorous activity, low inflation and easy monetary policy, it is like many other big economies (see chart).

After a decade of interest rates at record lows, those central banks that are inclined to tighten policy naturally attract attention. The Bank of England's monetary-policy committee raised its benchmark interest rate from 0.25% to 0.5% on November 2nd, the first increase since 2007. On the same day,

the Czech National Bank raised interest rates for the second time this year. The Federal Reserve kept interest rates unchanged this week, having raised them in March and June, but a further increase is expected in December.

In Turkey, perhaps the only big economy that is obviously overheating, the central bank—which has been browbeaten by the president, Recep Tayyip Erdogan, who believes high interest rates cause inflation—opted on October 26th to keep interest rates on hold. Yet in most biggish economies, underlying inflation is below target (see chart) and monetary policy is being relaxed. Brazil's central bank cut interest rates on October 25th from 8.25% to 7.5%. Two days later, Russia's central bank trimmed its main interest rate, to 8.25%. On October 31st the Bank of Japan voted to keep rates unchanged and to continue buying assets at a pace of around ¥80trn (\$700bn) a year. These economies are gathering strength. It is a puzzle that, in such circumstances, global inflation is stubbornly low.

To figure out why, consider the model that modern central banks use to explain inflation. It has three elements: the price of imports; the public's expectations; and capacity pressures (or "slack") in the domestic economy. Start with imported inflation, which is determined by the balance of supply and demand in globally traded goods, such as commodities, as well as shifts in exchange rates. Commodity prices have picked up smartly from their nadir in early 2016. The oil price, which fell below \$30 a barrel then, has risen above \$60.

This has put upward pressure on headline inflation: in the euro zone it is 1.4%, half a percentage point higher than the core rate. Where inflation is noticeably high, it is generally in countries, such as Argentina (where it is 24%) or Egypt (32%), that have withdrawn costly price subsidies and whose currencies have fallen sharply in value, making imported goods dearer. In Britain, rising import prices linked to a weaker pound have added around 0.75 percentage points to inflation, which is 3%.

A second influence on inflation is the public's expectations. Businesses will be more inclined to push up their prices and employees to bid for fatter pay packets if they believe inflation will rise. How these expectations are formed is not well understood. The measures that are available are broadly consistent with the central bank's inflation target in most rich economies. Japan is something of an outlier. It has struggled to meet its 2% inflation target in large part because firms and employees have become conditioned to expect a lower rate of inflation. Japan's prime minister, Shinzo Abe, recently called for companies to raise wages by 3% in next spring's wage round to kick-start inflation.

Leave aside the transient effects of import prices, and inflation becomes a tug-of-war between expectations and a third big influence, the amount of slack in the economy. The unemployment rate, a measure of labour-market slack, is the most-used gauge. As the economy approaches full employment, the scarcity of workers ought to put upward pressure on wages, which companies then pass on in higher prices. On some measures, Japan's labour market is as tight as it has been since the 1970s. America's jobless rate, at 4.2%, is the lowest for over 16 years. Inflation has nevertheless been surprisingly weak.

In other words, the trade-off between unemployment and inflation, known as the Phillips curve, has become less steep. A paper last year by Olivier Blanchard, of the Peterson Institute for International Economics, found that a drop in the unemployment rate in America has less than a third as much power to raise inflation as it did in the mid-1970s.

The central banks that see a need for tighter monetary policy are worried about diminishing slack. There are tentative signs of stronger pay pressures in Britain and America, and firm evidence of them in the Czech Republic, where wage growth is above 7%. Even so, with inflation expectations so steady, the flatter Phillips curve suggests that the cost for central banks in

higher inflation of delaying interest-rate rises is rather low. The ECB is quite a way from such considerations. The unemployment rate is falling quickly, but remains high, at 8.9%. There is still room for the euro-zone economy to grow quickly without stoking inflation. The dull routine of good news is likely to continue. ■



全球通货膨胀

不知所踪

世界经济正在积聚动力——但是通货膨胀去哪儿了？

几年前，有关欧元区经济清一色都是单调的负面新闻。而最近，没完没了的利好数据同样令人觉得乏味。11月数据显示，截至9月底的三个月里GDP增长了0.6%（年化增长率为2.4%）。欧盟委员会的经济景气指数上升至近17年的最高点。然而，10月26日欧洲央行管理委员会召开会议，决定维持几近为零的利率不变，并且将债券购买计划（即“量化宽松”，QE）再延长九个月。

欧洲央行表示将会减少每月债券购买规模，从2018年1月起降至每月300亿欧元（350亿美元）。但行长马里奥·德拉吉（Mario Draghi）拒绝为QE设定退出时间。他指出，在通货膨胀率稳定在欧洲央行略低于2%的目标前，仍然有必要投放巨额的宽松货币。尽管经济走强，但几乎没有迹象表明欧洲央行能够实现这一通胀目标。根据欧洲央行会议几天之后发布的数据，今年10月，排除了食品和能源价格波动的基本通胀率即核心通胀率从1.1%跌至0.9%。2010到2012年间欧元区的惨状非同寻常，但现在，那里经济活动旺盛、通胀率低、货币政策宽松，境况有所改善，一如很多其他大经济体（见图表）。

经历了连续十年利率维持在历史低点后，那些意欲收紧货币政策的央行自然引人注目。11月2日，英国央行的货币政策委员会将基准利率从0.25%提高到0.5%，自2007年以来首次加息。同一天，捷克央行年内第二次加息。美联储继3月和6月两次加息之后，本周维持利率不变，但预计会在12月进一步提高利率。

土耳其或许是唯一明显过热的大经济体。总统埃尔多安认为高利率会引发通货膨胀，在他的施压下，该国央行在10月26日决定暂时维持利率不变。然而在多数较大型的经济体，基本通胀率都低于目标（见图表），货币政策正在变得宽松。10月25日，巴西央行将利率从8.25%降低到7.5%。两天

后，俄罗斯央行将其主要利率降至8.25%。10月31日，日本央行表决决定维持利率不变，并且继续以一年约80万亿日元（7000亿美元）的规模买入资产。这些经济体正渐有起色。在这样的环境下，全球通胀率持续走低，令人费解。

要理清原因，需要从现代央行用来解释通胀的模型入手。这一模型有三个因素：进口商品价格、公众预期，以及国内经济中的产能压力（即“闲置产能”）。先说输入型通胀。它由诸如大宗商品的全球贸易品的供需平衡以及汇率变化决定。大宗商品价格从2016年初的谷底迅速反弹。当时跌破每桶30美元的油价现在已经超过60多美元。

这已经给整体通胀带来了上行压力：欧元区的整体通胀率为1.4%，比核心通胀率高出0.5个百分点。通胀率明显高企的地方往往是阿根廷（通胀率24%）或者埃及（32%）这样的国家，它们取消了高昂的价格补贴，加上货币急剧贬值，使得进口商品价格更高。在英国，与英镑下跌有关联的进口价格上升已经使通胀率增加了大约0.75个百分点，达到3%。

第二个对通胀的影响是公众预期。如果公众认为通胀会上升，那么企业会更倾向于提高产品价格，雇员也会要求更高的报酬。这些预期形成的原因尚不明确。在大多数富裕经济体中，现有的通胀预期指标大体上与央行通胀目标相一致。但日本多少是个特例。日本一直难以达到2%的通胀目标，很大程度上是因为公司和雇员已经开始习惯更低的通胀预期。日本首相安倍晋三最近号召公司在明年的“春斗”（春季的调薪斗争）中将工资提高3%，给通胀注入一剂强心针。

如果不考虑进口价格的瞬时效应，通胀就成了公众预期与第三大影响因素——经济中的闲置产能——之间的拉锯战。失业率作为劳动力市场闲置的指标，是最常用的衡量标准。当经济体接近充分就业，劳动力短缺应该会推动工资上涨，再由公司转嫁到更高的产品价格上。以某些标准衡量，日本的劳动力市场和20世纪70年代以来一样紧张。美国失业率为4.2%，是16年以来最低。然而通胀仍是惊人地疲软。

换句话说，失业率和通胀之间的反向牵制关系，即菲利普斯曲线，已经变得更平缓。彼得森国际经济研究所（Peterson Institute for International Economics）的奥利维耶·布兰查德（Olivier Blanchard）去年撰写了一篇论文，他发现，在美国，失业率下降对于通胀率上升的拉动作用不到20世纪70年代中期的三分之一。

那些认为需要收紧货币政策的央行对闲置劳动力的减少感到担心。薪资压力增大的迹象在英国和美国初步显现，在捷克则已是不争的事实：该国工资增长率超过7%。即便如此，由于通胀预期如此稳定，更加平坦的菲利普斯曲线表明，通胀较高国家的央行推迟加息的代价相当低。欧洲央行几乎没有加息的考虑。失业率虽然在快速下降，但仍处于8.9%的高位。欧元区经济仍有可能在不加剧通胀的情况下实现快速增长。单调乏味的利好消息很可能还会继续。 ■



Household debt in Asia

Mutable values

Asian consumers shed their prudence and buy on credit

ONE of the more persistent beliefs about the global economy is that Asians are more frugal than others. Explanations have drawn on culture (the self-discipline of Confucianism), history (memories of privation) and public policy (flimsy social safety-nets forcing people to save). For Lee Kuan Yew, the founding father of Singapore, and other theorists of “Asian values”, thrift was one of them. Whatever the true reason, data long supported the basic claim that Asian households were indeed careful with their cash. But over the past few years consumers across the region have done their best to prove that prudence was perhaps just a passing phase.

Household debt in advanced economies has generally declined as a percentage of GDP since the 2008 global financial crisis, according to the Bank for International Settlements. In a number of Asian countries, however, it has been going in the opposite direction (see chart). The biggest increase has been in China, where households have borrowed about \$4.5trn over the past decade. But Chinese households were starting from an extremely low base. Relative to income levels, South Korea, Thailand and Malaysia have reached much loftier heights. Over the same period, consumer borrowing has also risen in Hong Kong and Singapore.

The increase in debt is, to a certain extent, healthy. An oft-heard criticism of Asian economies is that, in terms of global growth, they have been punching below their weight. They produce lots of stuff but rely on profligate Westerners to buy it. The rise in debt has, so far at least, helped change that dynamic, fuelling more consumption. Retail spending in Asia, excluding Japan, has grown by about 10% a year over the past half-decade. Greater access to credit has made it easier to buy homes, cars and clothes.

But debt can also be dangerous. A recent paper by the IMF observed that, in the short term, an increase in household borrowing props up economic growth and keeps unemployment down. After a while, though, these gains are reversed. The IMF study found that a five-percentage-point increase in the household debt-to-GDP ratio over three years tends to result in a 1.25-percentage-point decline in real growth three years in the future. And an increase of a single percentage point in household debt increases the likelihood of a banking crisis by a similar percentage.

In Asia financial fragility is not the main worry. Even if households have been indulging themselves more freely, most regulators have remained prudent. In South Korea they mandate that mortgages cannot exceed 70% of a property's value. Singaporean homebuyers who borrow from banks must make downpayments of at least 20%—and potentially much more if they already have outstanding loans. Asian banks are also reluctant to pursue the kind of subprime lending that made consumer debt so toxic in America a decade ago.

The bigger risk in Asia is interest rates, says Frederic Neumann, co-head of Asian economic research at HSBC. He notes that fixed long-term rates are rare in the region. Most consumer loans have shorter durations, so if central banks start to increase rates, debt-servicing costs for households will quickly rise. That will eat into incomes and act as a drag on consumption.

It is already possible to detect headwinds. Mortgage payments in China have reached about 4.5% of total annual household income, up from 3.6% in 2015, according to Ernan Cui of Gavekal Dragonomics, a research firm. That, in turn, is beginning to weigh on consumption. For the government this entails a trade-off. The increase in mortgages has helped reduce a glut of unsold homes, which posed a graver danger to the economy than does consumer debt.

There is also an uglier side to the rise in household borrowing. As in other parts of the world, unscrupulous lenders prey on the most vulnerable. In South Korea the share of low-income households struggling under heavy debt burdens has been creeping up. Choi Pae-kun, an economist at Konkuk University in Seoul, points out that poorer people may have no choice other than to borrow to cover living and medical costs. In China online lenders have been involved in a series of scandals. Some have demanded exorbitant interest rates and, in a number of cases, forced students to post as collateral naked selfies, with the threat they could be distributed if dues are not paid. Debt can undermine Asian values in more ways than one. ■



亚洲的家庭债务

可变价值观

亚洲消费者抛弃审慎，开启借贷消费

人们对全球经济颇为坚持的一个观点是亚洲人比其他地区的人更俭省。他们从文化（儒家思想推崇的自律）、历史（关于物资匮乏的记忆）和公共政策（社会保障网络脆弱，人们只得存钱）等方面寻求解释。新加坡的开国元首李光耀及其他倡导“亚洲价值观”的理论家认为，节俭是亚洲人的价值取向之一。不管真正的原因为何，长久以来一直有数据支持这样一个基本的看法：亚洲的家庭对待自己的钱财确实很小心。然而过去几年，该地区的消费者竭尽所能，证明了这种审慎可能只是暂时的。

国际清算银行称，自2008年全球金融危机以来，发达经济体中家庭债务占GDP的比例普遍下降。然而在一些亚洲国家，形势却恰好相反（见图表）。过去十年来，中国的家庭债务增幅最大，借贷总额约达4.5万亿美元。不过中国的家庭债务是从极低的基数上发展起来的。相对于收入水平，韩国、泰国和马来西亚的家庭债务升幅要高得多。同一时期内，香港和新加坡的消费者借贷也呈上升之势。

家庭债务增加在一定程度上是健康的。对于亚洲经济体，一个屡屡听到的批评就是它们并未对全球增长做出力所能及的贡献。它们生产出大量产品，却要靠大手大脚的西方人来购买。至少就目前来看，家庭债务的增长帮助改变了这样的态势，促进了消费增长。过去五年来，除日本外，亚洲的零售消费每年大约增长10%。获取贷款变得更容易，买房、买车、买衣服也就更容易了。

但债务也可能是危险的。国际货币基金组织近期发布的一篇论文观察到，家庭债务增加在短期内会促进经济增长，压低失业率。然而用不了多久，良好局面就会发生逆转。该研究发现，三年内家庭债务占GDP的比率若增加五个百分点，未来三年的实际增长往往会因此下降1.25个百分点。家庭债务每增加一个百分点，发生银行业危机的可能性就相应增加约一个百分

点。

在亚洲，金融体系脆弱并不是主要的担忧。即使亚洲家庭花钱更恣意，大多数监管者也一直都很谨慎。在韩国，监管机构要求抵押贷款额不得超过房产价值的70%。新加坡的购房者在向银行借贷时必须支付至少20%的首付——如果他们已有未偿贷款，首付比例也许还会高得多。亚洲的银行对次级贷款也不愿涉足——十年前，这种贷款在美国造成了严重不良的消费者债务。

汇丰银行亚洲经济研究部门联席主管范力民（Frederic Neumann）表示，在亚洲，更大的风险在于利率。他指出，该地区极少采用长期固定利率。大部分消费者的还贷时间都比较短，因此，如果央行开始加息，家庭偿债成本将会迅速上升。这会消耗收入，并成为消费增长的绊脚石。

眼下已经可以察觉到一些不乐观的迹象。研究公司佳富龙洲（Gavekal Dragonomics）的崔尔南表示，在中国，抵押贷款月还款额占家庭全年总收入的比例已从2015年的3.6%升至目前的约4.5%。这反过来又已开始影响消费。政府需对此做出权衡。抵押贷款的增加帮助减少了过剩的房屋库存，而这对经济构成的威胁比消费债更加严峻。

家庭债务增加还有更丑恶的一面。和在世界其他地方一样，那些寡廉鲜耻的贷款机构掠夺最弱势的人。在韩国，因背负沉重债务而苦苦挣扎的低收入家庭占比持续上升。首尔建国大学（Konkuk University）的经济学家崔裴君（Choi Pae-kun，音译）指出，较贫困的人也许别无选择，只能通过借债来支付生活及医疗费用。在中国，在线贷款平台已卷入一系列丑闻。一些网贷机构设定了超高的利率，而在其他案例中，它们强迫学生以裸体自拍做抵押，威胁如果不按时还款就将照片散布出去。从很多方面来看，家庭债务都可能逐步削弱“亚洲价值观”。■



Age and inequality

The generation gain

Millennials are doing better than the baby-boomers did at their age. But the gap is closing

ALL men are created equal, but they do not stay that way for long. That is one message of a report in October by the OECD, a club of 35 mostly rich democracies. Many studies show how income gaps have evolved over time or between countries. The OECD's report looks instead at how inequality evolves with age.

As people build their careers, or don't, their incomes tend to diverge. This inequality peaks when a generation reaches its late 50s. But it tends to fall thereafter, as people draw redistributive public pensions and quit the rat race, a contest that tends to give more unto every one that hath. Old age, the OECD notes, is a "leveller".

Will it remain so? Retirement, after all, flattens incomes not by redistributing from rich seniors to poor, but by transferring money to old people from younger, working taxpayers. There will be fewer of them around in the future for every retired person, reducing the role of redistributive public pensions.

One logical response to the diminishing number of workers per pensioner is to raise the retirement age. But that will exacerbate old-age inequality, if mildly. Longer careers will give richer workers more time to compound their advantages. And when retirement eventually arrives, the poor, who die earlier, will have less time to enjoy their pensions.

Today's youngsters may resent having to provide for more pensioners, not least because they feel that older generations have it easier than them. The

OECD provides qualified support for this complaint. Baby-boomers (mostly born in the 1950s) have accumulated far more wealth (property, shares and other savings) than Generation X (mostly in the 1970s) and millennials (the 1980s and after).

But that is partly because they have had more time to do so. Comparing generations at a similar stage of life paints a different picture. Today's young adults have a significantly higher disposable income than previous generations had at the same age. OECD citizens now in their early 30s have 7% more than members of Generation X had at that age and over 40% more than boomers enjoyed when they were similarly short in the tooth (see chart). Youngsters may sigh with impatience when an old codger tells them how life was tougher "when I was your age". But it was.

This millennial privilege is, however, smaller in America, which tends to set the tone for the generation wars. (Indeed Americans in their early 30s are slightly worse off than the preceding generation was at a similar age.) The gap also appears to close as the later generations get older. Gen-Xers were far more comfortable in their 30s than the people born a decade or two before them. But now they are in their 40s, their incomes have stopped rising, whereas their seniors enjoyed strong gains at the same age.

This may reflect the lingering influence of the global financial crisis. But if this trajectory persists, a time may soon come when old folk sigh with impatience as youngsters tell them how much easier life was "when you were my age". ■



年龄与不平等

代际增益

千禧一代目前比同龄时的婴儿潮一代过得更好，但差距正在缩小

人人生而平等，但这种状态并不长久。这是经合组织（有35个成员国，主要是富裕民主国家）10月发布的一份报告所传递的信息。许多研究都表明收入差距随时间或在不同国家之间变化，而经合组织的报告却着眼于不平等随年龄的演变。

有人事业成功，有人成就寥寥，人们的收入因而出现差异。当一代人快到60岁时，这种不平等达到顶峰。但那之后，不平等水平往往会回落，因为人们将领取再分配的公共养老金，退出那种往往让富者更富的激烈竞争。经合组织指出，老年期令人们趋向平等。

这种情况会持续吗？毕竟，退休使收入趋于平等，靠的不是把富裕老人的财富重新分配给贫困的老人，而是将还在工作的年轻纳税人的钱转移给老人。未来，供养每一位退休人员的年轻纳税人数量会减少，这将削弱公共养老金的再分配作用。

供养每一位退休老人对应的劳动者人数在减少，对此一个合乎逻辑的应对方式就是提高退休年龄。但这会加剧老人的不平等状况，即使程度很轻微。更长的职业生涯将给予富有的劳动者更多时间来扩大自身优势。而当最终退休时，寿命通常较短的穷人享用自己退休金的时间也会更短。

如今的年轻人可能会为不得不供养更多老人而感到不满，尤其是因为他们觉得上几代人过得比自己轻松。经合组织的研究在一定程度上支持了这种抱怨。婴儿潮一代（大多出生于上世纪50年代）积累的财富（房产、股票和其他积蓄）要比X一代（主要出生于上世纪70年代）和千禧一代（出生于上世纪80年代及以后）多出很多。

但这在一定程度上是因为婴儿潮一代有更多的时间来积累财富。将几代人

的同一个人生阶段加以比较，就会得到一幅不同的图景。如今年轻人的可支配收入明显高于同龄时期的上几代人。目前，经合组织成员国30岁出头的公民收入比同龄时的X一代高出7%，比同龄时的婴儿潮一代高出40%（见图表）。当老家伙对小伙子说“我在你这个年纪”生活要更艰难时，后者也许会不耐烦地叹气。但当时的确如此。

不过，千禧一代的这一优势在美国却没那么显著，而美国往往是为世代战争定下基调的地方。（事实上，30岁出头的美国人比上一代人同龄时要稍穷一些）。随着后面几代人年龄渐长，差距似乎同样趋于消失。比起那些比他们早出生二三十年的人，X一代在30多岁时生活要更宽裕得多。但现在他们已经40多岁了，收入已经停止增长，而其前辈在同一年龄段的收入却增长强劲。

这可能反映了全球金融危机那挥之不去的影响。但如果这个趋势持续下去的话，那么用不了多久，就会出现年轻人对老年人说“你在我这个年纪”生活多么轻松，而老年人不耐烦地叹气的情景了。■



Counterfactual underwriting

Might-have-beens

A Lloyd's report urges insurers to ask "what if?"

ON JULY 7th disaster was narrowly averted when an Air Canada passenger plane, trying to land on a full taxiway at San Francisco airport, pulled up just in time. Five seconds longer, and it might have crashed into fully loaded planes and killed over 500 people, in potentially the deadliest aviation disaster ever. Instead, the incident became a non-event—not just in collective memory but also in insurance. With no losses, there was nothing to log. Yet ignoring such near-misses, argues a report published in October by Lloyd's of London, an insurance market, and RMS, a risk-modeller, is a missed opportunity.

Counterfactual “what if” thinking may be an enjoyable pastime for historians—“What if Hitler had been assassinated?” being one favourite—but is not common among underwriters. They prefer to base estimates of future risk—and hence premiums—on hard data of what happened in the past, eg, the number of aeroplanes that crashed and the total losses incurred. Since actual aviation losses have been light this year compared with previous years, they may well conclude that such risks are falling. Particularly in a weak market for insurance, where pressure on prices is constant, the temptation to lower premiums merely because losses have been low can be dangerous, warns RMS's Gordon Woo, a “catastrophist” (ie, specialist in the mathematical modelling of extreme risks).

For common perils, such as car crashes or burglaries, plenty of data are available, allowing confident predictions based on the past. But for unusual, emerging or extreme risks—such as natural catastrophes, cyber-threats or terrorism—the lack of precedents means such methods can be

inadequate. This leaves underwriters with blanks to fill in, particularly around how frequently a rare event—a tsunami, say, or an epidemic—might occur and what the maximum losses could be. Models which run hundreds of thousands of loss simulations can help fill in such blanks but are not perfect. And the lack of real-life data makes accurately underwriting an event that has never happened very hard.

To make up for such shortcomings, the report calls on the industry to keep an alternative-claims book in which they record hypothetical losses from near-misses (such as the Air Canada plane) and could-have-been-worses (“suppose Hurricane Irma had hit Miami”), multiplied by their probability. They could then use this as an underwriting aid. By this logic, because the chance of Irma’s striking Miami was roughly 20%, and it would have increased estimated maximum losses by \$100bn, this would be recorded as an additional potential loss of \$20bn. Besides deepening the data pool on which underwriters base risk assessments, such calculations could help regulators submit catastrophe models to stress tests.

Adding a layer of what-if analysis may well increase premiums, as insurers realise they need to be more cautious about certain risks than losses suggest. But it could also reduce some premiums, particularly for emerging perils that underwriters tend to overprice so long as they lack data. “We are most scared about things we don’t understand,” says Jonathon Gascoigne of Willis Towers Watson, an insurance broker. Launching an in-depth investigation into every near-miss would be costly. It might make more sense for several insurers to pool resources. Better still, says Trevor Maynard from Lloyd’s, if other bodies also joined in, from municipalities and governments to capital providers. They too share an interest in preparing for disaster.

Today it is hard for insurers to raise premiums, though this may change once hurricane-season claims come in. Many struggle to stay profitable;

around a third of the London market expects to lose money from underwriting in 2017, according to PwC, a consultancy. Low interest rates and weak capital returns mean few can count on investment income to make up for lousy business. In this context, some might be tempted to undercharge for risk, says Mr Woo, adding that now more than ever “insurers would benefit from looking at the past as just one realisation of what might have happened”. ■



反事实承保 险些成真

劳合社的报告敦促保险公司多提假设性问题

今年7月7日，加拿大航空的一架客机准备在旧金山机场降落时飞向了一条停满飞机的滑行道，幸好及时拉升，才不至酿成大祸。如果再迟五秒，飞机便可能与其他满载乘客的飞机相撞，导致超过500人死亡，造成航空史上最严重的灾难。然而，事件平淡收尾，不但没有进入人们的集体记忆，也不见于保险记录。既然没有损失，也就没什么可记录的。但伦敦保险市场劳合社（Lloyd's）及风险建模公司RMS10月发表报告称，忽视这类未遂事故实为错失机会。

思考反事实的假设问题对历史学家来说也许是种愉快的消遣——“如果希特勒被暗杀了会怎样？”就是他们最喜欢琢磨的问题之一，但保险公司往往不会这样思考。它们更愿意根据过去的实际数据来估算未来的风险并计算保费，如坠毁的飞机数量及产生的总损失。如果相比前几年，今年航空事故的实际损失较轻，保险公司就很可能认为这类风险在下降。RMS的“灾难分析师”（对极端风险进行数学建模的专家）戈登·吴（Gordon Woo）警告说，特别是在保险市场疲软、价格持续承压的情况下，如果仅仅因损失较低就考虑降低保费，可能会比较危险。

对于车祸或入室盗窃等常见风险，因为有大量数据可用，所以可根据过往历史做出可靠预测。但针对不寻常、新出现或极端的风险（如自然灾害、网络威胁或恐怖主义），由于先例不足，上述预测方法可能有所欠缺。这就需要保险公司自行填补空白，特别是在估算海啸、瘟疫等罕见事件发生的频率及可能造成的最大损失方面。运行数十万次损失模拟计算的模型有助于填补这类空白，但结果并不完美。缺乏现实数据令保险公司难以准确承保从未发生过的事件。

为弥补这类不足，该报告呼吁保险业设立“另类索赔档案簿”，记录未遂事故（如上述的加航误降事件）及后果本可能更严重的事件（“假设飓风‘艾

尔玛’正面袭击了迈阿密”)的假设损失，再乘以其发生概率。保险业可将此作为承保的辅助手段。按这一逻辑，由于“艾尔玛”袭击迈阿密的几率约为20%，如果发生，最大可能损失将增加1000亿美元，这将被记录为200亿美元的额外潜在损失。这类计算除了能深化保险公司评估风险所依据的数据库，还可以帮助监管机构对灾难模型进行压力测试。

增加一层假设分析很可能会使保费上升，因为保险公司意识到需要更审慎地对待某些风险，不能单凭过往损失来下判断。但这也可能令部分保费下降，尤其是那些因保险公司缺乏数据而往往定价过高的新风险。“对于不了解的事情，我们是最害怕的。”保险经纪公司韦莱韬悦（Willis Towers Watson）的乔纳桑·加斯科因（Jonathon Gascoigne）说。要对每一项未遂事故做深入调查，费用会很高昂。多家保险公司集中并共享资源可能是更明智的做法。劳合社的特雷弗·梅纳德（Trevor Maynard）表示，更好的方法是让各级政府和投资商等其他机构加入进来，为灾祸未雨绸缪对它们也有好处。

保险公司现在难以提高保费，尽管随着飓风季索赔的到来，情况也许有变。据咨询公司普华永道（PwC）的数据，许多保险公司难以保持盈利，伦敦保险市场中约有三分之一的公司在2017年承保的业务预计会亏损。低利率及资本回报疲软令保险公司难以依靠投资收益来弥补业务亏损。戈登·吴说，在这种情况下，部分公司可能会低价承保风险。但他强调，比以往任何时候都更重要的一点是，“把历史看做仅仅是众多可能性中实现了一种，保险公司将会得益”。■



IBM's tricky transformation

Big blue yonder

IBM lags in cloud computing and its “Watson” technology underwhelms in artificial intelligence. Can the tech industry’s great survivor recover?

TECHNOLOGY giants are a bit like dinosaurs. Most do not adapt successfully to a new age—a “platform shift” in the lingo. A few make it through two and even three. But only a single company spans them all: IBM, which is more than a century old, having started as a maker of tabulating machines that were fed with punch cards.

Yet after 21 quarters with falling year-on-year revenues (see chart), doubts had been growing about whether IBM would manage the latest big shifts: the move into the cloud, meaning computing delivered as an online service; and the rise of artificial intelligence (AI), which is a label for all kinds of digital offerings based on insights extracted from reams of data. In May Warren Buffett, chief executive of Berkshire Hathaway, a holding company, announced that his firm had sold a third of its total stake in IBM, then valued at \$13.5bn, saying that “I don’t value IBM the same way I did six years ago when I started buying.” Analysts were starting to wonder how long Ginni Rometty, the firm’s boss (pictured), would remain at the helm.

On October 17th, however, IBM’s quarterly results suggested that sceptics might just be wrong. Revenues slipped again, to \$19.2bn, but they did so less than expected. The firm indicated that it could see growth return in the next quarter and its shares rose on October 18th by 8.9%, the biggest one-day gain since 2009. Could Big Blue, still one of the world’s largest information technology (IT) firms with nearly 390,000 employees, have turned the corner?

If big IT firms often fail to adapt to such shifts, it is because these changes

require more than adopting new technology. They also force companies to question what they stand for, according to Michael Cusumano, a business professor at the Massachusetts Institute of Technology. The brand, the technical skills, how products and services are sold, must all be examined. Many firms choose to defend their existing domains instead.

After a near-death experience in the early 1990s, when sales of its mainframes collapsed, IBM seemed to have found a formula to stay ahead in technology. Under Louis Gerstner and Sam Palmisano, its former bosses, it quickly adapted to the internet and was one of the first big IT firms to back open-source software. It ditched businesses about to become commodities, such as personal computers and low-end servers. And it stuck to a financial “road map” telling investors how profitable it intended to be over the next five years. Nor did it hesitate to spend billions buying back stock to lift its earnings per share.

Yet this fixation on financial metrics (a stance that predated Ms Rometty) is a big reason why IBM had a late start in the cloud—a trend it had spotted earlier than many competitors. As a result, it is now an also-ran in cloud computing, at least in the part of it called the “public cloud”, or networks of big data centres shared by many firms. IBM is number three at best; Amazon and Microsoft lead the pack by some distance, benefiting from the growing number of firms moving applications into the cloud, rather than running them on their own computer systems. More than 40% of IBM’s revenues come from products and services that directly compete with public-cloud offerings, says Steve Milunovich of UBS, an investment bank.

IBM has tried to avoid the problem, being, for example, the first tech giant that went big on AI. Building on a technology called Watson, which in 2011 won “Jeopardy!”, an American quiz show, the firm two years later launched a new line of business to help organisations make predictions from patterns in their data. It promoted the effort heavily and invested billions,

particularly in health care, for example to help hospitals to use patient data to gauge health risks. Yet progress has proved slow, mainly because it is often hard to make sense of patient records. The M.D. Anderson Cancer Centre in Houston earlier this year cancelled a Watson project after spending \$60m because it was deemed not ready for clinical use. People in the field of AI are now dismissive of Watson, which in turn affects its ability to attract talent.

The slow take-off of the AI business makes managing the decline of old businesses while quickly growing the new ones even harder for IBM. In addition to the cloud and AI it is developing cyber-security, mobile services and offerings based on blockchains, special databases that also underlie Bitcoin, the cryptocurrency. "It's like having to run up an escalator in the wrong direction", says Frank Gens of IDC, a market-research firm.

For the past five years IBM has not been running fast enough, resulting in declining revenues. Now, according to its own measures, at least, it has enough upward momentum that it will no longer be slipping down. Revenues of what it calls "core business", or sales of IBM products and services that are used in conventional computing, fell by 9% in the latest quarter, down from 11% in the previous one. By contrast, the firm's "strategic imperatives", which mainly include the cloud and AI, grew by 10%, up from 7%. These generate 45% of IBM's business, up two percentage points from the previous quarter. "We are now exactly where we promised early this year we would be," says Martin Schroeter, the firm's chief financial officer.

Still, the company was in a similar place a year ago, only to see the decline of its old businesses accelerate and the growth of the new ones slow. This time the positive trends may continue, due to a seasonal effect around chief information officers needing to spend their budgets (last year revenue rose by \$2.5bn from the third to the fourth quarter). Mr Schroeter expects

the bump to be between \$300m and \$400m higher this time around, in part because a recently introduced new version of IBM's mainframe has been selling well.

The real test will come later on, when the effect of the new mainframes wears off and IBM must still prove that it has reached an inflection point in its efforts to change. And that will not be easy. The old core will continue to decline. Notwithstanding the success of the new mainframe models, which specialise in thwarting hacking attacks, this computing franchise "is eroding", in the words of Mr Milunovich, who expects it to continue to shrink by 3% annually. This will weaken the corporate edifice. According to some estimates, although mainframe sales generate only 2% of the firm's revenues, related software and services account for a quarter of its revenues and more than two-fifths of its profit.

As for the new businesses, they seem to be gaining momentum, but how much is unclear. IBM includes many types of related products and services in its cloud revenue, even the "private" clouds it is building for customers on their premises. But it is the public cloud that has become the centre of gravity in IT and the main source of innovation, says Mr Gens. It is where new software and, increasingly, new hardware, such as specialised AI chips, are developed. Microsoft is now even building tools for developers in the public cloud so that they can experiment with quantum computers, which are much more powerful than conventional ones.

With AI the financial picture is similarly blurry. IBM does not reveal Watson's profits. In July Jefferies, another investment bank, warned in a report that profits from IBM's AI investments may in fact only barely cover their cost of capital. The firm itself says that AI is now woven like a "silver thread through all its products", in the words of Mr Schroeter. It also says that more customers are using the technology to power new services, such as tax advice and automated customer support. And it has made certain AI

products, such as speech recognition and translation, available as online services for other firms to combine them with their own offerings. But Amazon, Microsoft and many startups sell similar “cognitive services”, some of which are said to be better than IBM’s.

The new businesses may simply not be as profitable as the old ones. Mr Schroeter says that they are and that margins will fatten (profits were down 4.5% in the past quarter, to \$2.73bn). In mid-October bounce in IBM’s shares suggest that investors are giving Ms Rometty the benefit of the doubt. But the firm has yet to show that this optimism and the expectation of a successful turnaround are justified. ■



IBM的艰难转型

蓝色巨人的憧憬

IBM在云计算方面落后，其“沃森”技术在AI领域也遭冷遇。科技业著名的“不倒翁”这次能翻身吗？

科技巨头有点像恐龙。它们大多无法成功适应新时代——用行话说就是“平台转换”。有些巨头能熬过两次甚至三次改朝换代，但只有一家公司跨越了所有更迭——那就是以生产打孔卡制表机起家、至今已届百年的IBM。

然而，在IBM连续21个季度收入同比下滑后（见图表），人们日益担忧它能否跨越最新一次重大转变：向“云端”的转移（将计算作为一种在线服务提供给用户），以及人工智能（AI，通过分析大量数据来提供的各种数字产品的统称）的崛起。今年5月，控股公司伯克希尔·哈撒韦（Berkshire Hathaway）的首席执行官沃伦·巴菲特宣布其公司已经出售所持IBM股份的三分之一，这些股份当时市值为135亿美元。他表示，“我对IBM的估值已经和六年前刚购买它股份的时候不一样了。”分析师们开始猜测IBM的老板罗睿兰（Ginni Rometty，上图）还能掌舵多久。

然而10月17日公布的IBM季度业绩表明，怀疑者也许错了。收入仍旧下滑，跌至192亿美元，但跌幅却低于预期。公司表示，可以预见下一季度收入会重现增长，而其股价在10月18日上涨了8.9%，为2009年以来最大的单日涨幅。拥有近39万员工的IBM仍是全球最大的IT公司之一，这位“蓝色巨人”已经扭转局面了吗？

如果说大型IT企业往往无法适应这类更迭，那是因为这些变化不是单靠采用新科技就能应付的。麻省理工学院的商科教授迈克尔·库苏马诺（Michael Cusumano）指出，变化还迫使企业反省自己的立场和主张。品牌、技术能力、产品和服务的营销，都必须加以审视。但许多公司都只选择守护现有领域。

上世纪90年代初，IBM的大型机销售一溃千里，在那次死里逃生之后，IBM似乎已找到了保持技术领先的秘诀。在郭士纳（Louis Gerstner）和彭明盛（Sam Palmisano）前后两任老板的领导下，公司快速调整，迈入互联网时代，并成为最早支持开源软件的大型IT企业之一。IBM舍弃了个人电脑及低端服务器等即将成为基础产品的业务。此外，它坚持按财务“路线图”行事，向投资者明示IBM未来五年的盈利目标。为提高每股收益，公司还不惜花费数十亿美元回购股票。

然而，正是对财务指标的执着（罗睿兰上任前就已如此）在很大程度上造成了IBM在云计算方面起步落后，尽管它比许多竞争对手都更早发现了这一趋势。结果，IBM如今在云计算领域只是个陪跑者，至少在该领域中的“公有云”（众多公司共享的大数据中心网络）部分是这样。IBM顶多只能排第三位，亚马逊和微软领先于大部队——得益于越来越多的公司把应用程序从自家的计算机系统转移到云端。IBM有超过40%的收入来自与公有云直接竞争的产品和服务，投资银行瑞银集团的史蒂夫·米卢诺维奇（Steve Milunovich）说。

为免再度落后于人，IBM曾作过一番努力，比如大举开发AI技术，成为第一个挺进该领域的科技巨头。2011年，IBM的“沃森”在美国电视智力竞赛节目《危险边缘》（Jeopardy!）中获胜，两年后公司以“沃森”这一技术为基础，打造并推出新业务线，根据各机构自身的数据模式协助其作出预测。公司大力推动这项工作，投入数十亿美元，特别在医疗保健方面，例如帮助医院利用患者数据衡量健康风险，然而最终进展缓慢，主要是因为病历往往难以解读。美国休斯敦的安德森癌症中心（M.D. Anderson Cancer Centre）今年早前终止了已耗资6000万美元的“沃森”合作项目，认为该技术还不足以用于临床。如今AI界人士对“沃森”不屑一顾，这进而又让该项目难以吸引技术人才。

AI业务起飞缓慢，让IBM更难于在应付旧业务衰退的同时快速发展新业务。除了云计算和AI，IBM还在开发网络安全、移动服务以及基于区块链（一种特殊数据库，也是加密货币比特币的底层技术）的产品。“这就像是逆着自动扶梯往上跑。”市场研究公司IDC的法兰克·吉恩斯（Frank

Gens) 说。

过去五年里，IBM跑得不够快，导致收入下跌。现在，至少据IBM自己的计算，公司已具备足够的上升势头令收入不再下滑。它所谓的“核心业务”收入（即用于传统计算的IBM产品和服务的销售额）最近一季度下跌9%，而再上一季度的跌幅为11%。相比之下，云计算和AI等“战略要务”的收入上升了10%，再上一季度的升幅为7%。上述方面占IBM业务的45%，比上季度增长了两个百分点。“现在的数字正是我们年初承诺要达到的水平。”公司首席财务官马丁·施勒特（Martin Schroeter）表示。

然而，IBM去年也经历了与现在类似的状况，结果只见旧业务下滑加速，新业务增长缓慢。这一次，积极态势也许能持续，原因是季节性效应——恰逢首席信息官们急需花掉手上的预算（去年第四季度收入比第三季度增加了25亿美元）。施勒特估计今年的增长额会比去年多三至四亿美元，部分原因是最近推出的新款IBM大型机销量不俗。

真正的考验还在后面。待新款大型机的效应消退后，IBM仍须证明自己已达到转型努力的拐点。这并不容易。旧的核心业务将继续衰退。尽管IBM专注于抵御黑客攻击的新款大型机销售业绩颇佳，但用米卢诺维奇的话说，公司的计算业务“正在销蚀”，他估计这一业务将继续以每年3%的幅度收缩。这将削弱IBM整个集团的根基。据一些人估计，虽然大型机的销售仅占全集团收入的2%，相关软件和服务却占其收入的四分之一、利润的五分之二以上。

至于新业务，势头似乎有所增长，但程度几何并不清楚。IBM在统计云端业务收入时纳入了许多相关产品和服务，连在客户办公地打造的“私有云”业务也算在其中。但吉恩斯表示，公有云才是IT界的重头戏，也是创新的主要来源。新软件以及越来越多的新硬件（如专门的AI芯片）正是在公有云上开发的。微软甚至在公有云上为开发人员构建工具，方便他们试用比传统计算机强大得多的量子计算机。

在AI业务上，财务状况同样模糊不清。IBM没有透露“沃森”带来的利润。

今年7月，另一家投资银行杰富瑞集团（Jefferies）在一份报告中警告说，IBM的AI投资产生的利润实际上只能勉强抵消资本成本。IBM引用了施勒特的说法，称AI技术“像银线一样，贯穿在所有产品中”。公司还表示，越来越多客户正在运用AI技术驱动新服务，例如税务咨询及自动化客服。IBM还在线提供语音识别和机器翻译等AI产品，供其他公司将这些产品与自己的服务相结合。但亚马逊、微软及许多创业公司都在销售类似的“认知服务”，有的产品据说比IBM更胜一筹。

新业务的盈利水平也许根本不如旧业务。但施勒特表示不然，并称公司利润将上升（但其上季度利润为27.3亿美元，下降了4.5%）。IBM股价在10月中旬反弹，显示投资者选择相信罗睿兰。但IBM还需要证明，这种乐观和对其成功转型的期望是合理的。 ■



Norway's \$1trn wealth fund

Something for a rainy day

Norway's sovereign-wealth fund surpassed \$1trn in assets

A year earlier than expected, Norway's sovereign-wealth fund, the world's largest, surpassed \$1trn in assets on September 19th. It had gained over \$100bn in the past year, thanks in large measure to the global stockmarket boom in 2017: around two-thirds of its assets are held as equities (over 1% of shares globally). It helps that Norwegians continue to earn fat revenues from pumping North Sea oil and gas, which go to the fund to be invested abroad. The fund is so big it is becoming a tool for 5m-odd Norwegians to shape values abroad. It is an increasingly activist shareholder, speaking out on executive pay, ethical behaviour, companies' use of water, child labour and more. Both its size and influence are likely to keep on growing. ■



规模达一万亿美元的挪威主权财富基金

未雨绸缪

挪威主权财富基金的资产规模突破一万亿美元

9月19日，世界最大的主权财富基金挪威主权财富基金的资产规模突破一万亿美元大关，比预期早了一年。去年该基金的营收超过1000亿美元，很大程度上要归因于2017年全球股市的繁荣：其资产中大约有三分之二以股权形式存在（在全球股市市值的占比超过1%）。挪威持续通过开采北海的油气获得丰厚的收入，这一点也有助益——所获收入被注入该基金，用于在国外投资。该基金规模如此之大，正成为五百多万挪威人在国外塑造价值观的工具。它日益扮演维权股东的角色，公开就高管薪酬、道德行为、公司用水、童工等其他多种事务发表意见。该基金的规模和影响力都可能继续扩大。 ■



The future

Part and parcel

How e-commerce will change cities and jobs

A STRETCH OF Bleecker Street, in Manhattan's West Village, is among the loveliest in New York, with quaint shopfronts opening on to tree-lined pavements. Until recently a landfill across the Hudson river, in New Jersey, was among the region's most repulsive. For years smouldering hazardous waste sparked fires among the rubbish. But Bleecker Street is now dotted with empty shops, their landlords unable to find tenants. The lot in New Jersey has been cleaned up and turned into a giant warehouse by Prologis, the world's biggest industrial-property firm. The chemical fires are out. Delivery trucks are in.

E-commerce will not obliterate all retail trade. Stores that are distinctive in one way or another—because they offer excellent service, for instance, or unique products—will remain. But consider the change already wrought in America, where e-commerce accounts for about one-tenth of retail spending. If that share were to rise to one-fifth, let alone one-third, the effects would be vast. In the longer run the impact of e-commerce will not be limited to the conventional retail industry it is increasingly replacing. It will also change how consumers spend their days, transform the landscape, disrupt workers' lives and reshape governments' view of corporate power.

For consumers, e-commerce has ushered in a golden age. They can choose from more products of better quality than ever and spend far less time and effort to get what they want. Once-complacent manufacturers must compete fiercely for their business. No wonder Amazon is the most popular company in America, according to a recent Harris poll.

But there are downsides, too. Debates over privacy will intensify as

consumer tracking online, at home and in shops becomes ever more pervasive. Companies say they anonymise and aggregate customer data collected by tracking, but their methods are opaque, says Marc Rotenberg, head of the Electronic Privacy Information Centre. In essence, firms just tell consumers that “we will take care of it”, he says. “I don’t think that reassurance is adequate.”

The effects of e-commerce on the physical landscape are just beginning. So far, the most notable changes have been in rich countries, and particularly in America. Recent announcements of store closures by Macy’s, Gap and American Eagle will be followed by more. According to Green Street Advisors, a property firm, sales by department stores continue to shrink faster than the selling space of the stores themselves.

As demand for physical shops ebbs, that for warehouses will surge. Citi estimates that 2.3bn square feet (214m square metres) of new warehousing—equivalent to about 20,000 football pitches—will be needed worldwide over the next 20 years. But what will happen to the shops that no longer have enough customers, and where will the new warehouses go? There is no easy way of turning one into the other. Companies want to build warehouses close to consumer hubs, but the malls most likely to shut down are farther afield.

So warehouses will probably be built close to residential developments, with which they are already competing for land. In Enfield, an area of north London, logistics centres and new homes are being built side by side. Since land is scarce and expensive, warehouses will get taller, as many in Asia already are. For same-day deliveries, smaller distribution centres will spring up near central business districts. Rents there are likely to rise.

| *How about a cycling studio?*

The future for ailing stores is less certain. Many shops in big cities will

remain, less as sales hubs than as showrooms. Rents for them will probably come down. Retail rents are already falling in America and in much of Asia, according to CBRE, a property agency. One space in midtown Manhattan formerly occupied by clothes retailers now contains a coffee shop, a smoothie bar and a cycling studio. But there may not be enough of those to take over all the retail space that will become vacant in the years ahead. In places where there is little demand from the private sector, governments may have to step in. In Cleveland, Ohio, one large store has become a community centre, with a gym and offices for city employees, financed by municipal bonds.

An even hotter topic is the effect of all this on employment. So far the decline in traditional retail jobs in America seems to have been offset by a rise in warehousing work. Between 2007 and 2017 the number of retail jobs shrank by 140,000 while those in e-commerce and warehousing rose by about 400,000, according to Michael Mandel of the Progressive Policy Institute, a think-tank. But the net gain in jobs may be temporary. Stores are only now starting to close, and those that remain are just testing automation. More robots will be used in warehouses, too, as their costs come down and their picking skills improve.

That need not be a bad thing. In America, real retail wages have been flat for three decades. Technological change will improve productivity and create new types of work, and the jobs that remain will probably be better paid. But workers will need new skills as stores try to create more footfall.

The question looming over all this is whether governments might step in. Chinese leaders may want to exert more control over their powerful technology giants. According to one report, the state is mulling a direct investment in some of them. In America, Donald Trump periodically skewers Amazon: he has claimed that the *Washington Post*, which is owned by Mr Bezos and has criticised Mr Trump, intimidates politicians into

granting Amazon favourable tax treatment. The firm now pays sales tax in every American state that has one. Antitrust enforcers judge firms based on market control, where Amazon does not look overmighty, and the effect on consumers, who so far seem to have only gained. But scrutiny in America is likely to intensify, though the most imminent regulatory risk for Amazon may be abroad. In October the European Commission ordered Amazon to pay back taxes. It recently slapped Google with a €2.4bn (\$2.8bn) fine for using its power as a search engine to boost its comparison-shopping business; more action against e-commerce platforms may follow.

Barring any dramatic intervention, however, the biggest e-commerce sites look set to get bigger. Amazon and Alibaba typify a new breed of conglomerate that benefits from network effects. The more shoppers firms can muster, the more sellers will flock to them, attracting yet more shoppers. These effects are turbocharged by the breadth of their businesses and the vast amount of data they generate. This does not mean they will dominate every sector or market, but their mere presence in an industry will reshape it. The question is not if they will keep upending retailing, manufacturing and logistics, but which industry and part of society they will change next. ■



未来

核心势力

电子商务将如何改变城市和工作

位于曼哈顿西城的布里克街（Bleecker Street）有一段是纽约市最迷人的街道之一，绿树成荫的人行道两旁开着各种别致的店面。在哈德逊河的另一边，新泽西州的一个垃圾填埋场直到最近都是该地区数一数二的令人反胃的地方。多年来，冒着烟的危险废品不时在垃圾堆里引发火情。不过，布里克街如今散布着空空荡荡的店面——房东找不到新租户了。而新泽西的这片垃圾填埋场已清理干净，被全球最大的工业物业公司安博（Prologis）改建成了一个巨大的仓库。化学品火灾不复存在，送货的卡车进进出出。

电子商务不会取代所有的零售业务。那些以某种形式独树一帜的商店，比如提供一流的服务或者独特的产品，还会保留下来。但是，让我们想想在美国已经发生的变化——电子商务约占零售支出的一成。假如这一占比升至五分之一甚至三分之一，其影响将是巨大的。从长期看，电子商务的影响不会只限于它正日益取代的传统零售业，它还将改变消费者的生活，改造城市景观，颠覆劳动者的人生，重塑政府对企业权力的认知。

对消费者来说，电子商务带来了一个黄金时代。他们如今有了比以往更多更好的选择，花费在购物上的时间和精力也更少了。过去安于现状的制造商如今必须展开激烈的竞争。难怪，最近的哈里斯民调显示，亚马逊是目前美国最受欢迎的企业。

但它也不是十全十美。对消费者的网上追踪——不论他们在家里还是实体店购物——变得日益普遍，围绕隐私问题的争论将愈发激化。企业称自己对追踪收集的顾客数据做了匿名处理，但它们使用的方法并不透明，电子隐私信息中心（Electronic Privacy Information Centre）的主管马克·罗滕贝格（Marc Rotenberg）说。基本上，企业只是告诉消费者，“我们会妥善处理的，”他说，“我认为这样的保证并不充分。”

电子商务对实体景观的影响才刚刚开始。到目前为止，最明显的变化发生在富裕国家，尤其是在美国。近年，梅西百货、盖璞（Gap）和美鹰傲飞（American Eagle）宣布关闭大批实体店，还会有更多公司步其后尘。根据物业公司绿街顾问（Green Street Advisors）的数据，百货公司销售额的下跌速度继续快过这些店铺面积缩小的速度。

对实体店铺的需求在减退，对仓库的需求却会飙升。花旗银行估计，未来20年里，全球将需要兴建2.14亿平方米的仓库——约相当于两万个足球场。但那些门庭冷落的店铺会如何呢，而新仓库又会出现在哪里？并没有简单的方法将店铺直接转变成仓库。企业想在靠近消费者聚集地的地点建仓库，而最可能关门的商场都位于偏远的地点。

因此，仓库可能会盖在新建住宅区的附近，它们已经在那里争夺地盘了。在伦敦北部的恩菲尔德（Enfield），物流中心和新住宅比邻而居。由于土地稀缺又昂贵，仓库会越建越高——在亚洲很多仓库已是如此。为“当日发货”配备的小型发货中心将在临近中心商业区的地点涌现，那里的租金很可能会升高。

| 改换成动感单车？

那些乏人问津的商铺的未来就不那么确定了。大城市里的许多商铺还会保留，但会更多地充当陈列展示厅而非销售中心。向它们收取的租金可能会下降。不动产服务公司世邦魏理士（CBRE）公司称，在美国和亚洲大片地区，租金已经在下跌。在曼哈顿中城的某处，过去是间服装店，现在包括一家咖啡馆、一间奶昔饮料屋和一个动感单车健身房。不过，可能并没有那么多这类店铺来取代未来多年里腾空的零售店。那些民间需求少的地方可能需要政府的干预。在美国俄亥俄州的克利夫兰市，一个大型商场已经变成了社区中心，里面有为公务员准备的健身房和办公室，它靠发行市政债券来融资。

一个更热门的话题是所有这些变化对就业的影响。到目前为止，美国传统零售业职位的减少似乎都已经由仓储类职位的增加所弥补。智库发展政策研究院（Progressive Policy Institute）的迈克尔·曼德尔（Michael

Mandel) 说，2007年到2017年的十年间，零售业职位减少了14万个，而电商和仓储类职位增加了约40万个。但职位的净增长可能只是暂时的。商铺的关闭潮才刚刚开始，而那些保留下来的商铺正在测试自动化技术。随着机器人成本的下跌以及机器人抓取货物的技能增长，仓库也会使用更多机器人。

但这不一定是坏事。在美国，实际零售业工资在过去30年里没有变化。技术变化可能会提升生产率，并创造新型职位，而留下来的岗位报酬可能会增加。不过，在商铺尽力创造客流之时，工人们也需要拥有新的技能。

一个困扰全局的问题是政府是否会出手干预。中国领导人可能想要对国内影响力强大的技术巨头施加更多控制。据一份报告称，中国政府正仔细考虑直接投资于其中一些企业。在美国，特朗普时不时地严厉斥责亚马逊。他声称，曾经指摘过自己并由贝索斯拥有的《华盛顿邮报》曾威吓政客，让亚马逊得到税赋优惠。亚马逊如今在所有征收销售税的州都要缴纳消费税。反垄断执法者根据企业的市场控制力和对消费者的影响来评判它们，但亚马逊看起来势力还不至于过大，而到目前为止消费者看来都是受益方。但美国的监管很可能加强，不过亚马逊最急迫的监管风险可能发生在国外。10月，欧盟委员会勒令亚马逊补缴税款。欧盟近期已对谷歌罚款24亿欧元（28亿美元），它称该公司利用其搜索引擎的影响力来提升自己的比价购物业务。未来可能会有更多针对电商平台的行动纷至沓来。

除非发生剧烈的干预，否则最大的电商网站势必越变越大。亚马逊和阿里巴巴代表了新一类从网络效应中获益的企业集团。这些企业能聚集的顾客越多，就会有越多店家涌进其平台，继而吸引更多的顾客。这一效应又因为这些平台本身业务的广度以及它们生成的海量数据而增强。这并不是说它们将主导每个行业或市场，但是，只要它们出现在某个行业或市场，就会带来重塑。问题并不在于这些企业会不会继续颠覆零售业、制造业和物流业，而是它们接下来将改变哪一个行业和社会的哪一部分。■



Traditional retailing

Shop till you drop

The painful metamorphoses of physical shops

WHEN AMERICA'S RETAIL bosses gathered in New York earlier this year for the annual shindig of their trade association, the National Retail Federation, there was much talk about new technology to improve the industry's prospects, from sensors that read consumers' facial expressions to machine-learning software that can optimise prices. The ghost at the banquet was the company that gave no presentations but made its presence felt everywhere: Amazon.

Traditional retailing has had a tough time lately. Traffic in shopping centres in Europe's biggest markets has been declining. In America, which has about five times as much space in shopping centres per person as Britain, the pain is acute. Chains that were faltering even before Amazon's ascent are now in even deeper trouble. Macy's, a department store, last year said it would close 100 of its 728 shops. Fung Global Retail & Technology, a consultancy, expects nearly 10,000 stores in America to close this year, about 50% more than at the height of the financial crisis in 2008. And there will be more to come.

Shops used to compete by offering a combination of selection, price, service and convenience. E-commerce's most obvious edge is in selection and convenience. Even the biggest store cannot hold as many items as Amazon can offer. Walmart conquered America by saving consumers money; Amazon is doing the same by saving them time. Shops still provide immediacy and a personal experience. But though getting attentive service at Gucci may be fun, waiting to pay at the supermarket is not.

E-commerce firms are also competing on new kinds of service and pricing.

A website knows more about you than any shop assistant can, enabling it to offer personalised recommendations straight away. Online, a shopper can easily compare prices between retailers. More intriguingly, merchants can quickly move prices up or down, using bots to match competitors' offerings. Eventually this pricing may become more personalised. Alibaba and JD already use their troves of data to offer discounts on particular products to some of their customers.

All this has meant that consumers are now buying a wider range of goods online. The shift has been most dramatic in America, home to both a relentlessly disruptive e-commerce giant and a herd of entrenched retailers (which China lacks). Consumers still buy certain types of goods in stores, such as food and building equipment. But many shops have had no choice but to follow consumers online, setting up their own e-commerce businesses as they maintain their bricks-and-mortar ones. In the short term, this only exacerbates their problems. Building an e-commerce business on top of a traditional one is costly; firms must create websites and ship products to individual consumers, rather than to stores in bulk.

It does not help that Amazon has conditioned consumers to think delivery should be free. Moreover, online sales often cannibalise those from existing shops. Analysts at Morgan Stanley reckon that for each additional percentage point of shopping that moves online, a retailer's margins shrink by about half a point. Bricks-and-mortar shops also often have trouble recruiting technology staff. For a hotshot data scientist, working at a department store is not an obvious choice. Traditional chains must routinely pay a premium to lure skilled tech workers. Amazon has no such difficulty.

Startups, tech firms and consultants are offering tools to help smaller retailers adjust. Some of the more interesting ones promise to narrow the gap between what e-commerce sites and physical stores know about their

customers. Floor mats can measure store traffic, video analytics will track shoppers' age, sex and mood, and beacons can gather data about what customers do in the shop once they have signed up for free Wi-Fi. For now, though, many American firms are reluctant to invest in such expensive new technology for shops that may not be there for much longer.

In China, those offering to remedy retailers' woes include some of the big e-commerce firms, and retailers may be happy to work with them because their platforms are so pervasive. In the West, small merchants already pay Amazon to list products on its site and store goods in its warehouses. The small sellers can reach more consumers more easily; Amazon earns fees and, thanks to sellers' listings, can offer a broader selection.

Big retailers, on the other hand, seem much less likely to team up with Amazon. Target and Toys"R"Us chose Amazon to handle their e-commerce businesses in the early 2000s, but both ended the partnership, with Toys"R"Us doing so in court. Unlike Alibaba, Amazon owns much of the stuff it sells, so competes directly with any seller that uses its services.

Despite such troubles, there are examples of how bricks-and-mortar shops might thrive. One strategy is to offer distinctive products that are not available elsewhere (as does Zara, a clothing chain owned by Inditex), or which are difficult to sell online. A second is to give shoppers a great deal. TJX, an American firm, offers manufacturers' surplus goods at bargain prices. Another option is a great experience: champagne at Louis Vuitton, perhaps, or personalised advice at Nike. The most difficult route is to try to match Amazon's retail standards and offer more.

Walmart, once the undisputed king of American retailing, is mounting the boldest counteroffensive. It can no longer simply open stores to boost growth; 90% of Americans already live within ten miles of a Walmart. So the company is seeking to protect its margins by making stores even more

efficient—saving \$7m by printing shorter receipts, for instance—while investing online. Last year it spent \$3.3bn buying Jet.com, an e-commerce site founded by Marc Lore, who now oversees Walmart's suite of online businesses. He is not trying to match Amazon's breadth. "We are focused on being a retailer," he declares. But Walmart is trying to catch up with Amazon in other ways. The company now offers free two-day shipping. Just as JD's integration with Tencent is helping it challenge Alibaba, Walmart may succeed by partnering with tech giants. In August it said it would sell through Google's voice assistant, in a bid to counter Amazon's Alexa.

Walmart can also use its vast network of stores to do things Amazon cannot. In one experiment, Walmart staff drop off customers' orders on their way home. And as America's biggest grocer, it has developed an easy way for customers to order food online, then drive to a Walmart where staff load it into their car.

Even as Walmart adapts, however, Amazon continues to morph. It is using machine learning to measure the ripeness of a peach and to determine how many blue shirts to stock in which size. Constant innovation gives it a huge competitive advantage which many retailers will struggle to match. Too many physical stores lack the strategy or distinctive merchandise that might help them thrive in retail's new era. And in the main they still rely on the customers coming to them to choose their purchases, whereas their rivals deliver. ■



传统零售

买到腿软

实体店的痛苦嬗变

今年早些时候，美国零售业老板在纽约经济一堂，参加行业协会全国零售联合会一年一度的庆典。会上很多人谈论利用新技术来改善行业前景，从用传感器读取消费者面部表情，到可以优化价格的机器学习软件。然而宴会上的幽灵是那家并未发表演讲却无处不在的公司：亚马逊。

传统零售业近来时运不济。欧洲最大市场的购物中心人流量一直在下降。对于人均购物中心空间约为英国五倍的美国而言，更是疼痛难忍。在亚马逊崛起之前就摇摇欲坠的那些连锁店如今形势更加严峻。梅西百货公司去年表示将关闭其728家门店中的100家。咨询公司冯氏全球零售及科技研究（Fung Global Retail & Technology）预计，美国今年将关闭近万家门店，比2008年金融危机最严重时还要高出约50%。而且未来还会关闭更多。

商店以前通过提供选择、价格、服务和方便的组合来竞争。电子商务最明显的优势在于选择和方便。即使是最大的商店所容纳的商品数也无法与亚马逊媲美。沃尔玛通过为消费者省钱征服了美国，亚马逊则是通过为他们节省时间而开疆拓土。商店仍然提供即时性和个性化体验。但是，尽管在古驰（Gucci）享受贴心服务可能很有趣，在超市排队付钱就另说了。

电子商务公司也在新服务和定价方面竞争。网站比任何店员都更了解你，能够立即提供个性化的建议。在线购物者可以轻松比较零售商之间的价格。更有趣的是，商家可以快速上调或下调价格，使用机器人来匹配竞争对手的出价。到头来，定价可能会更加个性化。阿里巴巴和京东已经在用自己的数据宝库为某些客户提供特定产品的折扣。

所有这一切意味着消费者在网上购买的商品种类越来越广泛。这一转变在美国最为显著，一边是无情碾压的电子商务巨头，一边是一群地位根深蒂固的零售商（中国并没有这些）。消费者仍然在商店购买某些类型的商

品，如食品和建筑材料。但是，许多商店别无选择，只能跟随消费者上线，建立自己的电商业务，同时保留实体店。在短期内这只会加剧它们的困境。在传统业务之上建立电商业务花费不菲；公司必须创建网站并把产品寄送给个体消费者，而不是批量送进商场。

亚马逊已经让消费者认定送货应该是免费的，这一点更是雪上加霜。此外，在线销售往往会侵蚀现有商店的业务。摩根士丹利的分析师认为，每有一个百分点的销售转移到网上，零售商的利润率就降低约半个点。实体店在招聘技术人员时也经常遇到困难。对于出色的数据科学家来说，在百货公司工作并不是一个显而易见的选择。传统的连锁店必须经常付出额外的高价来吸引熟练的技术人员。亚马逊则没有这样的困难。

创业公司、科技公司和咨询公司正在提供工具来帮助小零售商做出调整。一些更有趣的公司承诺缩小电子商务网站和实体店对客户了解程度的差距。地垫可以测量店面流量，视频分析将跟踪购物者的年龄、性别和情绪，信标可以在客户注册免费无线网后收集有关客户在店内做什么的数据。然而，现在很多美国公司都不太愿意为那些可能撑不了多久的商店投资此类昂贵的新技术。

在中国，一些大型电子商务公司愿意为零售商的困境出一把力，而由于这些大企业的平台普及度如此之高，零售商可能会乐意与其合作。在西方，小商家已开始向亚马逊付费，把产品挂在其网站上，并把货物存放在其仓库中。小商家可以更容易地接触到更多消费者，亚马逊会收取费用，而由于卖家上货，它可以提供更多样的选择。

反过来，大型零售商似乎不太可能与亚马逊合作。塔吉特和玩具反斗城在21世纪初选择了亚马逊来管理其电商业务，但都结束了合作关系，玩具反斗城甚至是在法庭中与亚马逊了断的。与阿里巴巴不同，亚马逊拥有其销售的大部分东西，因此可以直接与任何使用其服务的卖家竞争。

尽管有这样的麻烦，仍有一些实体店繁荣兴旺的例子。一个策略是提供其他地方没有（如盈迪德[Inditex]集团旗下的服装连锁店飒拉[Zara]）或难以

在线销售的独特产品。第二个是给购物者很好的折扣，比如美国公司TJX以便宜的价格提供制造商的剩余库存。另一个选择是出色的体验：路易威登的香槟，或是耐克的个性化建议。最困难的路线是尝试匹配亚马逊的零售标准并提供更多服务。

昔日美国无可争议的零售之王沃尔玛正在开展最勇猛的反击。它无法再单靠开店来促进增长；90%的美国人已经住在距沃尔玛10英里以内的地方。因此，该公司正在通过进一步提升商店效率来保护利润率，比如通过缩短打印收据省下了700万美元，同时启动在线投资。去年，它斥资33亿美元买下由马克·罗尔（Marc Lore）创立的电子商务网站Jet.com，马克如今负责沃尔玛的在线业务部门。他并不想追求亚马逊的广度。“我们专注于零售商的身份。”他表示。但沃尔玛正试图以其他方式赶上亚马逊。该公司现在提供免费两天送货。正如京东与腾讯的整合正在帮助它挑战阿里巴巴，沃尔玛也可能通过与科技巨头合作获得成功。今年8月，它表示将通过谷歌的语音助手进行销售，以对抗亚马逊的Alexa。

沃尔玛也可以利用其庞大的门店网络来做亚马逊做不到的事情。在一个实验中，沃尔玛员工在回家时顺路为客户送货。这家美国最大的食品杂货店也已经开发了一种简便的方法，让客户可以在线订购食品，然后开车到沃尔玛，由员工将货物装到他们的汽车上。

即使沃尔玛适应了，亚马逊也会继续嬗变。它正在使用机器学习来测量桃子的成熟度，并确定要库存多少件什么尺寸的蓝色衬衫。不断创新给它带来了巨大的竞争优势，许多零售商都将难以匹敌。太多实体店缺少能让它们在零售新时代兴盛发展的策略或特色商品，而且它们主要还是依靠客户到店选购，但竞争对手则是将商品送到眼前。■



Manufacturing

Burying the Hachette

Makers of goods, from books to biscuits, are trying to adapt to e-commerce

NO COMPANY WANTS to replicate what happened to Hachette in 2014, when the publisher balked at Amazon's terms. Suddenly its book shipments seemed to be delayed and Amazon was recommending titles from other publishers. The dispute ended with Hachette getting more control over pricing. But the deal showed the risks for producers of all kinds as online platforms gain strength.

The old system suited many businesses. Clothing manufacturers followed a predictable calendar for when goods would be produced and distributed. Giant makers of household products and food had to deal with stingy retailers such as Walmart, but they could also swat away smaller competitors with spending on expensive television ads.

E-commerce is changing all this. Companies that sell dresses and shoes to conventional retailers like Macy's find them in turmoil, threatened both by online sellers and by nimbler bricks-and-mortar ones such as Zara. For larger producers of packaged consumer goods, the rise of e-commerce compounds problems created by customers' increased interest in healthier, more "natural" products. E-commerce helps small rivals distribute their products. Thanks to online reviews and blogs, shoppers no longer have to rely on big brands.

Yet for those brands, all is not lost. Evidence from Sanford C. Bernstein, a research firm, suggests that the strongest ones will be fine, just as Adele and Taylor Swift have thrived in the age of streaming music; it is the mediocre brands that will fade away as both smaller competitors and giant ones flourish. And e-commerce brings its own opportunities. Alibaba and

JD make it easier for big firms to reach China's smaller cities, which are expected to provide more than 70% of new online shoppers by 2020. New distribution methods can also reap efficiencies by cutting out the middleman. Other stages of a product's life such as design and production might be transformed, too. Mattel, an American toy company, is working with Alibaba to mine the Chinese firm's data to develop toys that appeal to Chinese mothers.

E-commerce is also changing how manufacturers advertise their goods. Companies have long used cookies to follow consumers around the web, bidding in automated auctions to place ads before the right kind of shoppers. Now those strategies are being further refined. Sebastien Szczepaniak, an Amazon veteran, is head of e-commerce for Nestlé, the world's biggest food company. He matches Amazon's data with Nestlé's own sources to target messages to individuals rather than just to certain types of consumers. "We are moving from marketing to the unknown to marketing to the known," he explains. Chinese e-commerce firms, given the scope of their activities, have even more useful data about consumers' habits and purchases, both online and in stores.

Meanwhile all producers will continue to worry about big online platforms amassing too much power. It is Amazon, not the companies that sell on it, that knows what customers buy, and when. It makes some of these data available to others, for a fee, but Ali Dibadj of Bernstein notes that the data are limited and come at a high price.

Amazon now looks set to wield even more power over manufacturers. Alexa can suggest that consumers buy certain items, for instance, and might eventually be programmed to shop automatically. "We'll be having bots trying to influence your bots about buying our products," predicts Keith Weed, chief marketing officer for Unilever. To complicate matters, Amazon is steadily introducing its own private-label goods to compete. Mr

Bezos's tolerance for low profits—"Your margin is my opportunity," as he once put it—provides little comfort.

"We need Amazon, and Amazon needs us," says Mr Szczepaniak. But another executive privately describes the company as a "freight train" heading for his business. In future, many makers the world over are likely to pursue a three-part strategy, distributing on sites such as Amazon, in stores and through their own channels. Avoiding the first option is getting increasingly hard. Nike, which had withheld its products for years, recently agreed to sell on Amazon after all. ■



制造业

埋葬阿歇特

从图书到饼干的商品制造者正努力适应电商时代

没有哪家公司想重复阿歇特图书出版集团（Hachette）在2014年的遭遇。当时这家出版社拒绝了亚马逊的条款，一夕之间，它的图书在亚马逊上的发货似乎开始延迟，而亚马逊开始向用户推荐其他出版商的书。这场争端以阿歇特获得更大的定价控制权收场，但这场交易显示出，网上平台影响力增加之时，也为各类生产商带来了风险。

旧有体系对众多行业的生产商均适用。服装生产商遵循一张何时生产和发货的可预测时间表。大型家居用品和食品生产商必须和沃尔玛这类尽力压价的零售商打交道，不过它们也能通过在电视广告上一掷千金来赶走小型竞争对手。

电子商务正在改变这一切。那些向梅西百货等传统零售商供货的鞋服类企业发觉自己陷入了困境，受到在线上销售平台和Zara等更灵活的实体店的夹击。而对于规模更大的快速消费品生产商，电子商务的崛起加剧了它们原本就面临的一个问题：顾客对更健康、更“天然”的产品越来越感兴趣。电子商务帮助小型竞争对手销售产品。而有了网上评价和博客后，人们在购物时不再需要依赖大品牌。

不过，这些大品牌还没有输掉比赛。调研公司盛博（Sanford C. Bernstein）的数据显示，最强大的品牌不会有什么问题，就像阿黛尔和泰勒·斯威夫特在在线音乐的年代也一样走红。逐渐退出人们视线的将是那些中档平庸的品牌，而小型竞争者和巨头都会繁荣发展，电子商务本身也带来了机遇。阿里巴巴和京东让大企业更容易覆盖中国的小城市，预计到2020年，这些城市将带来超过70%的新增网上购物人口。新的销售方式也因为砍掉了中间人而提升了效率。产品制造的其他阶段，如设计和生产也可能会遭遇变革。美国玩具公司美泰（Mattel）正和阿里巴巴合作，挖掘后者拥有的数据，力图研发出能吸引中国妈妈们的玩具。

电子商务也在改变制造商做广告的方式。长期以来，企业使用网页的 cookie 来追踪消费者，并投标自动广告位，将广告推送到目标用户的眼前。如今这些策略正得到进一步完善。塞巴斯蒂安·什切潘尼亚克（Sebastien Szczepaniak）曾在亚马逊任职多年，如今是全球最大食品公司雀巢的电商部主管。他将亚马逊的数据和雀巢自身的信息源匹配，向每个消费者而非某类消费者发送定制化消息。“我们正从‘向未知目标推销’转向‘向已知目标推销’。”他解释道。中国的电商企业由于业务范围广，拥有更多有用数据，比如消费者线上线下的习惯和购物记录。

与此同时，所有生产商都会继续担忧大型线上平台会聚集太多的市场影响力。知道顾客在何时买了什么的是亚马逊，而不是那些在亚马逊上卖东西的店家。亚马逊将一部分这类数据有偿提供给商家，但盛博的阿里·迪巴迪（Ali Dibadj）指出，这些数据很有限，而且收费很高。

现在看来，亚马逊势将对制造商产生更大的支配力。比如，亚马逊的 Alexa 能建议消费者购买某些东西，最终可能会被编程用来自动购物。“我们将会用机器人尝试影响你的机器人来买我们的产品。”联合利华首席营销官基斯·威德（Keith Weed）预测道。而让情况更复杂的是，亚马逊正在稳步推出自有品牌来加入竞争。贝索斯对低利润的容忍程度更是雪上加霜。“你的利润就是我的机会。”他曾说。

“我们需要亚马逊，亚马逊也需要我们。”什切潘尼亚克说。但另一个高管私下形容亚马逊仿佛一列向他的企业逼近的“货运列车”。未来，世界各地的众多制造商很可能都会采取一个三方位策略，通过亚马逊等网站、实体店，以及自己的渠道来分销。要避开第一个选项变得越来越难了。耐克曾坚持不进亚马逊多年，最近不还是接受了后者的邀请？ ■



Going global

Home and away

E-commerce giants are trying to export their success

IN SEPTEMBER 2014 Jeff Bezos announced his first big investment in India, hopping aboard a colourful bus in Bangalore. It was the start of a rapid \$5bn investment in India, part of Mr Bezos's plans to take Amazon global. Two months later Alibaba's Jack Ma appeared in Delhi. "We will invest more in India," he declared. The following year Alibaba put \$500m into Paytm, an Indian digital-payments company. This year it led a fundraising round for Paytm's e-commerce arm. The two giants seem set for an epic clash in India.

But in their home markets they have so far stayed out of each other's way. Amazon has only a tiny business in China. Alibaba's strategy in the United States has been to help American businesses sell in China and vice versa. "People always ask me, when will you go to the US?" says Alibaba's CEO, Mr Zhang. "And I say, why the US? Amazon did a fantastic job." The two firms have mostly invested in different foreign markets: Alibaba across South-East Asia and Amazon across Europe. But much of the rest of the world is still up for grabs.

The biggest tussles will probably be over growing economies and cross-border commerce. Alibaba aspires to serve 2bn customers around the world within 20 years—a benevolent empire that supports businesses. In some cases it has begun with digital payments, as in India with Paytm. In others it has invested in e-commerce sites, as with Lazada, in South-East Asia. But it intends to build a broad range of services within each market, including payments, e-commerce and travel services, and then link local platforms with Alibaba's in China.

Mr Ma wants to enable small firms to operate just as nimbly as big ones on the global stage. Alibaba helps Chinese companies sell in places such as Brazil and Russia, and assists foreign firms with marketing, logistics and customs in China. Eventually it hopes to use its technology to link logistics networks around the world so that any product can reach any buyer anywhere within 72 hours. That is still a long way off, but it gives a glimpse of the company's staggering ambition.

Amazon already earns more than one-third of its revenue from e-commerce outside North America. Germany is its second-biggest market, followed by Japan and Britain. This year it bought Souq, an e-commerce firm in the Middle East. Its criteria for expansion elsewhere include the size of the population and the economy and the density of internet use, says Russ Grandinetti, head of Amazon's international business. India has been one of its main testing grounds.

Amazon, like Alibaba, also wants to help suppliers in any country to sell their products abroad. An Amazon shopper in Mexico, for instance, can buy goods from America. Mr Grandinetti sees such cross-border sales as an increasingly important component of Amazon's value to consumers and sellers alike.

Yet both companies run the risk that strategies which did well in their home countries may not succeed elsewhere. In China, for instance, the popularity of e-commerce relied on a number of special factors. China's manufacturers often found themselves with excess supplies of clothes and shoes; Alibaba provided a place to sell them. Alipay thrived because few consumers had credit cards. China has also benefited from having cheap labour and lots of big cities—more than 100 of them with over 1m people—creating a density of demand that made it worthwhile for logistics firms to build distribution networks.

As they expand, however, Amazon's and Alibaba's business models may shift and, in some markets, start to converge. So far the companies have differed in important ways. Amazon owns inventory and warehouses; Alibaba does not. But Alibaba has a broader reach than Amazon, particularly with Ant Financial's giant payments business. As Amazon grows, it may become more like Alibaba. In India, for instance, regulations prevent it from owning inventory directly. And Amazon recently won a licence from the Reserve Bank of India for a digital wallet. Alibaba, for its part, may become more like Amazon. As the Chinese firm set its sights on South-East Asia, it invested in SingPost, Singapore's state postal system. In September it became the majority owner in Cainiao, a Chinese logistics network, and said it plans to spend \$15bn on logistics in the next five years.

Their advances may be slowed by other rivals. Smaller firms can flourish in niches. Flipkart, whose backers include Naspers and SoftBank, is competing fiercely with Amazon in India; the two companies routinely bicker over which has the bigger market share. Yoox Net-a-Porter, an online luxury-goods seller, is also expanding around the world.

Among the questions facing the two giants are whether other technology firms will pour more money into e-commerce, and what partnerships might emerge. Tencent's WeChat Pay is already challenging Alipay in China. About one-third of WeChat's users in China shop on that platform. Tencent is trying to recruit shops to accept its payment app in other countries, too, and recently took a stake in Flipkart. In deploying its services abroad, Tencent might get a helping hand from Naspers. The South African company owns about one-third of Tencent and has backed e-commerce firms around the world. Facebook is now muscling in on this business by making it easier for its users to buy goods through its messaging service as well as its other platforms, WhatsApp and Instagram.

| *The A-list still stands*

For now, however, Amazon and Alibaba remain each other's most formidable international rivals. Success in e-commerce requires scale, which needs lots of capital. Local e-commerce firms in India have come under pressure from investors to boost profitability. Amazon has no problems on that score. As Amit Agarwal, head of Amazon India, puts it: "We will invest whatever it takes to make sure we provide a great customer experience."

Big firms also have a natural advantage as they expand, because technologies developed for one market can be introduced across many. "It's like a Lego set," says Lazada's chief executive, Maximilian Bittner. He can use pieces of Alibaba's model, such as algorithms for product recommendations, to improve Lazada's operations. Amazon's investments in machine learning have myriad applications anywhere in the world.

That does not mean that Amazon and Alibaba will dominate every country around the world, nor that they will crush every competitor. Bob Van Dijk, chief executive of Naspers, maintains there is room for many operators: "I don't believe in absolute hegemony." But given the two giants' ambitions and the benefits of scale, they are bound to become more powerful and compete directly in more places. That has implications for all sorts of industries, but particularly the retail sector. ■



走向全球

主场与客场

电子商务巨头正试图“出口”自身的成功

二零一四年九月，杰夫·贝佐斯在班加罗尔登上了一辆色彩艳丽的巴士，宣布了首个在印度的大型投资。这是快速在印度投资50亿美元的开端，而这些投资是贝佐斯的亚马逊全球推广计划的一部分。两个月后，阿里巴巴的马云现身德里。“我们会对印度进一步投资。”他说。第二年，阿里巴巴向印度数字支付公司Paytm投入了5亿美元。今年，它为Paytm的电子商务部门的一轮融资领投。两大巨头似乎是要在印度上演大对决了。

但是在各自的国内市场，它们至今仍相互退避三舍。亚马逊在中国只有很小一块业务。阿里巴巴在美国的战略则一直是帮助美国企业在中国进行销售，以及帮助中国企业在美销售。“人们总是问我，你什么时候去美国？”阿里巴巴的首席执行官张勇说。“我说，为什么去美国？亚马逊已经做得非常出色了。”这两家公司主要投资于不同的国外市场：阿里巴巴遍布东南亚，亚马逊横扫欧洲。但是，全球其他大部分地区还可供争夺。

最大的争夺可能集中于增长中的经济体和跨境贸易。阿里巴巴希望在20年内为全球20亿客户提供服务，建立一个支持其他企业的仁慈帝国。在有些地方，它从数字付款着手，比如在印度对Paytm的投资，在其他地方则投资于电子商务网站，如东南亚的拉扎达（Lazada）。但它计划在每个市场都建立多种服务，包括付款、电子商务和旅游服务，再将当地平台与阿里巴巴的中国平台连接起来。

马云想让小公司在全球舞台上像大公司一样灵活运作。阿里巴巴帮助中国企业在巴西和俄罗斯等地销售，并协助外国企业在中国开展营销、物流和清关。最终，阿里希望利用其技术连接全世界的物流网络，让任何产品都可以在72小时内送达任何买家。这还有很长的路要走，但从中可以看出这家公司惊人的野心。

亚马逊已经有超过三分之一的收入来自北美以外的电子商务。德国是其第二大市场，之后是日本和英国。今年，它收购了中东电子商务公司Souq。亚马逊国际业务负责人拉丝·格兰迪内蒂（Russ Grandinetti）表示，该公司考量是否要在其他地区扩张的标准包括人口、经济规模，以及互联网使用密度。印度一直是其主要试验场之一。

亚马逊和阿里巴巴一样，也希望帮助各个国家的供应商将产品出口到国外。例如，墨西哥的亚马逊购物者可以从美国购买商品。格兰迪内蒂认为，无论对买家还是卖家，这种跨境销售在亚马逊的价值中都是越来越重要的一环。

然而，两家公司都面临风险，即在本国做得好的策略未必会在其他地方成功。在中国，电子商务的普及依赖于一些特殊的因素。中国的制造商经常发现自己的衣服和鞋子积压，而阿里巴巴正好提供了一个销售场所。支付宝流行是因为很少有消费者拥有信用卡。中国也从廉价劳动力和大量大城市中受益匪浅——有100多个城市的人口超过一百万，形成了密集的需求，值得物流公司建立配送网络。

不过，随着规模的扩大，亚马逊和阿里巴巴的业务模式可能会发生转型，并在一些市场开始趋同。到目前为止，两家公司仍有重大差别。亚马逊拥有库存和仓库，而阿里巴巴没有。但阿里巴巴的业务范围比亚马逊要广，特别是算上蚂蚁金服的庞大支付业务之后。随着亚马逊的发展，它可能会变得更像阿里巴巴。例如在印度，法规限制使它无法直接拥有库存，而且亚马逊最近拿到了印度储备银行的数字钱包许可证。阿里巴巴也可能会变得更像亚马逊。随着中国企业将目光投向东南亚，它投资了新加坡邮政（SingPost）这一国家邮政系统。今年9月，阿里成了菜鸟物流的大股东，并表示计划在未来五年内为物流投入150亿美元。

其他竞争对手可能会阻碍这两家公司的脚步。小公司可以在利基市场中蓬勃发展。由纳斯珀斯（Naspers）和软银等支持的Flipkart在印度与亚马逊激烈厮杀，两家公司时不时地要为谁的市场份额更大打嘴仗。在线奢侈品卖家Yoox Net-a-Porter也在进行全球扩张。

两大巨头面临的问题还包括其他科技企业是否会为电子商务投入更多资金，以及可能出现什么样的合作关系。腾讯的微信支付已经在中国挑战支付宝。中国约有三分之一微信用户通过该平台完成购物支付。腾讯也试图在其他国家招募接收其付款应用的商家，最近还入股了Flipkart。在向海外部署服务时，纳斯珀斯可能会助腾讯一臂之力。这家南非公司拥有腾讯约三分之一的股权，并在全球各地支持电子商务公司。Facebook也要挤进这一业务，通过其消息服务以及WhatsApp和Instagram等平台，让用户更轻松地购买商品。

| 大腕依然

不过在目前，亚马逊和阿里巴巴仍是彼此最强大的国际竞争对手。电子商务的成功需要规模，而规模需要大量资金。印度当地的电子商务公司受到投资者施压，要求其提高盈利能力。而亚马逊在这方面没有任何问题。亚马逊印度公司负责人阿米特·阿加瓦尔（Amit Agarwal）表示：“我们将不惜一切投入资金，确保提供卓越的客户体验。”

大公司在扩张时也具有天然优势，因为针对一个市场所开发的技术可以用在很多市场上。拉扎达的首席执行官马克西米利安·比特纳（Maximilian Bittner）说：“这就像是乐高。”他可以使用阿里巴巴的产品推荐算法等模型，来改善拉扎达的运作。亚马逊对机器学习的投入在世界各地都有无数的应用。

这并不意味着亚马逊和阿里巴巴将主宰世界上每个国家，也不意味着他们会碾压每个竞争对手。纳斯珀斯的首席执行官鲍勃·范·德克（Bob Van Dijk）坚持认为许多厂商都有发展空间：“我不相信绝对霸权。”但鉴于两巨头的野心和规模效益，它们势必会变得更强大，并在更多地方直接竞争。这对所有行业都有影响，但零售行业首当其冲。■



E-commerce

There be giants

Amazon and Alibaba represent a new type of conglomerate. How should rivals and governments adapt?

SHOPPERS will spend record sums online in the next few weeks—in China for Singles Day on November 11th, in America on Black Friday and around the world in the run-up to Christmas. E-commerce has been growing by 20% a year for a decade, shaking up industries from logistics to consumer goods. Nowhere does debate rage more fiercely about what this means than in America, where thousands of stores have shut this year and where retailing accounts for one in nine jobs.

Astonishingly, online shopping has only just got started. Last year it amounted to a mere 8.5% of the world's retail spending. In America the share was about 10%. Its effects on business and society will be huge. Not just because retailing is a big employer that touches many industries, but also because its two greatest exponents, Jack Ma and Jeff Bezos, the founders of Alibaba and Amazon, have used it to amass a new sort of conglomerate (see our special report). The question is whether its creation will foster competition or demand restraint.

In the past two decades Alibaba and Amazon have added ever more services, from cloud computing to video. The firms' businesses will reinforce each other as consumers and companies become more likely to use their platforms, and diverse sources of revenue and data power further growth. As a result, the two giants sit at the centre of all sorts of activity. In America Amazon is showing, week by week, the havoc that an innovative e-commerce firm can wreak in a giant, mature market. In China Alibaba is showing how dramatically one company can reshape business in a fast-growing economy. They will not conquer every industry they touch but, as

they expand, few firms will change as many sectors in as many places.

Through one lens, this is a boon for competition. The e-commerce sites of Amazon and Alibaba lower barriers to entry by providing a simpler, cheaper way for small manufacturers to distribute goods and find potential buyers. Local manufacturers are challenging multinational giants. Consumers benefit, as they can choose from more and better products than ever.

Yet as the giant e-commerce platforms grow, so does unease about their might. With access to cheap, patient capital, Amazon can make big investments, including in warehouses, artificial intelligence and other firms such as Whole Foods, a grocer it bought for \$13.7bn this year. Those investments, combined with the vast amounts of data on the consumers and businesses on its platform, mean that competitors struggle to keep up.

Amazon's challengers should learn from China, where Alibaba's rivals are teaming up. Tencent began as a gaming and messaging company. It now has a thriving digital-payments business and is the biggest shareholder in JD.com, Alibaba's closest e-commerce competitor. JD is working with other retailers and tech firms, too. In August it announced that shoppers could buy through Baidu, China's leading search engine.

Amazon's would-be competitors might follow a similar path, by forging partnerships. Walmart (another investor in JD), for example, seems to be adopting JD's tactics, making its products available through Google's voice assistant to counter Amazon's Alexa. Facebook wants to make it easier for customers to buy goods featured in its ads. And Google, to the horror of some privacy advocates, is tracking consumers to help bricks-and-mortar shops see which online ads work. American firms may yet catch up with their Chinese counterparts.

Will that be enough to guarantee competition? Regulators must be vigilant.

More mergers are now likely among both makers of consumer goods and retailers, as they seek the heft to battle Amazon. Deals between retailers and tech firms will complicate matters further.

| *Watch the giants*

In antitrust cases America's courts have tended to assume that new entrepreneurs would challenge profitable incumbents. But in America venture-capital funding for e-commerce firms is dropping, in part because investors think Amazon will be dominant. This newspaper has argued that regulators should weigh the effect of mergers on the control of data as well as market share—especially for Amazon, given its existing power and range. Antitrust rules, as with so much else in the Amazon era, look as if they will need updating. ■



电子商务

巨头当道

亚马逊和阿里巴巴代表着一种新型的企业集团。竞争对手和政府应如何去适应？

接下来的几周买家们的网上消费要创纪录了：中国有11月11日的光棍节，美国有“黑色星期五”，全世界也都在为圣诞节热身。十年来电子商务以每年20%的速度增长，撼动了从物流到消费品的各行各业。至于这意味着什么，没有哪个地方兴起的争论比美国更激烈——在美国，今年有成千上万家实体店关门，而零售业占了所有就业岗位的九分之一。

令人惊讶的是，网上购物才刚刚起步。去年它仅占全球零售总额的8.5%，在美国这个比例约为10%。网上购物将对商业和社会产生巨大的影响。这不仅因为零售业是一个涉及许多行业的大雇主，还因为其两大代表人物——阿里巴巴的创始人马云和亚马逊的创始人杰夫·贝佐斯（Jeff Bezos）利用这一行业汇聚起一类新的企业集团。问题是，这样的集团是会促进竞争，还是需要限制。

过去20年，阿里巴巴和亚马逊增加了从云计算到视频等越来越多的服务。随着消费者和公司使用其平台的几率增加，这两家公司各自的业务线将会相互促进，而多种多样的收入及数据来源又推动了公司进一步发展。结果，这两大巨头已经位居各类活动的核心。在美国，亚马逊每周都在展示一个创新的电子商务公司如何给一个巨大的成熟市场带来浩劫。而在中国，阿里巴巴正展示在一个快速增长的经济体中，一家公司能够如何剧烈地重塑行业。这两家公司不会征服所接触的每个行业，但随着它们的扩张，极少有公司会与之一样，在这么多地方改变这么多行业。

从某个角度看，这对竞争是一大福音。亚马逊和阿里巴巴的电子商务网站降低了准入门槛，为小型制造商提供了一种更简单、更廉价的方式来分销商品、寻找潜在买家。本地制造商正在挑战跨国巨头。消费者也从中受益，因为他们有比以往更多更好的产品可选。

然而，随着巨型电商平台日益发展，人们对其威力的担忧也逐步加深。有了廉价的长期投资资本，亚马逊可以做出大笔的投资，包括投资于仓库、人工智能和收购其他公司，比如今年它以137亿美元收购了食品杂货商全食超市（Whole Foods）。这些投资，再加上其平台上生成的有关消费者和企业的海量数据，令竞争对手难以匹敌。

亚马逊的挑战者应该向中国学习：在那里，阿里巴巴的竞争对手们正抱团合作。腾讯最初是一家游戏和即时通讯公司，如今其数字支付业务也在蓬勃发展。它还是京东的最大股东，而京东是阿里巴巴在电商领域最大的竞争对手。京东也在与其他零售商和科技公司合作。今年8月，京东宣布顾客可以通过中国领先的搜索引擎百度购物。

意欲挑战亚马逊的竞争者可能也会采取类似的方式，缔结合作伙伴关系。沃尔玛（京东的另一个投资者）似乎正在采用京东的策略，借助谷歌的语音助手来销售产品，以此对抗亚马逊的Alexa。Facebook希望能让用户更方便地购买其广告中出现的商品。而让一些提倡保护隐私权的人士感到恐惧的是，谷歌正在追踪消费者，帮助实体商店了解哪些在线广告能起作用。在这方面，美国公司说不定还是能赶上中国同行的。

这足以保证竞争吗？监管机构必须保持警惕。消费品制造商和零售商为获得能与亚马逊竞争的實力，今后可能会达成更多的合并。零售商和科技公司之间的合作协议则会让形势变得更加复杂。

| 警惕巨头

在反垄断案件中，美国法院一贯倾向于认为新的企业家会挑战盈利的在位企业。然而在美国，电子商务公司获得的风险投资正在减少，部分原因是投资者认为亚马逊将占据主导。本刊认为，除了对市场份额的影响，监管机构也应该权衡合并对数据控制的影响——尤其要留意亚马逊，毕竟它实力雄厚，业务范围广阔。看起来，反垄断法就像亚马逊时代的其他许多事物一样，也需要更新了。■



Economic and financial indicators

Global investment-banking revenue

J.P. Morgan is the top bank for equity-market deals

In the first nine months of this year worldwide revenues from investment banking were \$60.5bn, 7% higher than in the same period in 2016, according to Dealogic, a financial-data provider. Although banking fees were high in the first half of the year, third-quarter revenues fell to \$18.9bn. Equity-market revenues may have fallen in the last quarter, but they grew by 29% year-on-year from January to September. The UniCredit rights issue in February is the biggest deal of the year, worth \$13.7bn. Japan Post Holdings boosted third-quarter fees for the banks with a \$10.8bn equity sale last month. J.P. Morgan is the top bank for equity-market deals: so far this year it has handled 319 transactions. ■



经济与金融指标

全球投行收入

摩根大通居股市交易数量的首位

金融数据提供商Dealogic的数字显示，今年前九个月，全球投行业收入为605亿美元，较2016年同期增长7%。虽然上半年银行费用处于较高水平，第三季度的收入却降至189亿美元。上一季度股市收入可能有所下降，但1月至9月的收入却较去年同期上升了29%。意大利裕信银行（UniCredit）于2月股权增发是今年规模最大的一笔交易，价值137亿美元。上月，日本邮政控股公司（Japan Post Holdings）上市融资108亿美元，增加了投行业第三季度的费用收入。摩根大通位居股市交易的首位：今年截至目前，该银行处理了319宗交易。 ■



Glassmaking

Gorilla tactics

One of the world's oldest products shapes up for a digital future

AFTER 4,000 years of development, you might assume that just about everything there is to be known about glassmaking has already been found out. Not so. Though the basic recipe of sand, soda and lime remains the industry's core, first alchemists and then chemists have tinkered with the ingredients over the centuries to produce specialised products. For clarity and sparkle in tumblers and decanters, they added lead. For heat resistance in ovenware, they added boron. For a beautiful blue colour in drinking vessels and decorative bowls, they added cobalt. To increase the speed at which light traverses it, as may be useful in an optical fibre, they added germanium. To reduce that speed, they added fluorine. And so on.

So when, one day in 2006, Steve Jobs, the founder of Apple, came knocking on the door of Corning, one of the world's biggest glassmakers and based in an upstate New York town from which it took its name, they were ready for him. The request was for a perfectly clear, tough and scratch-resistant glass to cover the screen of Apple's newly designed "iPhone". Jobs, being Jobs, wanted it in six months.

Scientists at Corning's research centre produce thousands of new formulations of glass every year. Some are promising enough to go to a small glassworks within the centre, for trial production—but only a few make it to market. Everything that is learnt, however, is filed away for a rainy day. A search in the archives in light of Jobs' request turned up a project from the 1960s to develop a toughened lightweight glass for industrial use. The new glass had been made in small volumes, but it never took off and was abandoned. Corning reworked the formula to produce a strong, thin glass suitable for touchscreens. They also reworked the name.

And thus was born Gorilla Glass.

| *Touchy feely*

Gorilla Glass's unique selling point is not that it is tough, but that it stays tough when formed into sheets thin enough to protect the surfaces of the touchscreens of today's increasingly skinny mobile devices without affecting those screens' function. That means permitting the circuits within a screen to locate the position of a finger placed on the surface. In many portable devices that is done by detecting a tiny change in an electrical charge across the screen at the point where the finger touches. Too thick a screen can make this change harder to detect. Since its launch, Gorilla Glass has been getting thinner and tougher still. According to Corning, a sheet less than 1mm thick, made of the fifth generation of the stuff (the latest iteration, released last year), can survive four times out of five if dropped facedown from a height of 1.6 metres (63 inches) onto a rough surface. As a consequence, Jobs' job was but the first of many. Gorilla Glass is now found in some 5bn smartphones, tablet computers, laptops and other devices produced by electronics companies around the world. It is beginning to appear in other things, too, including cars—an ironic development, as the motor industry, one putative destination of the original version from the 1960s, had rejected it back then.

Two tricks give Gorilla Glass its strength. One is its composition—or, rather, the way that composition is modified in the middle of the manufacturing process. The other is a detail of this process itself.

The material starts off as a mixture of silica, aluminium oxide (a standard strengthening agent) and sodium oxide. This mix, once molten, is turned into a sheet using the “fusion draw” process, a technique pioneered by Corning. Fusion drawing involves pouring molten glass into a V-shaped trough and letting it overflow down the sides of that trough, clinging to them and running down them as treacle might cling to and run down the

outside of a bowl.

As the two streams of glass meet at the bottom of the V their inner surfaces fuse into a single, thin sheet. Because the outside surface of each stream has had no contact with a production surface, those surfaces do not pick up any contamination or other damage, and emerge flat and devoid of defects. Materials break at their weakest point. For a sheet of glass that is often an impurity, crack or scratch on its surface. Fusion drawing eliminates such weakness.

The next stage, modifying the glass's composition to impart strength throughout its volume, involves immersing the fusion-drawn sheet in a hot bath of potassium salts. This results in a process called ion exchange, in which sodium ions within the glass are forced out and replaced by potassium ions from the bathing solution. Sodium and potassium are chemically similar, which is what permits this to happen. But potassium ions have about two-and-a-half times the volume of sodium ions. When the glass cools, this extra ionic volume compresses the material from the inside. That makes it more resilient to knocks and scrapes.

Gorilla Glass dominates the market for cover glass for electronic equipment, but it faces rivals, including Dragontrail, a chemically toughened glass manufactured by Asahi Glass in Japan. This is made using the float-glass system, in which molten glass is floated onto a bed of molten metal. (The technique was invented in the 1950s by Pilkington, a British glassmaker which is now owned by NSG, a rival Japanese glassmaker.) Another potential competitor is sapphire glass, which is not really a glass at all, but rather a crystalline material that is a synthetic version of the eponymous gemstone. Sapphire glass is extremely hard and is used in some high-end watches, but it can be heavy and is more expensive than Gorilla Glass—though researchers are trying to reduce both its weight and its cost.

Corning, meanwhile, is pushing Gorilla Glass, and other specialist glasses made by fusion drawing, into more areas. According to Jeffrey Evenson, the firm's chief strategy officer, tough, lightweight glass opens up new possibilities for giant display screens and for use as part of the architecture of buildings. Entire walls and tabletops could become displays with touch-sensitive surfaces. Windows, too, will contain electronic layers, allowing their transparency to be tweaked as desired—and perhaps even permitting them to gather solar energy from non-visible frequencies, to generate electricity. Other types of glass will become more flexible, enabling portable devices to be bendable, or even foldable.

One of the biggest areas for growth, Mr Evenson reckons, will be in cars. Already, instruments and switches on the dashboards of new cars are being replaced with touchscreens. As glass can be formed into different shapes, these screens can be curved into the contours of a vehicle's interior. But Gorilla Glass, or something like it, could also be employed to make car windows. These, being thinner than existing windows, would be lighter and thus save fuel (or, in a battery-powered car, electricity). A version of Gorilla Glass is already being used for the windscreen of Ford's GT sports car. Ford reckons the new glass is about 30% lighter than what it is replacing. It is also stronger, and scratch-resistant. Further ahead, electronics could be incorporated into the glass, to project images onto the windscreen, to assist drivers.

Perhaps, one day, one of Gorilla Glass's descendants will be strong and tough enough to abolish the windscreen altogether, and replace it, the other windows and the roof with a single, transparent canopy. For drivers, while drivers there continue to be, that will improve visibility. And, if cars of the future really do become driverless, it will let everyone on board relax and enjoy the scenery. ■



玻璃制造

大猩猩战术

世界上最古老的产品之一为数字化未来改进自身

玻璃制造已历经四千年的发展。你可能会以为，人们差不多已研究清楚该领域可供发掘的一切。实则不然。虽然由砂、苏打和石灰组成的基本配方仍是该行业的核心，但前有炼金术士，后有化学家，千百年来他们不断对这些原料做着小改动，来生产专门化的产品。为了让酒杯和醒酒瓶晶莹剔透，他们加入了铅。为了让烤炉器皿耐热，他们加入了硼。为了让酒具和装饰碗显现出漂亮的蓝色，他们加入了钴。为了加快光线透过玻璃的速度——这在光纤中应该会有用处——他们加入了锗。为了减慢这一速度，他们加入了氟。凡此种种，不一而足。

因此，当苹果公司创始人乔布斯在2006年的某天敲响康宁（Corning）的大门时，研究人员已有所准备。这是全球最大的玻璃制造商之一，位于纽约州北部，公司得名于其所在的康宁市。乔布斯想要一种十分清澈、结实且耐刮擦的玻璃，用作苹果最新设计的“iPhone”的屏幕盖板。乔布斯希望康宁六个月就能交付——典型的乔布斯做派。

康宁研究中心的科学家每年调配出数千个玻璃新配方，前景足够好的一些会在中心内部的小型玻璃工厂里试生产，但其中只有很少一部分最终会走向市场。不过，过程中获得的所有发现都被留存起来，以备不时之需。康宁对照乔布斯的要求在存档中搜寻，发现了上世纪六十年代一个研发工业用途的强化轻质玻璃的项目。当时康宁小批量生产了这款新型玻璃，但不受欢迎，接着就被放弃了。为了制造出适用于触摸屏的坚固而纤薄的玻璃，康宁修改了该款玻璃的配方，还为其起了新名字。这样，“大猩猩玻璃”便诞生了。

| 触摸感知模式

大猩猩玻璃的独特卖点并不在于它很结实，而在于它被制成薄片后仍然结实——这种薄的程度要能保护如今日益纤巧的移动设备的触摸屏表面，同

时又不会影响触摸屏的功能。触摸屏的功能就是让屏幕内的电路能够确定屏幕上手指的位置，在很多便携式设备中，该功能的实现是通过检测屏幕上手指触碰点所产生的细微电荷变化。如果屏幕太厚，变化就很难检测出来。自推出以来，大猩猩玻璃还在变得更薄、更坚固。按照康宁的说法，厚度不超过一毫米的第五代大猩猩玻璃屏（该产品最近的一次迭代，于去年推出）从1.6米的高度正面朝下掉落到粗糙表面时，完好率达到80%。因此，为乔布斯服务只是个开始，大量新客户纷至沓来。如今，全世界电子产品公司生产的大约50亿台智能手机、平板电脑、笔记本电脑及其他设备都使用了大猩猩玻璃。它还开始出现在其他产品上，包括汽车——这一进展有些讽刺：上世纪六十年代康宁研发最初版本的大猩猩玻璃时，公认的应用领域之一就是汽车业，但该行业当时拒绝了它。

大猩猩玻璃的优势源于两个秘诀。其一是它的构成——更确切地说，是康宁在制造过程中如何改进了它的构成。另一个是制作过程本身的细节。

一开始，原材料就是硅、氧化铝（一种标准的增强剂）和氧化钠的混合物，经熔化后，再采用康宁首创的“熔融拉制”工艺将其拉制成玻璃片。该制程需要将熔融态的玻璃倒入一个V型槽中，任其沿槽的外侧溢出，紧贴着槽的外壁流下，就像糖浆会紧贴着碗的外侧流下一样。

当两道玻璃流在V型槽的底部汇合时，它们的内表面融为一体，形成一张玻璃薄片。由于每道玻璃流的外表面在生产过程中并未与其他表面接触，因此没有受到任何污染或其他破坏，形成的玻璃平整而无瑕疵。材料通常都是在其最弱点破损，而一块玻璃的最弱点往往就是一丝杂质，一道裂缝，或表面上的一条划痕。熔融拉制制程消除了这样的弱点。

下一步是改进玻璃的构成，以赋予整块玻璃以强度。方法是将玻璃浸入高温的熔融状钾盐中。接下来便会发生离子交换，即玻璃中的钠离子被“挤出”，置换成盐浴溶液中的钾离子。钠和钾化学性质相近，因此能够实现离子交换。不过，钾离子的体积大约为钠离子的2.5倍。玻璃冷却后，这一增加的离子体积就会在玻璃内部形成压缩应力。这样，玻璃就会更耐敲击和刮擦。

大猩猩玻璃占据了电子设备盖板玻璃市场的主导地位，不过它也有了对手，日本的旭硝子（Asahi Glass）生产的化学强化玻璃“龙迹玻璃”（Dragontrail）就是其中之一。这款玻璃生产采用的是“浮法玻璃”制程，就是让熔融态玻璃浮在一层熔化的金属之上。这一技术在上世纪五十年代由英国玻璃制造企业皮尔金顿（Pilkington）发明，该公司如今隶属于其日本竞争对手板硝子（NSG）。大猩猩玻璃的另一个潜在竞争者是蓝宝石玻璃。其实它根本不是玻璃，而是人工合成的蓝宝石，是一种晶体材料。蓝宝石玻璃硬度极高，为一些高端手表所用。不过它也会比较重，价格也高于大猩猩玻璃，尽管研究者们正力求将它变轻、变便宜。

与此同时，康宁正在将大猩猩玻璃及其他利用熔融拉制工艺生产的专业玻璃推向更多领域。康宁的首席战略官杰弗里·埃文森（Jeffrey Evenson）表示，结实的轻质玻璃开启了新的可能性，例如用于巨型显示屏，或作为建筑结构的一部分。整面墙和桌面或许都可以变成附带触敏表面的显示器。窗户内也将会加入电子器件层，这样就可随意调整窗子的透明度，说不定还能让它们从不可见频率中汇集太阳能来发电。其他类型的玻璃将会变得更柔韧，让便携式设备能够弯曲甚至折叠。

埃文森认为，最大的增长领域之一将是汽车业。新款汽车的仪表盘上，仪表和开关已开始被触摸屏取代。由于玻璃可加工成不同的形状，因此这些触摸屏可以弯曲以贴合汽车内部的轮廓。不过大猩猩玻璃或与之类似的玻璃或许还可用来制造车窗。它们比现有的车窗玻璃薄，也就会更轻，因而可节省燃料（对电动车而言就是更省电）。福特GT跑车的挡风玻璃已经采用了一款大猩猩玻璃。福特估算，新采用的这款玻璃比它所取代的玻璃大约轻30%，而且强度更高且防刮擦。更长远来看，未来的玻璃中也许会加入电子设备，将图像投射到挡风玻璃上来辅助司机。

也许到了某一天，大猩猩玻璃的某代产品会坚硬、结实得足以完全淘汰挡风玻璃，用一个透明的一体化顶罩来取代挡风玻璃、其他车窗以及车顶。对司机来说——如果还有司机的话——这会提高可视度。而如果未来的汽车真的实现无人驾驶了，这样的顶罩能让车上的每个人都放松地欣赏车外的景色。■



Job tenure

Staying put

Millennials in America do not switch jobs faster than their parents did

EVERYBODY knows—or at least thinks he knows—that a millennial with one job must be after a new one. Today’s youngsters are thought to have little loyalty towards their employers and to be prone to “job-hop”. Millennials (ie, those born after about 1982) are indeed more likely to switch jobs than their older colleagues. But that is more a result of how old they are than of the era they were born in. In America at least, average job tenures have barely changed in recent decades.

Data from America’s Bureau of Labour Statistics show workers aged 25 and over now spend a median of 5.1 years with their employers, slightly more than in 1983 (see chart). Job tenure has declined for the lower end of that age group, but only slightly. Men between the ages of 25 and 34 now spend a median of 2.9 years with each employer, down from 3.2 years in 1983.

It is middle-aged men whose relationship with their employers has changed most dramatically. Partly because of a collapse in the number of semi-skilled jobs and the decline of labour unions, the median job tenure for men aged 45-54 in America has fallen from 12.8 years in 1983 to 8.4. That decline has been offset by women staying longer in their jobs and higher retirement ages, which is why the overall numbers have barely changed.

American workers are also now less likely to move home to find new work (see briefing). Fewer than 12% moved home last year, down from 20% in the 1950s. This pattern is true of younger workers, too: only a fifth of Americans between the ages of 25 and 35 moved last year; for past generations the fraction was closer to a quarter.

One place where millennials probably are switching jobs more often is western Europe. Data from the OECD, a think-tank, show that since 1992 in each of France, Germany, Italy and Spain, the average job tenure for workers has increased overall. But it has shortened for younger workers. However, it is far from clear that this is by the young workers' choice. Labour-market restrictions in Europe have forced a growing share of workers into temporary "gigs". Over half of workers aged 15 to 24 in those four countries are on fixed-term contracts.

Data on Britain, which has looser labour-market regulations than continental Europe, tell a more complicated tale. OECD statistics show that average job tenures have fallen for young Brits. But research from the Resolution Foundation, another think-tank, finds that millennials are actually less likely to leave jobs voluntarily than the previous generation. Britons are also moving home less often. Between 2001 and 2016, the share of workers moving home to change jobs fell from around 0.7% to 0.5%. The number of workers doing so for work in Britain has risen again in recent years, but is still below its 2001 peak.

Some workers are indeed hopping from startup to startup every six months, or working as quasi-freelancers for Uber. But they are the exceptions. A drastic increase in job-switching rates would probably require a correspondingly drastic increase in labour demand. Those who fret that millennials are fickle may have too rosy a view of the labour market. ■



任职时间

原地不动

美国的千禧一代换工作并不比他们的父母快

人人都知道——或者至少自以为知道——千禧一代上班都是骑驴找马。人们认为如今的年轻人对雇主没有忠诚可言，很容易“跳槽”。千禧一代（即大约1982年后出生的人）的确比他们年长的同事更容易换工作，但这更多是因为他们所处的年龄段，而不是他们出生的时代。至少在美国，近几十年来，平均任职时间几乎并无变化。

美国劳工统计局（Bureau of Labour Statistics）的数据显示，目前25岁及以上的劳动者在一家公司的任职时间中值为5.1年，略高于1983年的数字（见图表）。该年龄段中较年轻人群的任职时间有所缩短，但幅度轻微。现在，25岁至34岁的男性在每个雇主那里的任职时间中值为2.9年，而1983年为3.2年。

与雇主的关系变化最大的是中年男性。某种程度上，由于半熟练工作岗位数量锐减以及工会的式微，美国45岁至54岁男性的任职时间中位数已从1983年的12.8年下降到了8.4年。这种下降又被女性任职时间延长以及退休年龄延后所抵消，因此总体数字几乎没有变化。

美国的劳动者现在也不大会为了找新工作而搬家。去年搬家的劳动者不到12%，而上世纪50年代的数字是20%。这一模式还出现在年轻劳动者当中：去年，25岁至35岁的美国人搬家的只有五分之一，而在前几代人中这一比例接近四分之一。

在西欧，千禧一代可能在更频繁地更换工作。智库经合组织的数据显示，1992年以来，在法国、德国、意大利和西班牙，劳动者的平均任职时间总体而言都有所延长。但年轻劳动者的任职时间却缩短了。然而这是不是他们自己的选择，现在还远不能下定论。在欧洲，劳动力市场的限制已经迫使越来越多的劳动者去打“零工”。这四个国家15岁至24岁的劳动者中，超

过一半签订的是固定期限劳动合同。

英国劳动力市场的法规比欧洲大陆更宽松，其数据揭示的情况更复杂。经合组织的统计数据显示，英国年轻人的平均任职时间缩短了。但另一家智库决议基金会（Resolution Foundation）的研究发现，与上一代人相比，千禧一代实际上更不愿意主动离职。英国人现在也不太常搬家了。2001年至2016年间，为换工作而搬家的劳动者比例从大约0.7%降至0.5%。近年来，为工作而搬家的英国劳动者人数再次上升，但仍低于2001年时的高位。

有些劳动者确实是每六个月就从一家创业公司跳槽到另一家创业公司，或者作为准自由职业者为优步打工。但他们属于特例。跳槽率飚升可能需要劳动力需求也相应地激增。那些担心千禧一代做事没长性的人可能对劳动力市场过于乐观了。■



Economic and financial indicators

Youth unemployment

Since 2005 the share of NEETs has fallen slightly

Since 2005 the share of young people (aged 20-24) in the OECD who are not in employment, education or training (NEETs, for short) has fallen slightly, from 17.3% to 16.3%. Some countries have made striking progress, largely owing to increased access to further education. Nearly half of young Turkish adults were NEETs in 2005; by 2016 less than a third were. In Germany 18.7% of youths were NEETs back in 2005, well above the OECD average; by 2016 only 10.8% were. Other countries have not fared so well. Despite having more young people in education, the share of NEETs in Ireland, Portugal and Spain has risen to at least a fifth since 2005, principally because of the financial crisis and its aftermath. ■



经济与金融指标

年轻人失业情况

自2005年以来，“尼特族”占比略有下降

自2005年以来，经合组织国家20至24岁年轻人中“尼特族”（NEETs，即不上班、不上学、不接受培训的年轻人）的占比略微下降，从17.3%降至16.3%。一些国家取得了显著的进步，大体上是因为年轻人接受继续教育的机会增多。2005年，几乎一半的土耳其年轻人都是尼特族，到了2016年降至不到三分之一。德国在2005年有18.7%的年轻人是尼特族，远高于经合组织的平均水平，到2016年降到10.8%。其他国家表现欠佳。在爱尔兰、葡萄牙和西班牙，尽管接受教育的年轻人数量增加，但2005年以来尼特族的占比已经提高到五分之一以上，这主要是因为金融危机及其余波的影响。■



Chinese finance

Failing state

Government guarantees are not all they seem

THE Communist Party dominates China's economy and uses state-run companies, which it controls with an iron fist, to enforce its diktats. Or so the theory goes. Reality is messier: the party often struggles to monitor state-owned enterprises (SOEs), let alone to get them to toe its line. As it convenes its five-yearly congress, one of the financial system's dodgiest corners has served up a reminder of the limits to its power.

In the past two months at least seven online lenders backed by SOEs have collapsed. It was a business none should have been in, far removed from the industries they were supposed to focus on. The money potentially lost is trivial—roughly 1bn yuan (\$150m), compared with government assets worth more than 100trn yuan. Still, these cases highlight how hard it is for the party to stamp its authority on the vast state sector.

The troubled SOEs include distant subsidiaries of the national nuclear company, an aviation company and a big energy company in Shanxi, a northern province. They had acquired stakes, from as little as 20% up to 100%, in online peer-to-peer (P2P) lending platforms.

They were “marriages of convenience”, says Joe Zhang, chairman of China Smartpay, a financial-services company. The P2P firms got instant credibility; SOEs, many of them struggling, eyed quick profits. Some will have done well from the P2P boom: industry-wide loans have increased more than 30-fold since January 2014, to 1.1trn yuan. Yet this frenzied activity has also left problems in its wake. On average more than 100 P2P firms have failed each month since early 2015, some because of mismanagement, others victims of outright fraud.

Investors imagined SOE-backed platforms would be safer. Jinsu Online, a P2P lender backed by a subsidiary of the China National Nuclear Corporation, said its backer would guarantee all its funds. Lala Wealth, backed by a subsidiary of the Aviation Industry Corporation of China, vowed that its SOE shareholders would make it stronger. Both went into default in September. In the former case, the SOE had denied any involvement before the collapse; in the latter the SOE said it, too, was a victim.

The body that regulates China's state firms warned them last year to stay clear of P2P, fearing that online lenders would exploit their reputations. But industry data show an increase in the number of P2P firms with SOE shareholders since then of a third, to nearly 200.

It seems odd that the government has such weak control over SOEs, given President Xi Jinping's tightening grip on China's economy. But more than 100,000 companies technically count as SOEs. Most are owned by local governments. Moreover, as many as five layers of ownership have separated those that invested in P2P lenders from their parent groups; many also include private businesses as large shareholders. An optimistic conclusion is that these collapses might teach investors to think twice before assuming that the state always stands behind SOEs, however risky. A worrying one is that many still rely on such support. ■



中国金融

失能的政府

政府担保，看上去很美

共产党控制着中国经济，并借其铁腕控制下的国有公司来发号施令。话虽如此，现实却没那么简单：共产党常常很难监督国有企业，更别说让它们乖乖听命了。在党五年一届的代表大会召开之际，金融体系最大的“雷区”之一已让人意识到，党的控制力也有局限。

在过去的两个月里，至少有七家以国企为后盾的网贷公司倒闭。这项业务本不该有国企涉足，因为它与这些国企理应关注的行业相去甚远。尽管与价值100多万亿元的政府资产相比，大约10亿元（1.5亿美元）的潜在损失微不足道，但这些案例仍凸显出共产党要在庞大的国有部门保持控制力何其困难。

惹上麻烦的国企包括中国核工业集团公司多家关系遥远的子公司、一家航空公司，以及山西一家大型能源公司。它们都持有在线P2P借贷平台的股份，少则20%，多则100%。

金融服务公司中国支付通的董事会主席张化桥表示，国企拥有P2P公司股份是一种“权益联姻”——P2P公司立刻获得了公信力，而国企（其中许多困难重重）瞄准的则是快速盈利。一些国企从P2P的繁荣中获利颇丰：自2014年1月以来，全行业的贷款额已经增加30倍以上，达到1.1万亿元。然而这种疯狂之举随即也带来了问题。从2015年初开始，平均每月有100多家P2P公司倒闭，一些是因为管理不善，另一些则是受累于彻头彻尾的欺诈。

投资者以为有国企支持的借贷平台会更安全。金苏在线是一家由中国国家核工业公司的子公司支持的P2P贷款公司，它宣称其国企支持者会为所有资金提供担保。由中国航空工业公司的子公司支持的“拉拉财富”信誓旦旦地说它的国企股东会让它实力更加雄厚。然而，这两家公司9月都陷入了

债务违约。在金苏在线倒闭前，涉事国企就撇清了与它的所有关系；而在拉拉财富事件中，相关国企称自己也是受害者。

因为担心网贷公司会利用国企的声誉，去年，中国国有企业的监管机构警告国企远离P2P贷款。但行业数据显示，有国企入股的P2P公司数量从那时起增长了三分之一，达到将近200家。

看上去不无奇怪的是，尽管习近平主席加强了对中国经济的掌控，政府对国企的控制还是如此之弱。不过，中国严格意义上的国企超过10万家，大部分由地方政府拥有。此外，多达五层的所有权关系已经将那些投资P2P平台的公司与它们的母公司分离开来，这其中很多公司还引入私营企业作为自己的大股东。乐观的结果是，这些网贷公司的倒闭也许能教会投资者三思，不要以为无论有多大风险国家都会一直支持国企。而令人担心的是，许多人仍然倚赖这种支持。 ■



Real-time insurance

Pay-per-risk

The availability of huge volumes of data in real time is changing insurance

EVEN at weddings or whale watches, the buzz of a drone is no longer a surprise. Drone photography is booming. Gartner, a consultancy, says some 174,000 drones will be sold for commercial use around the world this year, and 2.8m to consumers. It is easy to imagine a few might fall out of the sky, causing damage the pilot cannot hope to pay for: crushed wedding cakes, injured spectators and so on. Amid scores of near-misses, several incidents have already occurred. In 2014, for example, a drone filming a triathlon in Australia crashed on a competitor's head.

Clearly, drone-users need insurance. Typically, risks are insured through the payment of an annual premium. Insure4drones, a British specialist, charges £738.86 (\$1,000) to cover a DJI Phantom, a bestselling drone, for a year. From October Flock, a London startup, will offer insurance on a flight-by-flight basis, at the push of a button in an app, to any commercial drone-operator in Britain. Cover for amateur pilots will soon follow. Costs will be about £5 per hour of flight, according to Allianz, an underwriter.

Flock's app relies on a wide range of data. Weather forecasts come from IBM, a computing giant which, having spent over \$2bn on The Weather Company in 2015, now offers forecasts to within a few hundred metres, and over a period of minutes. Live information about nearby aircraft is provided by a software company called Snowflake, which tracks aeroplanes around the planet. Flock also considers local topography, such as proximity to churches, hospitals and schools, as well as roads and traffic levels. It also monitors the drone itself, gathering data as it flies to build a risk profile for that machine. All these numbers are crunched when a customer requests insurance through the app. As well as offering a quote, the app tells pilots

how to reduce their risks.

Allianz then converts Flock's data-driven risk scores into a price. The attraction for Allianz is acquiring customers cheaply. "Rather than humans sitting and writing business, the algorithm does it on the spot," says Tom Chamberlain, who manages its aviation underwriting.

Conventional insurance works by pooling individual risks and then setting a price for that group—new drivers under 30, say. But that process can be much refined if the objects and people being insured can report to the insurer automatically, and if there is a wealth of data on the external environment. As an ever-growing number of sensors—in phones or watches, drones or cars—gather ever-greater volumes of data, more and more activities can be assessed for real-time risk (though in the absence of pooling, some risks may become prohibitively expensive to insure).

Flock is not alone. Verifly, a New York startup, competes with it in America. Root, a car insurer, offers drivers insurance based on their minute-to-minute behaviour behind the wheel. It even offers a discount to Tesla drivers if their car spends plenty of time in autonomous mode. Slice, a San Francisco startup, lets its customers insure their houses and cars for the time they are used on services such as Uber and Airbnb. Trov, also from San Francisco, insures personal possessions for short periods.

Flock's chief executive, Ed Klinger, says that he eventually wants to insure all kinds of future autonomous activities, from taxi rides to rolling delivery pods. He argues that selling insurance through annual premiums is inflexible. It less easily takes advantage of the large volume of live data that can now help estimate the risk posed by a given activity at a given time. For instance, a passenger in an autonomous taxi may be at far lower risk if the trip takes place outside rush hour, or in weather conditions in which the car performs at its best. Firms that dispatch delivery drones might use

Flock to calculate the risk for each flight automatically, depending on cargo and address.

The business model is in its infancy, but on-demand insurance seems bound to grow. In a world where consumers expect push-button convenience from their services, they will demand the same of the insurance those services rely on. ■



实时保险

按次计价

实时可获的大量数据正在改变保险业

即便是在婚礼现场或是观看鲸鱼时，无人机的嗡嗡声也已不是什么新鲜事。无人机摄影正在蓬勃发展。咨询公司高德纳（Gartner）称，今年全球将售出约17.4万架商用无人机和280万架消费级无人机。不难想象，其中一些可能会从空中坠落，造成操控员不得不赔偿的损失，例如压碎的婚礼蛋糕、受伤的观众等等。很多时候险情侥幸得以避免，但也有几次事故真的发生了。2014年，澳大利亚的一架无人机在拍摄铁人三项赛时砸中了一位参赛者的头。

显然，无人机用户需要保险。他们一般通过支付保险年费来覆盖风险。英国专业保险公司Insure4drones为最畅销的无人机大疆精灵（Phantom）开出的保费是每年738.86英镑（1000美元）。从10月起，伦敦创业公司Flock将向全英国的商用无人机运营商提供按次计费的保险，只需在一款应用上点击按钮即可。针对非专业无人机操控员的保险业务也将很快跟上。安联保险公司称，每飞行一小时的保费约为5英镑。

Flock的应用倚赖各种各样的数据。首先是来自计算巨头IBM的天气预报。IBM在2015年斥资逾20亿美元收购了天气公司（The Weather Company），现在能提供精确到几百米范围、几分钟内的天气预报。一家名为雪花（Snowflake）的软件公司提供了关于附近飞行器的实时信息。该公司追踪全球范围内的飞机。Flock还会考虑当地的地形地貌，比如到教堂、医院和学校的距离，以及道路和交通状况。它也会监控无人机本身，收集其飞行数据，为其建立风险档案。当用户通过应用要求投保时，应用会分析所有这些数据。除了给出报价，应用还会告诉操控员如何降低风险。

然后，安联会把Flock根据数据得出的风险评分转换成一个价格。对安联来说，这种方式的吸引力在于获得客户的成本很低。该公司负责航空保险

的汤姆·张伯伦（Tom Chamberlain）说：“算法随时随地就能搞定，不需要人们坐下来写保单。”

传统保险的运行方式是将个体的风险汇聚起来，然后为这个群体设定一个统一的价格，比如30岁以下的新手司机。但是，如果投保的人或物能够自动向保险公司报告，保险公司也拥有大量有关外部环境的数据，那么这个过程就可以大大改进。随着手机、手表、无人机、汽车等设备里安装的传感器越来越多，收集的数据也不断增加，越来越多的活动能够实现实时的风险评估（尽管在缺乏风险汇聚和分担的情况下，要为某些风险寻求保险可能会变得过于昂贵而无法实现）。

Flock并非一枝独秀。纽约创业公司Verifly是它在美国的竞争对手。汽车保险公司Root根据司机每一分钟的驾驶表现向他们提供保险。如果特斯拉车主花大量时间使用自动驾驶模式，Root甚至会给他们打折。当人们把自己的房屋和汽车用于优步和爱彼迎这类服务平台时，可以通过旧金山的创业公司Slice投保。另一家同样位于旧金山的公司Trov为个人财产提供短期保险。

Flock的首席执行官埃德·科林格（Ed Klinger）说，最终，他想要承保未来各种各样无人参与的活动，从无人驾驶出租车到带滚轮的送货机器人。他认为收年费卖保险不够灵活。这样不太容易利用大量的实时数据，而这些数据如今可帮助评估特定时间内由特定活动带来的风险。例如，如果在非高峰时段出行，或者出行时的天气状况最适合汽车行驶，那么乘坐自动驾驶出租车的乘客面临的风险要低得多。使用无人机送货的公司可能会用Flock来自动计算每次飞行的风险，这取决于货物和投递地址。

这样的商业模式还处于起步阶段，但按需保险看来势必会增长。在如今的世界，消费者期望点击按钮就能方便地使用服务，他们也会对这些服务所依赖的保险提出同样的要求。 ■



Premature deindustrialisation

Sew what now?

Automation is less of a threat to workers in the emerging world than it is made out to be

BANGLADESH EXPORTS 60% more ready-made garments than India, a country with over eight times its population. On the busy roads of Dhaka, Bangladesh's capital, white vans nose through the traffic on "Emergency Export Duty", according to the ambulance-like letters painted on their sides. The success of this quintessentially labour-intensive industry helped make Bangladesh a lower-middle-income country in 2014, according to the World Bank's classifications.

But some think that Bangladesh's garment industry now faces a new problem almost as grave as the traffic: the threat of automation. Robots are already common in other kinds of manufacturing, but still rare in clothes-making. Of the 1.63m industrial robots in operation worldwide in 2015 (the latest year for which figures are available), only 1,580 were in textiles, apparel and leather, says the International Federation of Robotics (IFR).

Robots find garment-making so hard because its basic materials are so soft. When fabric is picked up or put down, it loses its form, creasing, crumpling, folding and draping in unpredictable formations. That can make it hard for a robot to keep track of what it is handling and where to apply itself. It might be "easier to automate the activities of a fashion designer than to automate the people who sew clothing", suggests Michael Chui of the McKinsey Global Institute.

Jian Dai, a robotics professor at King's College London, once described the formidable feats of robotic dexterity required even to iron a garment, something any teenager is quite able (if not always willing) to do. It requires miniaturised infra-red sensors to find the edge of the fabric, which

must then be squeezed between robotic fingertips in an “impactive grip”. The robot also has to maintain the tension and smoothness of the material and align its seams. To manage all this, Mr Dai writes, the robot needs several moving parts linked in a “multiple kinetic chain”.

One firm that is tackling similar challenges is SoftWear Automation, based in Atlanta, Georgia, 8,000 miles from Dhaka. Its Sewbot uses high-speed cameras to keep track of the fabric, vacuum nozzles to pick up and rotate pieces, and rotating balls embedded in a worktop to move the fabric along. “Our technologies enable the micro-manipulation and macro-manipulation of the fabric to mimic what a seamstress could do,” says Palaniswamy Rajan, the company’s CEO. His machines can already make simple items like pillows and bath mats on a commercial scale. Next year the company hopes to offer a T-shirt production line. It says that a single Sewbot operator will be able to produce 1,142 T-shirts in an eight-hour shift, 17 times the number a traditional garment worker could make in that time.

These intriguing advances in Atlanta reflect broader progress in robotic technology. The machines are becoming cheaper, safer, more versatile and easier to instruct, notes Mr Chui. Unlike many existing industrial robots, which are kept in cages, the latest generation are safe enough to be used in crowded workspaces. They can also be easily “programmed”, a word Mr Chui puts in quotation marks, since no coding is required.

These pieces of kit are no longer the preserve of high-income countries like Japan or Germany. Of all the industrial robots shipped in 2015, a third ended up in middle-income countries, where they were mostly used in carmaking and electronics, according to IFR. China was the world’s biggest single buyer.

The rising efficiency of robots has made economists question some of their traditional prescriptions for success in development. Work by Simon

Kuznets in the 1960s and 1970s suggested that modern economic growth requires moving resources out of agriculture into industry, then out of industry into services. This arc of industrialisation is supposed to carry poor countries into prosperity before eventually turning down as sophisticated services take over.

But what if robots, not people, fill the factories? The McKinsey Global Institute calculates that it would be technically possible (if not necessarily economically sensible) to automate 67% of India's manufacturing employment. It came up with similar figures for Indonesia and Thailand. If poor countries cannot move enough workers into industry, the benefits of productivity gains in manufacturing cannot spread widely through their economies. Their opportunities for development will be squeezed by automation's impactive grip.

Indeed, the arc of industrialisation has already changed, according to Dani Rodrik of Harvard University. In today's emerging economies, industry's share of employment is peaking at a lower level than it used to do, and at an earlier point in their development. This trend towards premature deindustrialisation is "not good news for developing nations", he notes.

But Mr Rodrik's results are not as depressing as they seem. Asia, as he points out, has so far defied premature deindustrialisation. The same, in aggregate, is true of Sub-Saharan Africa. It is chiefly in Latin America that the arc of industrialisation has lost height and reach. This Latin deindustrialisation may reflect the gradual abandonment of "import substitution" after the 1960s, when governments lowered the tariffs protecting local alternatives to foreign industrial goods. It may also reflect the arrival of China as a manufacturing superpower in recent decades. But it probably has little to do with robots, which are no more prevalent in Latin America than elsewhere.

Some researchers have questioned whether the developing world as a whole has deindustrialised. They argue that manufacturing employment became geographically more concentrated after 1990, but no less important. Nobuya Haraguchi of the United Nations Industrial Development Organisation (UNIDO), Charles Fang Chin Cheng of the University of New South Wales and Eveline Smeets, a consultant, have painstakingly pieced together employment data on over 100 developing countries, going back to 1970. They find that the average of each country's manufacturing-employment ratio has indeed declined since the early 1990s, as Mr Rodrik showed. But when they look at developing countries in aggregate, the share of manufacturing employment is higher than in earlier decades (see chart).

These results are not as contradictory as they seem. To see why, imagine that the world contained only two countries: Colombia and China. In Colombia, industry accounted for about 30% of employment in 1990, according to the International Labour Organisation. That fell to around 20% in 2015. For China, the opposite was true. On average, then, industry's share remained roughly the same in both years: around 25%. But in aggregate, industry's share increased enormously, because a tenth of China's workforce is a much bigger number than a tenth of Colombia's.

China's takeover of manufacturing employment may itself have peaked. The number of Chinese working in industry started falling in 2013, and China's share of world clothing exports has also stagnated since then. This represents a "historic opportunity" for countries like India, notes Arvind Subramanian, chief economic adviser to India's government. Countries such as Bangladesh, Indonesia and Vietnam are seizing it, but India itself is lagging. Its handicaps are largely self-imposed. The country's garment-makers pay high duties to import the man-made fibres that now dominate the industry. Exporters can get a refund, but the procedure is cumbersome. Perhaps it could be automated.

As things stand, regulatory barriers are far more damaging for South Asia's garment-makers than automation. Indeed, the practical people who orchestrate supply chains for clothing retailers are somewhat sceptical about the role of robots in the industry. "There are many people who have done semi-automation. But fully automated garment factories, we have not seen any...we're probably years away," says Spencer Fung, chief executive of Li & Fung in Hong Kong. The company's chairman, William Fung, agrees. E-commerce may have transformed retailing, but "the supply chain that supplies this highly digitised consumer market is actually analogue."

Automation can speed things up, but it also adds to costs. The operator of one of SoftWear's Sewbot lines may be 17 times as productive as a traditional garment-worker, but the typical cost of labour in the United States, even on the minimum wage, is more than 18 times as much as in Bangladesh. And that does not count the cost of the bot.

| *Bots for basics*

SoftWear Automation itself is surprisingly measured in its claims for its technology. "There's the perception that robots will take over and automate everything," says Mr Rajan, the firm's boss; but he believes the sewbots will remain in the minority even 20-30 years into the future. "I expect we'll probably automate about 20-25% of the apparel industry," he predicts. Robots will take care of "the high-volume basics". But "the higher fashion, lower batch sizes are always going to be done by people."

SoftWear Automation occasionally receives calls from Bangladeshi garment-makers, but the company serves only the American market. "If you are looking to deploy our technology because you think you can save labour costs, then it's the wrong reason to do it," says Mr Rajan. Instead, his company aims to minimise transport costs, reduce environmental strains and relieve acute American labour shortages. One of their principal customers supplies America's armed forces, whose uniforms are required

by law to be made within the country. This anachronistic legislation is supposed to preserve America's industrial capacity to make the things its army needs, but "the average age of seamstresses in America is 56," Mr Rajan points out.

For the foreseeable future, then, the Sewbot is not a threat to the abundant labour in countries like Bangladesh. Its existence owes a lot to some cutting-edge innovation and more than a little to some long-standing American protectionism. Unfortunately, more examples of such protectionism are on the way. ■



过早去工业化

制衣工人现如何？

自动化对新兴国家工人的威胁并不像人们说的那么大

孟加拉国的成衣出口额比印度高60%，尽管后者的人口是前者的八倍。在孟加拉国首都达卡繁忙的街道上，白色货车在车流中缓慢前行，车身印着“紧急出口任务”的字样，就像救护车一般。制衣业这一典型的劳动密集型产业的腾飞令孟加拉国在2014年跻身中低收入国家之列（按世界银行的划分标准）。

但有人认为，孟加拉国的制衣业如今遇到一个新问题，严重程度堪比交通拥堵，那就是自动化的威胁。机器人已普遍应用于制造业其他领域，但在制衣业仍属少见。国际机器人联合会（IFR）表示，2015年（有数据可查的最近一年）在全球各地使用的163万台工业机器人中，仅1580台用于纺织、服装及皮革业。

机器人很难应用于制衣业是因为该行业的基本材料太过柔软。织物被拾取或放下时，形态会发生改变，或起褶打皱，或折叠悬垂，其状态难以预料。这可能会使机器人难以跟踪布料并判断在何处下手。麦肯锡全球研究院的崔德智表示，也许“相比缝制服装，把服装设计师的工作自动化还容易一点”。

英国伦敦大学国王学院的机器人学教授戴建生曾说，任何一个十几岁的孩子都会烫衣服（尽管不一定愿意做），但即使是这么简单的任务，也需要机器人有无比的灵巧度。要安装迷你红外传感器来定位布料的边缘，然后机器人的指端要以“冲击性抓力”夹压布料边缘。机器人还必须保持布料紧绷顺滑，对齐缝线。戴建生写道，要做到这一切，机器人需要以“多重动力链”相连接的多个活动部件。

有一家公司正研究解决这类挑战，这就是距离达卡8000英里、位于美国乔治亚州亚特兰大的自动化缝纫技术公司SoftWear Automation（以下简称

SoftWear)。它开发的缝纫机器人（Sewbot）用高速摄像机跟踪定位布料，用真空喷嘴拾取并旋转布块，用嵌入工作台的滚珠移动输送。“我们的技术对织物的宏观和微观操控能模仿手工裁缝的效果。”SoftWear的CEO帕拉尼史瓦米·拉詹（Palaniswamy Rajan）说道。他的机器已经可以商业化量产枕头及浴垫等简单产品。该公司希望明年开发一条T恤生产线，并表示一名缝纫机器人上班八小时将可生产1142件T恤，是普通制衣工人产量的17倍。

在亚特兰大发生的这些奇妙进展反映了机器人技术广泛的进步。崔德智指出，这些机器正在变得更便宜、安全、全能和易操作。有别于通常被隔离使用的现有工业机器人，最新一代机器人已足够安全，可以在拥挤的工作空间内使用。它们也可以被轻松地“编程”——崔德智给“编程”加了引号，因为实际上不需要写代码。

这些机器不再是为日本或德国等高收入国家专享。根据国际机器人联合会的数据，在2015年出货的所有工业机器人中，三分之一是运往中等收入国家的，其中大多数用于汽车和电子产品制造。中国是全球最大的单一买家。

机器人效率的提高导致经济学家们开始质疑他们为经济展开出的一些传统良方。西蒙·库兹涅茨（Simon Kuznets）在上世纪六七十年代提出，现代经济增长需要把资源从农业转移到工业，再从工业转移到服务业。这道工业化曲线应该能把贫穷国家带向繁荣，随着先进服务业主导经济，曲线最终转而下行。

但如果涌入工厂的劳动力不是人类，而是机器人呢？麦肯锡全球研究院计算认为，从技术上来说，印度制造业中67%的就业可以由自动化替代，尽管这从经济角度不一定合理。该机构对印尼和泰国也给出了类似的数字。假如贫穷国家不能把足够多的工人纳入工业体系，制造业生产力增长的好处就无法在经济体中广为散布。它们发展经济的机会将受到自动化那“冲击性抓力”的挤压。

哈佛大学的丹尼·罗德里克（Dani Rodrik）认为，工业化的发展曲线已经改变。在当今的新兴经济体中，工业就业比例的峰值比以往低，而且出现在更早的发展阶段。他指出，这种过早去工业化的势头“对发展中国家来说不是好事”。

罗德里克的结论看似沮丧，但其实没那么严重。正如他指出的，目前为止，亚洲并未陷入过早去工业化的境地。总的来说，撒哈拉以南非洲地区也是如此。工业化曲线的降低和提前主要发生在拉美地区。拉美的去工业化可能反映了上世纪60年代后拉美国家对“进口替代”战略的逐渐放弃，它们纷纷降低了为保护本国替代品而对外国工业产品征收的关税。它可能也反映了近几十年来中国作为制造业大国的崛起。但这大概与机器人无关，毕竟在拉美，机器人的普及程度并不比别处高。

一些研究人员质疑发展中国家已整体去工业化的说法。他们认为，制造业就业在1990年后在地理分布上变得更为集中，但重要性并没有降低。联合国工业发展组织（UNIDO）的原口信也（Nobuya Haraguchi）、新南威尔士大学的郑方俊（Charles Fang Chin Cheng，音译）和咨询顾问伊夫琳·斯梅茨（Eveline Smeets）倾力汇集100多个发展中国家早至1970年的就业数据。他们发现，正如罗德里克所指出的，每个国家制造业就业比例的平均值自上世纪90年代初以来的确下降了。但当把所有发展中国家看做一个整体时，这些国家的制造业就业比例高于前几十年的水平（见图表）。

这些结果看似矛盾，其实不然。我们来看一下原因。想象这世界仅包含两个国家：哥伦比亚和中国。根据国际劳工组织（International Labour Organisation）的统计，哥伦比亚的工业就业在1990年约占总体就业的30%，到2015年下降至约20%。而中国的情况刚好相反。平均起来，两个年份的工业就业比例大致相同：约25%。但合计起来，工业就业比例其实增幅巨大，因为中国劳动人口的10%远多于哥伦比亚劳动人口的10%。

中国引领制造业就业增长可能本身已达顶峰。中国的工业就业人数在2013年开始下滑，中国成衣出口占全球的比例也自此停滞不前。印度政府首席经济顾问阿文德·萨勃拉曼尼亚（Arvind Subramanian）指出，这是印度

等国家的“历史性机遇”。孟加拉国、印尼、越南等国家正在抓住机会，而印度自己却落于人后，主要原因是作茧自缚。印度的服装制造商需要支付高昂的关税来进口人造纤维（业内的主流原料）。出口商可以获得退税，但过程繁琐，也许该令这些程序实现自动化才对。

事实证明，监管壁垒对南亚服装制造商的损害远甚于自动化。的确，为服装零售商搭建供应链的从业者对于机器人在该行业里的角色还是有些怀疑。“许多人已采用了半自动化技术。但全面自动化的制衣工厂我们还没看到过……那大概得是多年以后的事了。”香港利丰集团（Li & Fung）的CEO冯裕钧说道。董事长冯国纶对此表示认同。电子商务可能已经改变了零售业，但“为这一高度数字化的消费者市场供货的供应链实际上仍留在模拟制式时代。”

自动化能提高生产效率，但也增加了成本。在一条运用SoftWear缝纫机器人的生产线上，一个机器人的效率可能是一名常规制衣工人的17倍，但在美国，即便是按最低工资计算，一般劳动力成本也是孟加拉国的18倍之多。而这还没计算机器人的成本。

| 机器人干基本活

SoftWear在描述自己的技术时也出奇地谨慎。“有人认为机器人将接管一切，令所有工作自动化。”老板拉詹说，但他认为，即便二三十年后，缝纫机器人仍然会是“少数派”。他预测，“估计我们大概能把20%到25%左右的制衣工作自动化。”机器人将用于生产那些“大批量基本款”，而“批量较小的高级时装总还是得由人工完成”。

SoftWear偶尔会收到来自孟加拉国服装制造商的咨询电话，但它仅服务美国市场。“如果你是为节省劳动力成本而打算部署我们的技术，那你就想错了。”拉詹说。相反，公司的目标是尽量降低运输成本、减少环境压力、缓解美国严重的劳工短缺问题。他的一个主要客户为美国军队供应制服，按法律规定，这些制服必须在美国国内生产。这一过时的立法是为了保持美国制造军需用品的工业能力，但“美国缝纫女工的平均年龄是56岁”，拉詹指出。

由此可见，在可预见的未来，缝纫机器人不会对孟加拉国这类国家充裕的劳动力造成威胁。其存在很大程度要归功于前沿科技创新以及美国长期存在的保护主义。不幸的是，这种保护主义的案例还在增多。 ■



Marriage

What goes down may come up

Eli Finkel counsels lowering expectations in hard times; Esther Perel advises grappling with adultery

FOR Eli Finkel, the rise of speed dating was almost too good to be true. A psychologist at Northwestern University who studies relationships, he found that hooking up recording equipment at the tables where singles have brief chats with multiple prospective dates offered an extravaganza of data. The ability to follow up with participants for years afterwards helped make Mr Finkel one of the leading lights in the realm of relationship psychology.

Then, after his wife suffered two difficult pregnancies and post-partum depression, his own marriage, rewarding up until that point, was suddenly struggling for life. Love, intimacy and sex were all but gone. In his candid first book, “The All-or-Nothing Marriage”, Mr Finkel examines both how he and his wife survived the worst, and how other couples might do the same.

He argues that high expectations for a marriage greatly benefit a couple when times are good, but are counterproductive when times are tough. Mr Finkel and his wife made it through their own emotional rough weather by lowering expectations for a few years. It was instinctive at the time, but he later discovered the research of James McNulty at Florida State University which finds that couples with high expectations are almost twice as happy during easier times as couples with lower expectations—but they are also almost twice as unhappy during hard times.

Mr Finkel describes other strategies that couples can use to heal damaged marriages. Some of these are minor “lovehacks” like cultivating gratitude. Research shows that when couples regularly spend time thinking about the

investments in the relationship that their partner has made, they end up feeling more committed to the marriage. And in ongoing work with his colleague Elaine Cheung, Mr Finkel is finding quantifiable value in outsourcing marital needs: seeking friends who provide something the spouse cannot, like a love of dancing or debate. Overall, he concludes that people today want their marriages to provide everything, but this unrealistic goal is often the enemy of making a marriage good enough to last.

Inevitably, some marriages face the hardest test: infidelity. Most books are prescriptive, with tips on how to prevent the crisis in the first place, or how to dump the bum and weather the trauma. As most are written for the loyal spouse, the philanderers are often cast as villains. Such moralising, suggests Esther Perel, is not helpful. With “The State of Affairs”, she hopes to inspire “a more productive conversation” about cheating.

Since publishing “Mating in Captivity” in 2006, Ms Perel has become a globe-trotting guru on sex and relationships. She has noticed that no subject fascinates and unnerves people more than infidelity—“universally forbidden yet universally practised”. People assume that affairs are symptoms of relationships gone awry; that the adulterer is always the selfish one; and that affairs are always harmful to a marriage. Ms Perel uses this sensible book to dispel these myths and to show that affairs can sometimes even fortify relationships, so long as they spur a couple to discuss what has long been left unsaid.

Just how many people stray is anyone’s guess, as few can agree on what counts as infidelity (sexting? a lap-dance?), and there are few incentives for honesty. But everyone seems to agree that the numbers are rising, largely because female philanderers are gaining on men. This may seem like a consequence of a sexually permissive age, yet views of infidelity are actually harsher than just a few generations ago. Ms Perel thinks that this is

because couples who marry for love invest more of their self-worth in their relationships. When a marriage is built on emotion, rather than pragmatism or duty, it is more vulnerable to the vagaries of the heart and the temptations of Tinder. When a lover is also a best friend and confidant, betrayal cuts more deeply.

Sometimes an affair is a signal that a relationship should end. But plenty of adulterers are content with their home lives. Prising out the stories of happy people who cheat, Ms Perel learns that many adulterers are most excited to discover a new self—one that is creative, erotic and very much unlike the devoted mum who spends her days chauffeuring her children.

Ms Perel's critics say she is soft on those who cheat, but she acknowledges the grim effects of infidelity. A betrayal can not only hijack a couple's hopes and plans, but also destroy their sense of history. There are good reasons why discovering an affair can make someone crazy, not least because transgressions nowadays tend to leave an extensive digital trace.

How do couples move past an affair? Once the initial crisis is over, Ms Perel recommends conversations rooted in curiosity. Partners who probe the meaning of an affair are better able to bring into their relationship what might have been missing, be it candour, eroticism or an awareness of a partner's allure to others. Although "our creative imagination seems to be richer when it comes to our transgressions than to our commitments," Ms Perel notes that quite a few people manage to bring their new-found selves back to their partners.

Ms Perel is not suggesting that couples in a rut indulge in a bit of infidelity. "I would no more recommend having an affair than I would recommend getting cancer," she says. But just as many people who survive life-threatening illnesses come to appreciate the pleasures of life anew, so too can couples who brave the turmoil of an affair emerge feeling

invigorated. ■



婚姻

艰难时日或可度过

伊莱·芬克尔告诫应在婚姻困难时期降低期望值；埃丝特·佩瑞尔建议直面和克服出轨

在伊莱·芬克尔（Eli Finkel）看来，“速配相亲”的兴起简直好得让人难以置信。芬克尔是美国西北大学研究婚恋关系的心理学家，他发现，在单身人士与多个潜在对象短暂聊天的桌子上安装记录设备，可获得大量有趣的数据。此后多年，他想办法继续追踪调查这些人，这帮助他成为婚恋心理学领域的权威之一。

后来，他的妻子经历了两段艰辛的孕期，还患上产后抑郁症，他本人此前一直美满幸福的婚姻突然坠入险境。爱、亲密和性生活都消失殆尽。在他第一本言辞坦率的著作《要么十全十美，要么一无是处》（The All-or-Nothing Marriage）中，芬克尔剖析了自己和妻子如何走出最艰难的时期，而其他伴侣或许也可以用同样的方法来解决。

他认为，对婚姻保持高期望值，在顺境时对伴侣裨益良多，但在逆境时则适得其反。芬克尔和妻子在几年里降低了期望值，走出了自身的情感风暴期。当时这么做是出于本能，但后来他从佛罗里达州立大学教授詹姆斯·麦克努尔蒂（James McNulty）的研究中找到了理论支撑。麦克努尔蒂发现，期望值高的伴侣在顺境时幸福感几乎是期望值较低者的两倍，但遇到逆境时，他们的不快乐几乎也是双倍的。

芬克尔还描述了夫妻可用以拯救受损婚姻的其他策略。其中一些是帮助“续爱”的小技巧，比如培养感激之情。研究表明，夫妻双方如果经常花时间想想对方在两人关系中的付出，就会对婚姻更为坚定。在他与同事伊莱恩·张（Elaine Cheung，音译）正在进行的一项研究中，芬克尔发现将婚姻中的需求“外包”具有可量化的价值：寻找朋友来提供配偶无法给予之物，例如对跳舞或辩论的爱好。总的来说，他的结论是，如今人们希望婚姻能提供一切，但这个不切实际的目标往往是维持美满婚姻敌人。

不可避免地，一些婚姻会面临最严峻的考验：不忠。对此大多数书都是教条的那一套，给你一些要诀，教你如何在一开始就防范危机产生，或者该如何甩掉负心人，克服创伤。由于这些书大多是写给忠诚的一方看的，出轨者往往被刻画成薄情寡义之徒。埃丝特·佩瑞尔指出，这种道德说教并无帮助。借由《外遇问题》（The State of Affairs）一书，她希望能就出轨现象激发出“更有成效的讨论”。

自2006年出版《围城云雨》（Mating in Captivity）后，佩瑞尔已成为奔走于全球的两性及婚姻关系大师。她注意到，人们最关注也最恐惧的话题莫过于不忠——“人们普遍视之为禁忌但又普遍犯忌”。他们以为，婚外情是情感出问题的症状，通奸者总是自私的一方，婚外情总是对婚姻有害。佩瑞尔以这本理智之作破除了这些迷思，并表明婚外情有时甚至可以强化夫妻关系，只要这一经历能促使两人去讨论长期未被言明的问题。

究竟有多少人有婚外情，这非常难说。毕竟，何谓不忠并无定论——发色情短信算不算？看艳舞算不算？而且诚实也得不到什么奖励。不过似乎可以取得共识的是，不忠行为有增无减，主要是因为女性出轨者的数量正逼近男性出轨者。这看似是纵情滥性时代的产物，但如今对不忠的评判实则比几十年前更严苛。佩瑞尔认为，这是由于因爱情而结合的夫妇在感情关系中投入了更多的自我价值。婚姻若建立在感情而非实用主义或责任之上，就更容易受心意变化和交友网站等外部诱惑的影响。如果爱人还是自己最好的朋友和知己，背叛就更伤人彻骨。

有时候，婚外情是一段关系应该终结的信号。但许多出轨者都对自己的家庭生活感到满意。佩瑞尔向婚姻幸福的出轨男女打探他们的故事，从中发现，最令许多偷情者兴奋的是他们发掘出自己新的一面——有创意、有风情，与终日忙于接送孩子的慈母形象迥然不同。

佩瑞尔的批评者称她对偷腥的人太宽容了，但其实她也承认不忠会带来恶劣的后果。情感背叛不但会夺去一对伴侣的希望和计划，同时也会摧毁他们的美好回忆。发现另一半出轨会让人抓狂并不奇怪，尤其是如今出轨行为往往会留下诸多数字痕迹。

伴侣如何能够克服婚外情而继续？佩瑞尔建议，最初的危机过后，两人应好好对话，探究缘由。会探讨婚外情意义的伴侣能更好地填补关系中缺失的东西，比如坦诚、“性趣”、以及对伴侣在别人眼中的魅力的认知。虽然“在婚姻关系中，我们的创造性想象力似乎不如在出轨时强”，但佩瑞尔指出，还是有不少人能带着新发现的自我回到配偶身边。

佩瑞尔并非建议生活一成不变的伴侣稍微沾惹下婚外情。“我完全不会建议大家出轨，就像我不会建议大家患癌一样。”她说。但正如许多熬过致命重病的人感念重获新生的喜悦，勇敢克服婚外情考验的夫妇也会有如重获“新婚”。■



Supply-chain finance

The missing link

Technology is reshaping the financing of firms that sell to other firms, and leading banks into new alliances

IN 2015 Kiddyum, a small company from Manchester that provides frozen ready-meals for children, won a contract from Sainsbury's, a big British supermarket chain. Jayne Hynes, the founder, was delighted. But sudden success might have choked Kiddyum's cashflow. Sainsbury's pays its suppliers in 60 days; Ms Hynes must pay hers in only 30.

In fact Kiddyum gets its cash within a few days. Once approved by Sainsbury's, its invoices are loaded onto the supermarket's supply-chain finance platform, run by PrimeRevenue, an American company. The Royal Bank of Scotland (RBS) picks up the bills, paying Kiddyum early. Kiddyum pays a fee which, Ms Hynes says, is a small fraction of the cost of a normal loan. Sainsbury's pays RBS when the invoice falls due.

Suppliers, of course, have always needed finance for the gap between production and payment. Traditionally, they could borrow on their own account, or sell their receivables—unpaid invoices—at a discount to businesses known as factors. Modern supply-chain finance, now some 25-years-old, also lets suppliers piggyback on the creditworthiness—and lower borrowing costs—of big corporate customers. Cash replaces receivables on their balance-sheets. Buyers can lengthen payment terms (from 60 to 90 days, say), knowing suppliers are less likely to fail for want of cash. Banks acquire good-quality assets.

Definitions of supply-chain finance abound and its scale is hard to pin down. But it is agreed that it is growing fast. BCR Publishing, which reports on the industry annually, estimates that at the end of 2014 banks and

factoring operations had €40bn-50bn (\$48bn-60bn) of “funds in use”. Thomas Olsen of Bain, a consulting firm, reckons (on a broader definition) that the market is expanding by 15-25% a year in the Americas and by 30-50% in Asia, with food and retailing among the most active industries. Naveed Sultan, who heads Citigroup’s trade-finance and treasury divisions, says supply-chain finance is the fastest-growing area of his trade business.

Unmet demand looks enormous. Even domestic supply chains are extensive. A new study by Mercedes Delgado of MIT’s Sloan School and Karen Mills of Harvard Business School finds that American firms supplying other firms employ 44m people. Of those, employers of 26.8m are involved in international trade. So far financing programmes have largely focused on big corporations and their first-tier suppliers. Among the obstacles to growth are know-your-customer and anti-money-laundering rules. The Asian Development Bank estimates the annual global “finance gap” in trade finance, a related field, at \$1.5trn. Anand Pande, head of supply-chain finance at iGTB, which provides technology to banks, calls supply-chain finance “a land of unrealised promise”.

That is true for both banks and borrowers. Eric Li of Coalition, a research firm, forecasts that this year large banks’ revenues from programmes instigated by big buyers will be \$2.8bn, 28% more than in 2010. If supplier-led finance is included, growth has been just 18%, far less than for lending volumes. Margins have been squeezed. The market is fragmented, Mr Li notes. After the financial crisis, many banks cut back their foreign operations.

| *Only connect*

They also face competition. Technology firms are pushing into supply chains. Online lenders have made less impact than third-party platforms that match buyers and suppliers to sources of finance. PrimeRevenue, for instance, connects 70 lenders, including 50-odd banks, to 25,000 suppliers

with \$7bn-worth of invoices a month. There is also space for specialists. Innervation Finance, based in New York, manages programmes for buyers offering finance to “diverse” suppliers (eg, run by people from ethnic minorities, women, veterans, the disabled or gay people) in banking, manufacturing and pharmaceuticals. Mark Ferguson, the chief executive, says the cost of capital for such firms may be two or three times that of other small businesses.

More banks are setting up programmes. Bank of Baroda, a public-sector bank that is India’s fifth-biggest by assets, began only a few months ago. Litesh Majethia, who runs the supply-chain business, admits that rival banks are already established. But with small and medium-sized Indian firms facing a funding gap of \$400bn, he says, there is plenty of room; and a spanking new digitised system is a plus.

Banks are not, however, being overthrown by technological upstarts—as, say, high-street retailers have been by Amazon. Symbiosis is the rule. Two big banks, HSBC and Santander, have allied with Tradeshift, an invoicing, finance and procurement network that connects over 1.5m buyers and suppliers worldwide. HSBC has also joined forces with GT Nexus, a global supply-chain management platform. Banks can tap into a new pool of customers; companies in the tech firms’ networks can find finance more easily. Smaller local banks, however, may lose out as the market expands, and suppliers spurn them to borrow more cheaply from larger lenders.

Technology is opening up more possibilities. C2FO, another financial-technology firm, matches suppliers’ requests for payment at a date and interest rate of their choosing, with buyers willing to lend. Typical supply-chain finance, says Sandy Kemper, C2FO’s boss, is far less flexible. His platform is available to smaller suppliers. Back-to-back deals along the chain are even allowing third- and fourth-tier suppliers to join in. No bank is involved, though the firm has recently teamed up with Citigroup. Citi can

lend to more companies; C2FO gains access to the giant's clients.

More is in the pipeline: banks are exploring, for example, how blockchain technology might align the flow of data and money more closely with the flow of goods. Bain's Mr Olsen sees several business models emerging, some led by single banks, some by groups of them, and others by platforms, big companies and e-commerce firms such as Amazon and Alibaba. Not every bank will win. The smaller fry in the world's supply chains just might. ■



供应链金融

缺失的一环

科技正在重塑供应商的融资方式，并推动银行结成新联盟

二零一五年，曼彻斯特一家经营儿童速冻食品的小公司Kiddyum赢得了英国大型连锁超市英佰瑞（Sainsbury's）的一份合同。Kiddyum的创始人杰恩·海恩斯（Jayne Hynes）相当欣喜。但这突如其来的成功却可能令Kiddyum产生现金流危机。英佰瑞对供应商的账期是60天，而海恩斯对自己供应商的账期仅为30天。

事实上，Kiddyum几天内便收到了货款。经英佰瑞核准后，付款单加载到该超市由美国公司PrimeRevenue运营的供应链金融平台上。苏格兰皇家银行（RBS）接过这个账单，提前向Kiddyum付款。Kiddyum需为此支付一笔费用，但海恩斯称，这笔费用只相当于正常贷款成本的一小部分。英佰瑞则会在付款单到期时付款给苏格兰皇家银行。

毋庸说，供应商总需要融资来填补生产和收款之间的资金缺口。常规做法是供应商自行借款或将应收账款（未支付的付款单）打折出售给被称为保理商的公司。已有约25年历史的现代供应链金融也令供应商可以借助大企业客户的信誉和它们更低的借款成本。在供应商的资产负债表上，现金取代了应收账款。买家可以延长账期（比如从60天延至90天），深知如今供应商因资金短缺而倒闭的可能性更小了。银行则可从中获得优质资产。

供应链金融的定义各种各样，规模也难以确定，但其快速增长则是人们公认的。每年就该产业发布报告的BCR出版集团（BCR Publishing）估计，2014年底，银行及保理业“相关用途资金”达400亿至500亿欧元（480亿至600亿美元）。贝恩咨询公司的托马斯·奥尔森（Thomas Olsen）认为，更广义的供应链金融市场正以每年15%至25%的增速在美洲扩展，在亚洲的年增速则为30%至50%，食品和零售是其中最活跃的行业。花旗集团的贸易金融及财资部主管纳维德·萨尔坦（Naveed Sultan）表示，供应链金融是其贸易金融业务部门中增长最快的领域。

未满足的需求看似巨大。单单是国内供应链市场也空间广阔。麻省理工学院斯隆学院的梅赛德斯·德尔加多（Mercedes Delgado）和哈佛商学院的凯伦·米尔斯（Karen Mills）的新研究发现，向其他公司供货的美国公司总共雇用了4400万人，其中2680万人的雇主企业涉足国际贸易。迄今为止，供应商融资项目主要针对大企业及其一线供应商。阻碍业务增长的因素包括“了解客户”和反洗钱的规定。亚洲开发银行估计，每年全球贸易融资（供应链金融的相关领域）的“资金缺口”达1.5万亿美元。为银行提供技术的交易银行业务平台iGTB的供应链金融主管阿南德·潘德（Anand Pande）称，供应链金融是“尚未实现的应许之地”。

对银行和借款方而言都确实如此。研究公司Coalition的埃里克·李（Eric Li，音译）预测，大型银行今年从大买家发起的融资项目中获得的收入将达到28亿美元，比2010年增加28%。但如果加上供应商融资这一块，增长则仅为18%，远低于贷款额的增长。利润已经受到挤压。埃里克·李指出，这是个分散的市场。金融危机后，许多银行削减了国外业务。

| 只是连接

它们也面临竞争。科技公司正向供应链领域推进。网络贷款机构产生的影响不及将买家及供应商与资金源头进行匹配的第三方平台。例如，PrimeRevenue把70家贷款机构（包括50多家银行）与每月收款总额达70亿美元的25,000家供应商连接起来。专业服务机构在其中也有发展空间。总部在纽约的Innervation Finance替买家管理面向银行、制造业及制药业内的“多元化”供应商（即由少数族裔、女性、退伍军人、残疾人或同性恋者经营）的融资项目。其首席执行官马克·弗格森（Mark Ferguson）表示，这类供应商的资金成本可能是其他小型企业的两三倍。

更多银行正在设立此类项目。以资产规模论在印度位列第五大银行的国有巴罗达银行（Bank of Baroda）几个月前才开始设立供应链金融项目。主管这一业务的利特什·马杰提亚（Litesh Majethia）承认，对手银行在这方面已发展成熟。但鉴于印度中小企业的资金缺口达4000亿美元，他认为这项业务还有充裕的发展空间，而巴罗达银行全新的数字化系统也是一项优势。

然而，银行并没像被亚马逊打倒的实体零售商那样被科技新贵推翻。共生才是正道。汇丰和桑坦德这两家大银行已与开票、融资及采购系统平台Tradeshift（连接全球超过150万买家和供应商）结成联盟。汇丰银行还与全球供应链管理平台GT Nexus达成合作。银行可借此接触到全新的客户群，而这些科技平台上的公司也更容易获得融资。然而，随着市场扩展，较小的地方银行则可能丢掉业务，供应商会抛弃它们转向大型贷款机构，以获得更低成本的贷款。

科技正在开启更多的可能性。另一家金融科技公司C2FO能按供应商选定的收款日期及利率匹配愿意贷款的买家。C2FO的老板桑迪·坎伯（Sandy Kemper）说，一般供应链金融的灵活性远低于此。他的平台可供小型供应商使用。供应链上的背靠背交易甚至允许三四线供应商参与。其中不涉及任何银行，但该公司最近已联手花旗集团发展业务。如此一来，花旗集团可向更多公司提供贷款，C2FO则可接洽到这一银行巨头的客户。

还有更多项目正在开发中。例如，银行正在探索如何运用区块链技术令数据流和资金流更紧密地与货物流配合。贝恩公司的奥尔森认为多种商业模式正在显现，有些由单一银行主导，有些由多家银行联手操控，其余则由平台、大企业及亚马逊和阿里巴巴这样的电子商务公司牵头。并非每家银行都能胜出，但全球供应链中的小角色倒有可能成功。■



Air travel

Mechanical engineers

Tiny robots will inspect and fix jet engines from the inside

IF YOU are reading this while sitting in an aircraft and are of a nervous disposition, do not be alarmed, but the temperature inside the jet engines keeping you aloft probably exceeds the melting point of the materials that those engines are made from. That they do not consequently turn into a molten mess is a feat of modern engineering. It involves a combination of tough alloys and advanced production techniques, such as 3D printing, which allow components to be made with tiny channels through which cooling air circulates. Parts exposed to the most extreme temperatures, which can reach more than 1,300°C, are given additional protection with a coating of special heat-resisting ceramics.

New jet engines are designed to run hot because that results in a more complete combustion, which lowers fuel consumption and cuts emissions. Hot engines, though, need nurturing. Nowadays the three big aircraft-engine makers, General Electric (GE), Rolls-Royce and Pratt & Whitney, usually include servicing as part of their sales, and many jet engines are leased on a “power-by-the-hour” contract. This means regular check-ups and maintenance are in the interests of airlines and producers alike. The difficult bit is inspecting an engine without dismantling it. That requires taking the aircraft to which the engine is attached out of service. And, with a power-by-the-hour contract, when a plane disappears into the workshop, it is not just the airline that loses money, but the engine maker, too. The hunt is therefore on for faster and more efficient ways to keep engines in tip-top condition.

Don Lipkin, a chief scientist at GE Global Research in Niskayuna, New York, and his colleagues Todd Danko and Kori Macdonald, think they have come

up with one. They are developing tiny robots which can venture inside an engine to inspect its innards and carry out any necessary repairs. Eventually, these robots may be able to work while a plane is waiting at a gate between flights.

| *Send in the microbots*

Dr Lipkin's robots are being tested in a laboratory, but he hopes to have them ready to go inside operating aircraft by the end of the year. To start with, they will conduct inspections. Later, once techniques are perfected, they will begin making repairs. Such robots will also be used to inspect and repair GE's gas turbines. These are jet engines used in power plants to generate electricity, rather than as propulsion devices. But they, too, would benefit from reduced downtime for maintenance.

Inspecting the fan blades that draw air into the front of an engine is reasonably straightforward, because those blades are large and visible. But things get harder the deeper you go. Following the fan are a series of closely packed blades that compress the air before it arrives at the combustion chamber. When the compressed air reaches that chamber, and is mixed with fuel and ignited, the resulting hot gases then blast out of the rear, providing thrust. Some of those gases are diverted through a series of stubby turbine blades near the back of the engine. These, via shafts, turn the fan and the compressor, and thus keep the whole arrangement running.

In a working engine, all of these components are so tightly packed together that sometimes the only way to peek inside is by inserting an endoscope (a camera on a flexible tube) through a hole in the engine's casing. But the view is limited. The researchers' robots, however, are small enough to navigate their way around all the various blades, photographing everything they see and relaying the pictures wirelessly to technicians. Then, once the pictures have been analysed, the robot itself can often effect a repair.

The team's robots come in several varieties. One is about the size of a small envelope and is flexible. It runs along a sort of rack-and-pinion track that is inserted into the back of the engine. The track is made from a long strip of plastic which, with a twisting action, can be flicked between the blades. The robot is attached to the track and employs a toothed drive-mechanism which connects to a series of holes in the plastic strip and permits the device to propel itself along. Once it has arrived at its destination, it expands so that it is gripped between a pair of blades. The track is withdrawn and the robot hitches a ride on the blades as these are rotated manually by technicians. That way it can photograph internal surfaces adjacent to the blades as it passes. Once its job is done, it can be pulled out on a cord.

Another type of robot, a few centimetres square, crawls inside an engine on caterpillar tracks. A third version uses magnetic wheels. These let it grip surfaces made with specialised steels in the cold front section of ground-based gas turbines, and thus work upside down if necessary. All the robots are driven by a human operator using a tablet computer. To repair things, the machines are fitted with tiny arms that reach out and inject ceramic coatings from a cartridge of material to fill in any damaged areas. The robots can also carry small grinding tools, to smooth down ragged surfaces.

Such repairs may not be as permanent as those during a full rebuild, but they are good enough to extend the time an engine can operate between major overhauls. Moreover, data collected by the robots would be used by GE to update the engine's "digital twin". These twins are virtual replicas, held on a computer, and contain the latest operating data sent via satellites from sensors mounted inside engines. The twins serve as test beds for spotting problems before they get serious. This means preventive maintenance can be carried out and unscheduled visits to the workshop avoided.

Robots will allow much finer monitoring of an engine's wear and tear. That varies, according to how aircraft are used—even by particular pilots, some of whom push aircraft engines harder than others do—and where in the world a plane most often operates. Airborne particles, particularly in polluted regions, can block the tiny cooling channels that help stop an engine melting. Wind-blown sand grains in places such as the Middle East subject blades to increased abrasion. Jet engines are already remarkably reliable, with the need for an in-flight shutdown now in the order of once in 20,000 hours of operation, which means a pilot may never experience a failure in his entire career. Tiny robots will make them more so. ■



航空旅行

机械工程师

微型机器人将从内部检修喷气式发动机

如果你看这篇文章时正在坐飞机，而你是个比较容易紧张的人，请不要因为接下来的文字而惊慌：带你高空飞行的喷气式发动机内部的温度之高，可能要超过发动机制造材料的熔点。但发动机并没有因此而融化成一堆烂铁，实在是现代工程技术的一项重大成就。这包括坚固的合金和先进的生产工艺，比如3D打印。3D打印能制造出带有细微通道的零部件，冷却用的空气可在这些通道中流通。那些暴露在最极端温度——可能超过 1300°C ——中的零部件还会被包裹上一层特殊的耐热陶瓷，作为额外的保护措施。

新的喷气式发动机要在发热的状态下运转，是因为这能实现更充分的燃烧，从而降低燃油消耗并减少排放。不过，在高温下工作的发动机需要保养。如今，世界三大航空发动机制造商——通用电气、罗尔斯·罗伊斯（Rolls-Royce）和普惠发动机公司（Pratt & Whitney），通常都将维修作为销售的一部分，而且还有许多喷气式发动机是以“按小时包修”的合同租出去的。这表明定期检查和养护对航空公司和制造商都有好处。难题在于如何在不拆解的情况下检查发动机。这需要搭载发动机的飞机停止服务。另外，在按小时包修合同下，当一架飞机进了维修车间，亏钱的不只是航空公司，还有发动机制造商。因此，人们正在搜寻能够更快、更有效地让发动机保持最佳状态的方法。

在位于纽约尼什卡纳（Niskayuna）的通用电气全球研究中心，首席科学家唐·利普金（Don Lipkin）和他的同事托德·丹科（Todd Danko）、科里·麦克唐纳（Kori Macdonald）认为他们已经找到了办法。他们正在研发一些微型机器人，能够探入发动机的内部检查设备并完成必要的修理。最终，这些机器人或许可以趁飞机在航班间歇停在登机口时展开工作。

| 派微型机器人出马

利普金的机器人目前还在实验室中接受测试，不过他希望年底之前能让它们进入服役的飞机内部。一开始，这些机器人会开展检查，等技术完善后，它们将着手维修。通用电气还会用它们来检修公司的燃气轮机。这些燃气轮机是在发电厂里发电用的喷气式发动机，而不是用作推进装置，但它们也会因为缩短停机维修的时间而受益。

那些将空气吸入发动机前部的风扇叶片检查起来比较简单，因为它们和大而且可见。不过越深入发动机内部，情况就越棘手。风扇后方密集排布着许多压气机叶片，它们负责在空气进入燃烧室前将其压缩。当压缩后的空气进入燃烧室，与燃料混合并点燃，产生的炽热气体就从后部喷射而出，提供一部分推进力。其中一些气体会转道经过靠近发动机尾部的短粗的涡轮扇叶，通过传动轴来推动风扇和压气机转动，从而维持整个装置的运转。

在运行中的发动机内，这些组件都被安装得十分紧凑，有时只能通过发动机罩上的一个洞插入内窥镜（安装在挠性管上的摄像头）来查看，但视野有限。上述研究人员的机器人却小到足以在各种扇叶间游走，拍摄所见的一切并以无线方式将照片传输给技术人员。图片经分析后，机器人通常自己就能修理部件。

该研究团队的机器人有若干种类。一种是大小与小信封相近的柔性机器人，沿着一种插入发动机后部的齿轮齿条轨道行进。轨道由一长条塑料制成，可做出扭转的动作而在扇叶间快速移动。机器人附着在轨道上并运用一个带齿的传动装置，此装置与塑料条上的一串孔洞相连，让机器人能推动自身向前移动。一旦到达目的地，它便会扩张，直至夹在两片扇叶中间。随后轨道被撤出，技术人员手动转动扇叶，机器人就能搭乘扇叶的“便车”，“沿途”拍摄临近扇叶的内表面。机器人完成任务后，可用一根绳子把它拉出来。

另一种机器人几厘米见方，靠履带在发动机内爬行。还有一种机器人采用磁轮，能吸附在地面燃气轮机前端低温部分用特殊钢材制成的表面上，必

要时能倒立工作。所有这些机器人都由操作员用一个平板电脑来操控。它们安装了微型手臂，维修时可以伸出手臂并将材料盒中的陶瓷涂层注入受损部位。这些机器人还可携带小型打磨工具，让粗糙的表面重新变平整。

这种修理的效果也许不如全面维修持久，但也足以延长发动机接受大修之前的工作时间。此外，通用电气还可以用机器人收集到的数据来升级该发动机的“数字双胞胎”。这些“双胞胎”是在计算机上运行的发动机的虚拟复制品，包含发动机内的传感器搜集并通过卫星发送的最新操作数据。“数字双胞胎”充当试验平台，在问题变严重之前将其识别出来，这样就可以实施预防性维护并避免突发性维修。

有了机器人，对发动机磨损状况的监测将变得精细很多。磨损情况的差异取决于飞机的使用情况（甚至与飞行员有关——他们当中有些人用发动机时较其他人更猛），同时也取决于飞机最常在世界哪个地区飞行。悬浮粒子会堵住防止发动机熔化的微小冷却通道，尤其是在在受污染的地区。在中东等地，风吹起的沙粒会加重叶片的磨损。喷气式发动机已经相当安全可靠，如今大约飞两万小时才会发生一次空中停车，这意味着飞行员在整个职业生涯中可能都不会遇到故障，有了微型机器人就更是如此了。■



Schumpeter

Reality distortion field

Companies that burn \$1bn a year are sexy, dangerous, and statistically doomed

YVES SAINT LAURENT, Lady Gaga, David Bowie. Some people do not operate by the same rules as everyone else. Might the same be true of companies? Most bosses complain of being slaves to short-term profit targets. Yet a few flout the orthodoxy in flamboyant fashion. Consider Tesla, a maker of electric cars. This year, so far, it has missed its production targets and lost \$1.8bn of free cashflow (the money firms generate after capital investment has been subtracted). No matter. If its founder Elon Musk muses aloud about driverless cars and space travel, its shares rise like a rocket—by 66% since the start of January. Tesla is one of a tiny cohort of firms with a licence to lose billions pursuing a dream. The odds of them achieving it are similar to those of aspiring pop stars and couture designers.

Investing today for profits tomorrow is what capitalism is all about. Amazon lost \$4bn in 2012-14 while building an empire that now makes money. Nonetheless, it is rare for big companies to sustain heavy losses just to expand fast. If you examine the members of the Russell 1000 index of large American firms, only 25 of them, or 3.3%, lost over \$1bn of free cashflow in 2016 (all figures exclude financial firms and are based on Bloomberg data). In 2007 the share was 1.4% and in 1997, under 1%. Most billion-dollar losers today are energy firms temporarily in the doldrums as they adjust to a recent plunge in oil prices. Their losses are an accident.

But a few firms love life in the fast lane. Netflix, Uber and Tesla are tech companies that say their (largely unproven) business models will transform industries. Two others stand out for the sheer persistence of their losses. Chesapeake Energy, a fracking firm at the heart of America's

shale revolution, has lost at least \$1bn of free cashflow a year for an incredible 14 years in a row. Nextera Energy, a utility that runs wind and solar plants, and which investors value highly, has managed 12 years on the trot.

Collectively these five firms have burned \$100bn in the past decade, yet they boast a total market value of about \$300bn. Combining punchy valuations with massive losses means taking the entrepreneurial art form to a dizzying extreme. Steve Jobs, Apple's co-founder, was said to have a "reality distortion field" that allowed him to bend the perception of others (although Apple itself was fairly timorous, losing just \$874 in its worst year, in 1993). The experience of the five suggests that bending reality today has three elements: a vision, fast growth, and financing.

Take the vision thing first. A charismatic leader with a world-changing plan is *de rigueur*. For its first 23 years Chesapeake was led by Aubrey McClendon, a cocky Oklahoman who pioneered the process of blasting rocks to extract gas and oil (he died last year in a high-speed car crash). Reed Hastings at Netflix plans to destroy the conventional TV industry by selling films and shows over the internet. Like Mr Musk, Travis Kalanick, Uber's tarnished former boss, dreams of changing how humans travel. Nextera is led by technocrats but their aim is grandiose—to usher in a new generation of energy technology.

The vision needs to be validated by runaway growth. Often firms emphasise a flattering operating measure, such as oil and gas pumped from the ground, the number of rides hailed and so on. Investors need to believe in a high "terminal value", a point in the future when high, stable profits will arrive. So it helps to show that, hypothetically, profits would gush if breakneck growth were to stop. Uber says it is profitable in cities where it has operated longest, such as San Francisco. Nextera says that if it stopped investing in new capacity, it would make \$6bn of free cashflow a year.

Netflix amortises the cost of content over periods of up to five years, so reports an accounting profit even as it bleeds cash.

The third element is financing to pay for huge cumulative losses. Each of the five firms has been a financial innovator, taking advantage of cheap money and growth-hungry investors. Uber has tapped private capital markets, Nextera has structured part of its business as a partnership, Tesla has taken deposits from customers and also trades environmental tax credits. Chesapeake Energy sparked Wall Street's lust for shale junk bonds, and Netflix has signed commitments to make \$14bn of future payments to studios and artists to buy creative content.

So sustaining a reality distortion field is possible, but the longer it goes on for, the harder it gets. More capital has to be raised and, in order to justify it, the bigger the firm's projected ultimate size—its terminal value—has to be. Fast growth puts huge strain on managers. At some point the edifice can come tumbling down. The five companies described here have \$60bn of borrowings, and one, Chesapeake, is struggling with its debt load.

| *Poker face*

A few firms other than Amazon have defied the odds. Over the past 20 years Las Vegas Sands, a casino firm, Royal Caribbean, a cruise-line company, and Micron Technology, a chip-maker, each lost \$1bn or more for two consecutive years and went on to prosper. But the chances of success are slim. Of the current members of the Russell 1000 index, since 1997 only 37 have lost \$1bn or more for at least two years in a row. Of these, 21 still lose money.

To justify their valuations, the five firms examined by Schumpeter must grow their sales by an estimated 8-33% each year for a decade. Based on the record of all American companies since 1950, and the five firms' present revenue levels, the probability of this happening ranges between 0.1% and

25%, using statistical tables from Credit Suisse, a bank.

Firms that burn piles of cash are often lionised in an era when growth is sluggish and few companies reinvest all their profits. But losing a billion dollars or more a year is a wildly risky affair and the odds are that such businesses will fall flat. This should not be a surprise—hardly anyone can pull off building a fashion empire around androgyny, wearing a raw meat dress to an awards ceremony, or singing about life on Mars. ■



熊彼特

现实扭曲力场

一年烧掉十亿美元的公司很有魅力却也危险，从统计学上看难逃厄运

伊夫·圣洛朗，Lady Gaga，大卫·鲍伊。有些人并不按大众遵从的那一套规则行事。或许这对企业来说也成立？大多数老板都抱怨自己成了短期利润目标的奴隶，不过却有少数人趾高气扬地公然无视这一正统目标。来看电动汽车制造商特斯拉。今年到目前为止，特斯拉仍未达到生产目标，且损失了18亿美元的自由现金流（即减去资本投资后公司所产生的现金）。这不要紧。只要其创始人伊隆·马斯克大谈无人驾驶汽车和太空旅行，公司股价就如火箭般蹿升——自1月初以来，特斯拉股价已上涨了66%。有这么一小群公司，它们为了追求梦想，享有损失数十亿美元的自由，特斯拉便是其中之一。这些公司实现梦想的可能性和那些有志成为流行歌星或高级时装设计师的人实现抱负的可能性差不多。

资本主义的要义在于今天投资，明天获益。2012年至2014年间，亚马逊在打造商业帝国的过程中损失40亿美元，如今终于盈利。然而，很少有大公司承受重大损失只为了快速扩张。若仔细查看追踪美国大公司的罗素1000指数的成员公司，会发现其中只有25家（即3.3%）在2016年损失了超过十亿美元的自由现金流（所有数字均排除金融公司，并以彭博的数据为依据）。2007年时这一占比为1.4%，1997年为不到1%。当前亏损超过十亿美元的公司大多是因近期油价骤降而暂时不景气的能源公司，它们的亏损是一个意外。

不过有些公司就是喜欢快车道上的惊险和刺激。Netflix、优步和特斯拉这样的科技公司称自己（大体上未经检验）的商业模式将给所在的行业带来变革。另外还有两家公司纯粹是因持续亏损而突出。在美国页岩油革命中处于核心地位的水力压裂公司切萨皮克能源（Chesapeake Energy）难以置信地连续14年每年至少损失十亿美元的自由现金流。经营风能及太阳能发电厂的公用事业公司新纪元能源（Nextera Energy，投资者对其估值很高）已连续12年亏损。

过去十年，上述五家公司合计烧掉了1000亿美元，然而它们的总市值却高达3000亿美元。高估值和巨额损失并存，意味着将创业的艺术发挥到乱花迷人眼的极致。苹果的联合创始人乔布斯据说具有一种“现实扭曲力场”，让他能够左右他人的看法（不过苹果本身胆子倒是没那么大，在情况最差的1993年也只损失了874美元）。这五家公司的经验显示，现如今要扭曲现实要具备三个要素：宏伟的构想、快速的增长，以及融资手段。

先来看宏伟构想。一位充满个人魅力的领导者怀揣一个改变世界的计划，这一点必不可少。切萨皮克创立后的前23年是由奥布里·麦克伦登（Aubrey McClendon）领导，这位傲慢自大的俄克拉荷马人开创了爆破石头开采油气的工艺（去年他在一场飞车事故中身亡）。Netflix的里德·哈斯廷斯（Reed Hastings）在互联网上销售电影及电视节目，计划以此摧毁传统电视产业。和马斯克一样，形象受损的优步前老板特拉维斯·卡兰尼克（Travis Kalanick）也梦想着改变人们的出行方式。新纪元能源由技术官僚领导，不过他们的目标也很宏伟——开创新一代能源技术。

这样的构想需要有迅猛的增长作为支撑。企业通常都强调让自己面上有光的衡量标准，例如从地下抽出的石油或天然气，叫车服务的完成数量等等。投资者需要相信会有一个很高的“终值”，即未来某个时候会出现稳定的高额利润。因此，比较有用的做法是向外界表明，假设某天惊人的增长停止了，利润便会滚滚而来。优步称自己在经营时间最长的城市例如旧金山已经实现盈利。新纪元能源表示如果自己停止投资新产能，每年将会产生60亿美元的自由现金流。Netflix内容成本的摊销期长达五年，因而仍能在亏损的同时产生账面利润。

第三个要素是通过融资为累积的大笔亏损买单。上述五家公司每一个都是金融创新者，占了低息贷款和渴求增长的投资者的便宜。优步利用私募资本市场筹钱，新纪元能源将部分业务打造成合伙企业，特斯拉向客户收取预付款，并从事环保税收抵扣的交易获利。切萨皮克能源点燃了华尔街对页岩油气行业垃圾债券的欲望。Netflix已签署协议，承诺未来投入140亿美元用于向电影公司及艺人购买创意内容。

因此，扭曲现实力场还是有可能保持的，只不过时间越长，保持的难度就越大。公司必须得筹集更多的资本，而要为融资提供说服力，公司预期的最终规模即“终值”就得更大。快速增长令经理人背负起巨大的压力。到了某个时候，大厦有可能轰然倒塌。本文描述的五家公司共有600亿美元的负债，其中切萨皮克已经因债务不堪重负。

| 不露声色

除了亚马逊，还有一些公司也克服了重重困难。过去20年来，博彩企业拉斯维加斯金沙集团（Las Vegas Sands）、邮轮公司皇家加勒比、芯片制造商美光科技（Micron Technology）均曾经连续两年亏损十亿美元甚至更多，但都实现了蓬勃发展。不过成功的机会很渺茫。罗素1000指数目前的成员企业中，自1997年以来至少连续两年损失十亿美元或更多的企业只有37家，它们当中有21家如今仍在亏损。

为了让自己的估值站得住脚，本专栏考察的这五家公司的销售额预计须以8%到33%的速度增长，并持续十年。利用瑞信银行的统计分析，根据所有美国公司自1950年来的记录以及这五家公司目前的收入水平，这一预期实现的概率在0.1%至25%之间。

在增长乏力且很少有公司将所有利润用于再投资的时代，烧掉大堆现金的公司往往会备受尊崇。但每年损失十亿美元甚至更多是一桩风险极大的事情，这样的企业很有可能会彻底失败。这应该没什么可让人惊讶的——还能有谁能以雌雄同体为灵感打造出一个时尚帝国，穿着生肉做成的礼服参加颁奖庆典，或为火星上的生活大唱赞歌呢？ ■



The business of sperm banks

Seed capital

Modern families and differing national laws on sperm donation mean opportunities for companies

BROWSING websites that list sperm donors is weirdly similar to online dating. “Sanford is the total package,” begins one online ad, describing his strong jawline and piercing blue eyes. With a degree in finance and a “charming demeanour”, he is more than a pretty face. You can listen to a voice recording from Sanford himself. If all that wins you over, you can have his baby without ever having to go on a date. For \$635, Seattle Sperm Bank (SSB) will post you a vial of his frozen swimmers.

The fact that the main customers for many sperm banks are now single women explains the marketing technique. “They tend to be highly educated, impatient and picky,” says Ole Schou, founder of Cryos International, the world’s largest sperm bank, based in Denmark’s second-biggest city, Aarhus. Its website is designed to resemble Match.com, a dating site, because “finding a donor should be as close to finding a natural partner as possible.”

Outside the Cryos office, a steady trickle of young men park their bicycles and head for the donor room, which is equipped with the usual pornographic magazines, a television and an inexplicable cactus. After they hand in their contributions, lab technicians test them and sort them by quality. The samples are labelled, frozen and stored in five large vats of liquid nitrogen at -196°C . Once orders come in they will be shipped to homes, clinics and other sperm banks in over 100 countries.

Fertility is a sizeable industry; commercial sperm banks are a crucial and profitable part of it. The global sperm-bank business could be worth nearly

\$5bn by 2025, according to Grand View Research, a market-research firm in California. Demand has risen strongly. That is partly because people in rich countries are postponing their childbearing years; they struggle to conceive as a result. But an even greater reason is that in more places, it is both legal and increasingly acceptable for lesbian couples and single women to have children. These groups make up 60% and 90% of clients at Cryos and SSB, respectively.

As demand rises, politicians and regulators are trying to exert more control. That has created a patchwork of rules that affect sources of both supply and demand. In some countries, such as Britain and the Netherlands, anonymous donation of sperm has been outlawed, contributing to sperm shortages; in others, such as France and Spain, donors must be anonymous. In Canada, donors cannot be paid; in most European countries they can be compensated only for expenses; in America there are no limits on remuneration.

As for buyers of sperm, many head for jurisdictions where waiting times and prices are lower or the level of testing or information about the donor greater, or because restrictive rules at home prevent them from receiving donor sperm altogether. In Hong Kong and Switzerland, for example, only married, heterosexual couples are eligible for treatment with donor sperm. In France lesbians and single women are excluded. This legislative hodgepodge represents opportunity for those that can export sperm. Thanks to dry ice, the internet and DHL, good-quality sperm has become highly tradable.

| *Where did you guys gamete?*

The industry has not always been in the hands of businessmen. For much of the 20th century, infertile couples would see a doctor who would pull his best-looking student from the corridor and use his freshly volunteered sperm to inseminate the woman, recalls Rene Almeling at Yale University.

No records were kept. The HIV epidemic of the 1980s ended such shenanigans. Freezing, quarantining and testing both sperm and donors became crucial.

Worried about rising costs and legal liability, medical clinics left the business and commercial sperm banks filled the gap. The market has become highly competitive. Many customers need between six and ten vials to conceive, and with lots coming back for siblings, the business is all about the first sell. Cryos's sales department is bigger than the science lab.

Sperm banks can be divided into two groups: those that regard sperm donation as a medical matter and those that do not. Firms such as Cryos are adamant that donation to a healthy woman is not a medical issue. "It takes place millions of times each day without a doctor," argues Mr Schou. Other sperm banks emphasise clinical expertise. "We provide the highest quality donors for the safest possible babies and happiest families," says Fredrik Andreasson, chief financial officer of Seattle Sperm Bank, which focuses not just on healthy but on "sellable" donors, such as doctors. It prides itself in accepting only 1% of donors and on testing for more genetic diseases than any other bank.

Prices for sperm have roughly doubled over the past decade at several banks. London Sperm Bank now charges £950 (\$1,261) per vial. At Cryos the cheapest, anonymous vials start at €40 (\$48); the highest quality, with an identifiable donor, extra tests and more information, cost up to €1,600. Customers can gain "exclusive access" by buying out a donor for €12,000-30,000. American banks tend to charge extra for information. Want to see a picture or hear the donor's voice? That will be \$25.

For Amy Graves and her partner Claire Harrison, from Britain, information from Cryos about donors was crucial. "As I was going to carry the baby it was important to us that there were similarities between the donor and

Claire,” explains Ms Graves. They settled on a man who loved football, like Claire, and martial arts, like Amy, and who shares Claire’s favourite colour (red) and some of her facial features.

The commercialisation of sperm, eggs and other human tissue makes many people uneasy. Sperm banks are elusive about profit margins, but if a donor is paid \$100 per sample, often split into as many as five vials, sold for \$500-1,000 each, margins ought to be healthy even after costs. Yet the non-profit market has failed many people desperate to have children. After Britain started a national sperm bank in 2014, it recruited just eight donors in two years.

The industry has challenges. Heterosexual couples are increasingly likely to freeze their own eggs and sperm cells for later; fertility treatments with the poorest sperm are improving. Last year the first steps towards making sex cells out of body cells were detailed in *Nature*, a science journal. But for the foreseeable future, more sperm banks will be advertising for donors who “have what it takes” and are willing to lend a hand to modern families everywhere. ■



精子库生意 种子资本

现代家庭以及各国对精子捐赠的不同法律规定带来了商业机遇

精子库网站上罗列着一个个捐精者的信息，浏览起来和婚恋网站离奇地相似。一条广告以“桑福德，一个完美男人”开头，描述了桑福德坚毅的下巴和敏锐的蓝眼睛。他可不是个花瓶——他拥有金融学学位，并且“风度翩翩”。你还可以听到来自桑福德本人的录音。如果这一切赢得了你的芳心，你根本不必与他约会就能怀上他的孩子。支付635美元，西雅图精子库（SSB）就会给你邮寄一小瓶他的冷冻“游泳健将”。

目前很多精子库的主要客户是单身女性，这样的营销技巧正是据此而来。“她们通常受教育程度高，急于要个孩子，而且挑剔。”世界最大的精子库“国际冰冻”公司（Cryos International）的创始人奥尔·舒尔（Ole Schou）表示。该公司总部位于丹麦第二大城市奥尔胡斯（Aarhus）。它的网站故意设计得很像婚恋交友网站Match.com，因为“寻找捐精者的过程应该尽可能地和寻觅真实伴侣一样”。

在“冰冻”公司的办公楼外，不断有年轻男性前来，他们停好自行车，向捐精室走去。这里按常规备有色情杂志和一台电视机，还匪夷所思地摆着一株仙人掌。精液上交后，实验室工作人员对其进行检测，并按质量分类。这些样本被贴上标签、冷冻，然后储存在零下196℃的五个大液氮罐内。一旦来了订单，它们就会被运往100多个国家的家庭、诊所和其他精子库。

生育是一个相当大的产业。商业化的精子库是其中关键且有利可图的一环。据加州一家市场调查公司Grand View Research预测，到2025年，全球精子库业务可能价值近50亿美元。市场需求已经强劲增长，原因之一是富裕国家的人们推迟生育年龄，导致难以怀孕。但更大的原因是，在越来越多的地方，女同性恋伴侣和单身女性生子不仅已合法化，也日益为人所接受。这些群体分别占“冰冻”公司和西雅图精子库客户数量的60%和90%。

随着需求上升，政客和监管机构正试图加强控制，由此产生了五花八门的法规，对供需双方的来源均产生了影响。在有些国家，比如英国和荷兰，匿名捐精已被列为非法，这造成了精子短缺；而法国、西班牙等国家则规定捐精者必须匿名。在加拿大，捐精必须是无偿的；在大多数欧洲国家，捐精者的报酬只限于补偿为捐精而支出的费用；美国对报酬则没有限定。

至于精子的买家，有很多人转向其他司法辖区购买：有些地方等待时间短、价格也低；有的地方检测水平高、对捐精者的信息了解得更多；有的人则完全是因为本国法规限制而无法获得捐献的精子。比如，在香港和瑞士，只有已婚的异性恋夫妇才符合受捐条件；在法国，女同性恋者及单身女性不能接受捐精。各国立法的差异之大为那些可以出口精子的企业提供了机遇。有了干冰、互联网以及DHL快递，已经很容易开展优质精子的贸易。

| 各位都是在哪里受孕的？

这个产业并不是一直都掌握在商人的手中。据耶鲁大学的雷内·阿来米琳（Rene Almeling）回忆，在20世纪的大部分时间里，不能生育的夫妇会去看医生，医生则常常会把自己长相最好的学生从走廊上拉进来，用他无偿提供的鲜活精子为这位太太人工授精。不会有任何医疗记录留存下来。到了20世纪80年代，这样的离谱行为因艾滋病开始大范围传播而告终。对精子的冷冻、隔离，以及对精子和捐精者的检验变得至关重要。

由于担心持续上涨的成本及法律责任，医疗诊所停止了这项业务，商业化的精子库随即填补了空白。市场竞争变得非常激烈。很多顾客需要买六到十小瓶精液才能怀孕，还有很多回头客想为孩子再添个弟弟妹妹，第一笔买卖对精子库的生意来说至关重要。“冰冻”的销售部门比它的科学实验室规模还大。

精子库可分为两种：一种将捐精视为医疗活动，另一种则不然。像“冰冻”这样的公司坚称捐精给健康妇女不是医学问题。按舒尔的说法，“每天有无数个案例在没有医生介入的情况下发生。”另一些精子库则强调临床专业技术。“为最大程度保证婴儿的平安、营造最幸福的家庭，我们提供最

优质的捐精者。”西雅图精子库的首席财务官弗雷德里克·安德里森（Fredrik Andreasson）表示。西雅图精子库看重的捐精者不仅健康而且受欢迎，比如医生。在那里，只有1%的捐精者被选中，他们接受的遗传病方面的检查比其他任何一家精子库的捐精者都要多，这是这家精子库引以为豪之处。

过去十年间，几家精子库的精子价格差不多已翻了一番。伦敦精子库（London Sperm Bank）目前的售价是每瓶950英镑（1261美元）。在“冰冻”公司，售价最低的匿名精子起价为每瓶40欧元（48美元），可确认捐精者身份、经过额外检验以及附带更多信息的最优精子，价格最高可达1600欧元。顾客还可以花1.2万到3万欧元买断一名捐精者的“独家使用权”。美国的精子库一般会对信息收取额外费用。想看捐精者的照片或听他的声音？请交25美元。

对英国的艾米·格拉芙（Amy Graves）和她的伴侣克莱尔·哈里森（Claire Harrison）来说，“冰冻”公司提供的捐精者信息至关重要。“因为是由我来怀这个孩子，因此捐精者与克莱尔之间要有相似点，这对我们很重要。”格拉芙解释道。她们选定了一个像克莱尔一样喜欢足球，又像艾米一样喜欢武术的男人，而且这个男人还和克莱尔一样最喜欢红色，脸长得也和她有几分相似。

精子、卵子以及其他人体组织的商业化让很多人忧心忡忡。精子库对其利润率总是闪烁其词。不过，如果捐精者每提交一次样本得到100美元，而一个样本常被分作五小瓶，每小瓶售价500到1000美元，那么除去成本后利润应该仍然可观。但是，非营利的市场已经让很多求子心切的人失望。2014年英国成立了国家精子库，之后的两年内只招募到八名捐精者。

这个产业也面临挑战。异性恋夫妻越来越有可能将自己的卵子和精子冷冻起来留待日后使用；用质量最差的精子治疗不孕的技术也在提高。人类已经迈出了利用体细胞培育生殖细胞的第一步，去年科学期刊《自然》对此做了详细阐述。但是在可预见的未来，会有更多的精子库刊登广告寻找“素质良好的”捐精者，并且愿意向世界各地的现代家庭伸出援手。■



Entrepreneurship in America

Gazelles in the heartland

American entrepreneurship is flourishing, if you know where to look

AT FIRST glance, it seems that America's economy is losing its mojo. Many economists, most notably Robert Gordon of Northwestern University, have lamented that productivity growth seems to be anaemic when compared with earlier golden eras (see *Free exchange*). A gloomy chorus of business leaders has echoed what media outlets have by now turned into a mantra, that American entrepreneurship is in steady decline. Surely America's overall competitiveness, then, is plummeting?

The answer from one influential think-tank, the World Economic Forum (WEF), is no. In its latest update to its long-running annual ranking of global economic competitiveness, published on September 27th, America rose from third place to second, ranking below only Switzerland.

This is partly because poor economic policies and weak productivity growth are bedevilling rivals such as China and Europe. Yet glaring American weaknesses, such as fraying infrastructure and fractured politics, are outweighed in the WEF analysis by the country's strengths in areas like business sophistication and technological readiness. And aside from market size, the variable on which America still outscores other rich countries the most is its culture of innovation and entrepreneurship.

Hand-wringing about a crisis in business formation relies on official data showing that fewer new firms are being started than in the past. The latest figures, released on September 20th, show that there were 414,000 firms that were less than a year old in 2015 (the latest available year), compared with an average of 511,000 in the decade before the financial crisis. Still, not every new firm is equal—some entrepreneurs want to create the next Tesla,

not open another bodega. Of the roughly 4.4m firms created in the last ten years, about 30,000 can be described as gazelles, or young, high-growth companies, according to the Kauffman Foundation, another think-tank that is known for its work on entrepreneurship. These firms have a disproportionate impact on job creation and innovation. They pack a powerful punch.

A forthcoming report from the Kauffman Foundation finds that high-growth entrepreneurship has rebounded in America from the trough induced by the global financial crisis and is now rocketing (see chart). These experts scrutinise three things: how quickly startups grew in their first five years; the share of firms scaling up past 50 employees by their tenth year; and the prevalence of “fast growth” firms with at least 20% annualised growth over three years (and \$2m or more in revenues).

The analysis also reveals that such gazelles are found in unexpected places. Consider ProviderTrust, a health-tech startup. The firm has developed a novel software-as-a-service offering that helps health-care firms track people’s professional credentials and licences efficiently. Because states do not typically share timely information about disciplinary actions taken against health-care workers, footloose rogues can create a costly regulatory headache for unwitting new employers in another state. The company has been growing at a rate of over 60% a year since its founding in 2010; revenues should reach \$10m this year.

Or look at Root Insurance, America’s first mobile-only insurance firm, which is increasing downloads of its app by nearly 50% month over month. It uses actual driving data to set insurance rates for all of its customers, and offers discounts to drivers for using the self-driving mode of their Tesla car. Alex Timm, its chief executive, explains that data collected via its customers’ mobiles proves that people are much safer when the car does the driving. His firm even punishes drivers for texting and driving, which it

discovers by analysing the micro-vibrations of smartphones.

These gazelles are found not in Silicon Valley or Boston but, respectively, in Nashville and Columbus. Other overlooked cities in the American heartland are also hotspots of high-growth entrepreneurship (see map). Mark Kvamme of Drive Capital, a venture-capital (VC) fund based in Ohio, points to Indianapolis as a rising technology hub: ExactTarget, a local software-marketing startup, was acquired in 2013 by Salesforce, a Californian software giant, for \$2.5bn. “Luring talent away from Silicon Valley and Seattle is getting much easier,” says Mr Kvamme, a native Californian who left Sequoia Capital, a top Silicon Valley VC fund, to found Drive.

Steve Case of Revolution, an entrepreneur turned venture capitalist (in 1985 he co-founded what later became America Online), calls this the “rise of the rest”. Having observed this trend on periodic bus tours across America, during which he encourages (and sometimes invests in) many local entrepreneurs, he thinks three factors are fuelling it. Barriers to entry have fallen, especially for technology companies. Access to risk capital for startups, including through crowdfunding, is no longer limited to the two coasts. Local governments are increasingly supporting training schemes, accelerators and other bits of soft infrastructure that greatly boost startups’ chances of success.

Challenged on whether high-growth entrepreneurship can really be spread like jam across America, Mr Case acknowledges there is value to clustering. He insists, however, that nearly three-quarters of all VC money need not go to just California, Massachusetts and New York. “Spreading this to 30 cities”, he reckons, “would transform America.” ■



美国创业公司

中西部的瞪羚

美国的创业浪潮正盛，只要你看对地方

乍看起来，美国经济似乎正在失去光环。以美国西北大学教授罗伯特·戈登（Robert Gordon）为首的许多经济学家哀叹，与早前的黄金时代相比，如今美国的生产力增长看起来羸弱无力。商界领袖们齐声唱衰，恰应和了如今媒体常挂在嘴边的论调，即美国的创业浪潮日渐衰退。那么，美国的整体竞争力想必是在直线下坠了？

颇具影响力的智库“世界经济论坛”（World Economic Forum）给出了否定的答案。在它于9月27日例行发布的最新年度全球经济竞争力排名中，美国从第三位上升至第二位，仅次于瑞士。

这在一定程度上是由于中国和欧洲等对手正饱受经济政策不力及生产力增长疲软的困扰。美国尽管有明显的弱点，如基础设施老化、政局分裂，但在世界经济论坛的分析中，这些缺陷被美国其他方面的优势盖过，如商业环境成熟、技术条件完备。而除市场规模以外，创新和创业文化仍然是美国超越其他富裕国家最多的因素。

人们非常担忧美国的创业文化遭遇危机，是因为官方数据显示新成立公司的数量较以往有所减少。9月20日发布的最新数字显示，在2015年（有数据可查的最近一年），成立不到一年的公司有41.4万家，而在2008年金融危机前的十年间平均每年有51.1万家。然而，并非所有新公司都可等量齐观——有些企业家想打造的是下一个“特斯拉”，而不是又一间杂货铺。另一家以创业研究闻名的智库考夫曼基金会（Kauffman Foundation）表示，过去十年成立的约440万家公司中，大概有三万家可称为“瞪羚”企业，即高成长的年轻公司。这些公司在创造就业和创新上的影响力远超其他新公司，冲击力十足。

考夫曼基金会即将发布的报告认为，在美国，高成长创业已从全球金融危

机引发的低谷反弹，目前迅速蹿升（见图表）。专家们审视了三个方面：创业公司在头五年的增长速度、创立第十年员工增至50人以上的公司占比、三年年化增长至少达20%且年收入达200万美元或以上的“高成长”公司占比。

该分析也显示，这类“瞪羚”企业出现在人们意想不到的地方。以医疗技术创业公司ProviderTrust为例，该公司开发了一款新颖的“软件即服务”产品，帮助医疗保健公司高效追查从业人员的专业资格及执照信息。由于各州通常不会及时互相通报针对医疗从业人员的处分，一些违法之徒可能会跑到其他州求职，而一旦被监管机构发现问题，不知情的新雇主将面临高昂罚款。ProviderTrust自2010年成立以来一直以每年60%以上的增速发展，今年收入应该可达1000万美元。

另一个例子是美国首家完全基于手机的保险公司Root Insurance，其应用下载量的月增幅接近50%。该公司利用实际驾驶数据为所有客户设定车险费率，并向使用特斯拉汽车自动驾驶模式的驾驶者提供保费折扣。公司的首席执行官亚历克斯·蒂姆（Alex Timm）解释说，从客户手机收集的数据证明，汽车采用自动驾驶模式时，安全性更高。该公司甚至能通过分析智能手机的微小震动发现驾驶者在驾车时发短信，从而对其做出惩罚。

上述两家“瞪羚”企业并不在硅谷或波士顿，而是分别位于纳什维尔（Nashville）和哥伦布（Columbus）。美国中西部其他被忽视的城市也是高增长创业公司的聚集地（见地图）。总部位于俄亥俄州的风投基金Drive Capital的马克·克瓦姆（Mark Kvamme）指出，印第安纳波利斯是新崛起的技术中心：当地一家数字营销创业公司ExactTarget在2013年被加州软件巨头Salesforce以25亿美元收购。“从硅谷和西雅图挖人才变得容易多了。”克瓦姆说。他是加州当地人，在离开硅谷顶级风投基金红杉资本（Sequoia Capital）后创立了Drive Capital。

风投公司Revolution的史蒂夫·凯斯（Steve Case，成为风险投资家之前是一位企业家，在1985年联合创办了“美国在线”的前身企业）称上述现象为“其他人的崛起”。他定期乘坐巴士穿行美国各地，为众多当地创业者打

气，有时也直接投资。在行程中他观察到了这一趋势。他认为三个因素起了助推作用：进入门槛已降低，尤其是对科技公司而言；创业公司要获得风险资本，包括通过众筹，已不限于要在东西海岸；地方政府加强了对培训计划、加速器及其他软基础设施建设的支持，大大提高了创业公司的成功率。

有人质疑高成长创业公司是否真的能在美国遍地开花。对此，凯斯承认集群确有其价值。但他坚称，不必将风投资金总额的近四分之三统统投向加州、麻省及纽约。“如果把这些钱分散投向30个城市，”他说，“美国将焕然一新。”■



Make America great again

The best MBA courses

Northwestern University's Kellogg School of Management returns to the top spot

American business schools dominate *The Economist's* 2017 Which MBA? ranking, taking 16 of the top 20 places. Northwestern University's Kellogg School of Management returns to the top spot for the first time since 2004. Kellogg students praise its facilities and collaborative culture. Their career opportunities are among the best, thanks in part to one of the largest alumni networks in the world; 97% of students find a job within three months of graduation, pocketing a 72% pay bump. All of the top ten slots in the ranking are now occupied by large, prestigious American schools, for which students are happy to pay extra. Their average tuition fee is \$134,600, and has risen quickly in recent years. Employers, too, are willing to shell out for the best students. Their average basic salary was \$127,300, a 70% increase on their pre-MBA pay cheques. But life, like rankings, isn't just about money. So we weight data according to what students tell us is important. The four categories covered are: opening new career opportunities (35%), personal development and educational experience (35%), better salary (20%) and networking potential (10%). ■



让美国再次伟大

最佳MBA课程排名

西北大学凯洛格商学院重回榜首

美国的商学院在2017年《经济学人》全球MBA排名中占据主导，排名前20的商学院中有16所是在美国。西北大学凯洛格商学院自2004年后首次重回榜首，其教学设施及合作文化受到本学院学生的赞誉。该学院毕业生有一流的职业发展机会，一定程度上是因为学院有着全世界规模数一数二的校友关系网。学院有97%的学生毕业三个月内找到了工作，薪资较读MBA课程之前大涨72%。本次排名前十的学院均为享有盛名的大型美国商学院，学生很愿意支付更高的学费入读这些学院。这十所学院的平均学费为134,600美元，且近些年涨势迅速。雇主也愿意花大价钱招揽最优秀的学生。这些学生的平均底薪为127,300美元，较读MBA之前提高了70%。但人生和排名一样，并不仅仅是钱的问题。因此，本排名根据学生们的意见来衡量不同数据在排名中的重要程度。数据涵盖的四个类别是：开拓新的工作机遇（占35%的权重）、个人发展及教育经历（35%）、工资水平提高（20%）、建立关系网的潜力（10%）。 ■



Artificial intelligence

Going places

The latest breed of AI can work things out for itself, without being taught by people

IN 2016 Lee Sedol, one of the world's best players of Go, lost a match in Seoul to a computer program called AlphaGo by four games to one. It was a big event, both in the history of Go and in the history of artificial intelligence (AI). Go occupies roughly the same place in the culture of China, Korea and Japan as chess does in the West. After its victory over Mr Lee, AlphaGo beat dozens of renowned human players in a series of anonymous games played online, before re-emerging in May to face Ke Jie, the game's best player, in Wuzhen, China. Mr Ke fared no better than Mr Lee, losing to the computer 3-0.

For AI researchers, Go is equally exalted. Chess fell to the machines in 1997, when Garry Kasparov lost a match to Deep Blue, an IBM computer. But until Mr Lee's defeat, Go's complexity had made it resistant to the march of machinery. AlphaGo's victory was an eye-catching demonstration of the power of a type of AI called machine learning, which aims to get computers to teach complicated tasks to themselves.

AlphaGo learned to play Go by studying thousands of games between expert human opponents, extracting rules and strategies from those games and then refining them in millions more matches which the program played against itself. That was enough to make it stronger than any human player. But researchers at DeepMind, the firm that built AlphaGo, were confident that they could improve it. In a paper just published in *Nature* they have unveiled the latest version, dubbed AlphaGo Zero. It is much better at the game, learns to play much more quickly and requires far less computing hardware to do well. Most important, though, unlike the original version, AlphaGo Zero has managed to teach itself the game without recourse to

human experts at all.

| *The eyes have it*

Like all the best games, Go is easy to learn but hard to master. Two players, Black and White, take turns placing stones on the intersections of a board consisting of 19 vertical lines and 19 horizontal ones. The aim is to control more territory than your opponent. Stones that are surrounded by an opponent's are removed from the board. Players carry on until neither wishes to continue. Each then adds the number of his stones on the board to the number of empty grid intersections he has surrounded. The larger total is the winner.

The difficulty comes from the sheer number of possible moves. A 19x19 board offers 361 different places on which Black can put the initial stone. White then has 360 options in response, and so on. The total number of legal board arrangements is in the order of 10^{170} , a number so large it defies any physical analogy (there are reckoned to be about 10^{80} atoms in the observable universe, for instance).

Human experts focus instead on understanding the game at a higher level. Go's simple rules give rise to plenty of emergent structure. Players talk of features such as "eyes" and "ladders", and of concepts such as "threat" and "life-and-death". But although human players understand such concepts, explaining them in the hyper-literal way needed to program a computer is much harder. Instead, the original AlphaGo studied thousands of examples of human games, a process called supervised learning. Since human play reflects human understanding of such concepts, a computer exposed to enough of it can come to understand those concepts as well. Once AlphaGo had arrived at a decent grasp of tactics and strategy with the help of its human teachers, it kicked away its crutches and began playing millions of unsupervised training games against itself, improving its play with every game.

Supervised learning is useful for much more than Go. It is the basic idea behind many of the recent advances in AI, helping computers learn to do things such as identify faces in pictures, recognise human speech reliably, filter spam from e-mail efficiently and more. But as Demis Hassabis, Deepmind's boss, observes, supervised learning has limits. It relies on the availability of training data to feed to the computer to show the machine what it is meant to be doing. Such data must be filtered by human experts. The training data for face recognition, for instance, consist of thousands of pictures, some with faces and some without, each labelled as such by a person. That makes such data sets expensive, assuming they are available at all. And, as the paper points out, there can be more subtle problems. Relying on human experts for guidance risks imposing human limits on a computer's ability.

AlphaGo Zero is designed to avoid all these problems by skipping the training-wheels phase entirely. The program starts only with the rules of the game and a "reward function", which awards it a point for a win and docks a point for a loss. It is then encouraged to experiment, repeatedly playing games against other versions of itself, subject only to the constraint that it must try to maximise its reward by winning as much as possible.

The program started by placing stones randomly, with no real idea of what it was doing. But it improved rapidly. After a single day it was playing at the level of an advanced professional. After two days it had surpassed the performance of the version that beat Mr Lee in 2016.

DeepMind's researchers were able to watch their creation rediscover the Go knowledge that human beings have accumulated over thousands of years. Sometimes, it seemed eerily human-like. After about three hours of training the program was preoccupied with the idea of greedily capturing stones, a phase that most human beginners also go through. At others it seemed decidedly alien. For example, ladders are patterns of stones that

extend in a diagonal slash across the board as one player attempts to capture a group of his opponent's stones. They are frequent features of Go games. Because a ladder consists of a simple, repeating pattern, human novices quickly learn to extrapolate them and work out if building a particular ladder will succeed or fail. But AlphaGo Zero—which is not capable of extrapolation, and instead experiments with new moves semi-randomly—took longer than expected to come to grips with the concept.

| *Climbing the ladder*

Nevertheless, learning for itself rather than relying on hints from people seemed, on balance, to be a big advantage. For example, *joseki* are specialised sequences of well-known moves that take place near the edges of the board. (Their scripted nature makes them a little like chess openings.) AlphaGo Zero discovered the standard *joseki* taught to human players. But it also discovered, and eventually preferred, several others that were entirely of its own invention. The machine, says David Silver, who led the AlphaGo project, seemed to play with a distinctly non-human style.

The result is a program that is not just superhuman, but crushingly so. Skill at Go (and chess, and many other games) can be quantified with something called an Elo rating, which gives the probability, based on past performance, that one player will beat another. A player has a 50:50 chance of beating an opponent with the same Elo rating, but only a 25% chance of beating one with a rating 200 points higher. Mr Ke has a rating of 3,661. Mr Lee's is 3,526. After 40 days of training AlphaGo Zero had an Elo rating of more than 5,000—putting it as far ahead of Mr Ke as Mr Ke is of a keen amateur, and suggesting that it is, in practice, impossible for Mr Ke, or any other human being, ever to defeat it. When it played against the version of AlphaGo that first beat Mr Lee, it won by 100 games to zero.

There is, of course, more to life than Go. Algorithms such as the ones that power the various iterations of AlphaGo might, its creators hope, be applied

to other tasks that are conceptually similar. (DeepMind has already used those that underlie the original AlphaGo to help Google slash the power consumption of its data centres.) But an algorithm that can learn without guidance from people means that machines can be let loose on problems that people do not understand how to solve. Anything that boils down to an intelligent search through an enormous number of possibilities, said Mr Hassabis, could benefit from AlphaGo's approach. He cited classic thorny problems such as working out how proteins fold into their final, functional shapes, predicting which molecules might have promise as medicines, or accurately simulating chemical reactions.

Advances in AI often trigger worries about human obsolescence. DeepMind hopes such machines will end up as assistants to biological brains, rather than replacements for them, in the way that other technologies from search engines to paper have done. Watching a machine invent new ways to tackle a problem can, after all, help push people down new and productive paths. One of the benefits of AlphaGo, says Mr Silver, is that, in a game full of history and tradition, it has encouraged human players to question the old wisdom, and to experiment. After losing to AlphaGo, Mr Ke studied the computer's moves, looking for ideas. He then went on a 22-game winning streak against human opponents, an impressive feat even for someone of his skill. Supervised learning, after all, can work in both directions. ■



人工智能

前途无量

人工智能再进化：无师自通，自学成才

2016年，世界顶尖棋手李世石在首尔以1：4败给了计算机程序AlphaGo。这在围棋史和人工智能（AI）历史上都是一件大事。围棋在中国、韩国及日本文化中的地位大致相当于国际象棋在西方的地位。赢了李世石之后，AlphaGo在一系列在线匿名比赛中击败了数十位知名好手。今年5月它再现江湖，在中国乌镇对决最强棋手柯洁。柯洁的赛果也不比李世石好多少，以0：3败北。

对AI研究人员而言，围棋的地位同样崇高。1997年，国际象棋冠军加里·卡斯帕罗夫（Garry Kasparov）输给了IBM的计算机“深蓝”（Deep Blue），标志着国际象棋被机器攻陷。但在李世石败北之前，围棋却因其高度的复杂性而抵挡住了计算机的进攻。AlphaGo的胜利引人注目，它展现了机器学习这类AI技术的力量。这种技术的目标是让计算机自学以完成复杂任务。

AlphaGo研究了数千盘人类高手之间的对局，从中提取规则和策略，然后在数百万局与自身的较量中改进它们。这足以使它比任何人类棋手都更强大。不过，打造了AlphaGo的公司DeepMind的研究人员相信他们还可以对其加以改进。近日他们在《自然》杂志上发表论文，介绍了它的最新版本，名为AlphaGo Zero。AlphaGo Zero下围棋厉害得多，学习速度大幅提升，所需的计算硬件也大大减少。不过最重要的一点是，与初始版本不同，AlphaGo Zero并不需要向人类棋手学习，而是可以自学成才。

| 见证新发展

像所有最好的游戏一样，围棋容易上手，但很难精通。围棋的棋盘由19条经线和19条纬线组成，执黑棋和白棋的两名棋手轮流在经纬线的交叉点上落子，目标是比对手占据更多的地盘，被对手的棋子包围的棋子会被从棋盘上拿掉。棋手对弈直到两方都不愿再继续为止，然后将各自在棋盘上的

活棋以及被活棋围起来的空白交叉点数量相加，总数多者胜。

围棋之难在于每一步都有大量的走法。棋盘上的经纬线各19条，形成361个交叉点。先走的黑棋有361个位置可以落子，然后白棋有360种走法来回应，如此继续。每盘棋可出现的局面多达 10^{170} 次方种可能，数量之庞大没有任何物理量可以类比（例如，在可观测宇宙中，估计有约 10^{80} 次方个原子）。

人类棋手转而注重在更高层次上理解围棋。围棋的简单规则使得游戏过程中会产生大量临时出现的结构。棋手们谈到“眼”、“征”等局势和走法，以及“劫材”和“死活”等概念。尽管人类棋手能理解这些概念，要用极为直白的语言解释这些概念从而给计算机编程可要难得多。初始版本的AlphaGo的做法是研究成千上万盘人类棋局，这个过程叫监督学习。由于人类对局能反映出人类对这些概念的理解，研究了足够多实例的计算机也就能掌握这些概念。等到AlphaGo在人类老师的帮助下对战术战略有了相当的掌握，它就出师了，并开始跟自己进行千百万次的无监督训练，不断提升自己的棋艺。

监督学习不止对学习围棋有用，它还是很多AI最新进展背后的基本理念。它帮助电脑学习各种任务，如识别照片中的人脸、可靠地识别人类语言、有效过滤垃圾邮件等。但Deepmind的老板戴密斯·哈萨比斯（Demis Hassabis）认为，监督学习有局限性。它依赖于可获得的数据，要把这些数据输入计算机才能让它明白该做什么。这些数据必须由人类专家过滤。举例来说，面部识别的训练数据是数以千计的照片，有些有脸部图像，有些没有，这都需要由人标记出来。这样的数据集成本很高，而且还要首先能够收集得到才行。此外，如论文所指出的，可能还会有更多微妙的问题。依靠人类专家的指导可能会让计算机的能力受制于人类的局限。

AlphaGo Zero的设计完全跳过辅助训练阶段，以此避免所有这些问题。程序最初只有下棋的规则和“奖励功能”，赢一盘加一分，输一盘扣一分。然后鼓励程序去尝试，即反复与自身的其他版本对弈。条件只有一个：尽可能获胜以取得最多的奖励。

这个程序一开始只是随意落子，并不知道自己在做什么。但它进步神速，才过了一天就具备了高段棋手的水平，两天后超越了2016年击败李世石的版本。

DeepMind的研究人员见证了他们的程序如何重新探索人类历经数千年累积起来的围棋知识。有时，这个程序神似人类，令人感觉很诡异。经过约三个小时的训练，它已经执迷于攻城略地，这是大多数人类围棋初学者也会经历的阶段。而其他时候，它似乎又与人类毫无相近之处。例如，“征”是一方棋手在棋盘上沿对角线方向落子以图吃掉对手一批棋子的走法，是围棋的常见招数。“征”由一个简单的重复走法构成，所以人类新手很快能学会推断一次征子是否有利。但AlphaGo Zero没有推断能力，而是以半随机的方式尝试新走法，因此掌握这个走法的时间比预想的要长。

| 步步为营

不过，不依靠人类提示而是进行自学，总的来说似乎是一大优势。例如，围棋的“定式”是在棋盘边角部选择一套常见的走法，其程式化特点有点像国际象棋的开局。AlphaGo Zero发现了人类棋手已经学会的标准定式，但也发现了几个完全由自己发明的定式，而且更喜欢用它们。领导AlphaGo项目的戴维·席瓦尔（David Silver）说，这台机器看来有着明显的非人类棋风。

最终得到的不仅仅是一个超人的程序，而是堪称超凡入圣。围棋的棋力（和国际象棋以及许多其他竞技一样）可以用埃洛等级分系统（Elo rating）进行量化，即基于过去的对战记录，给出一个棋手击败另一个棋手的概率。一个棋手有一半的机会击败具有同样埃洛等级分的对手，但只有25%的机会能击败等级分高出200分的对手。柯洁的等级分为3661分，李世石为3526分。经过40天的训练，AlphaGo Zero的埃洛等级分超过了5000分，远远领先于柯洁，相比之下柯洁好像只是业余高手。这样的等级分意味着在实际比赛中，柯洁或其他任何人类棋手都不可能打败它。AlphaGo Zero在与当初击败李世石的AlphaGo版本对弈时，取得了100:0的战绩。

当然，这个程序的意义远不止于下围棋。其创造者希望，这些驱动AlphaGo实现多种迭代的算法或许可应用于概念上类似的其他任务。

（DeepMind已经利用初始版AlphaGo的基础算法帮助谷歌削减了其数据中心的能耗。）但是，能够不依赖人类指导而自行学习的算法意味着可以放手让机器去解决人类无从下手的问题。哈萨比斯说，任何可以通过智能搜索大量可能性来最终解决的问题，都可以从AlphaGo的方法中获益。他提到了一些经典的棘手问题，例如研究蛋白质如何折叠成最终发挥其功能的形状，预测哪些分子有望做成药物，或准确模拟化学反应等。

AI的进步经常会引发人类对于自己将被淘汰的担忧。DeepMind希望这样的机器最终不会替代生物大脑，而是成为生物大脑的助手，就像搜索引擎和造纸等技术所做的那样。毕竟，看着机器发明新的方法来解决问题可以推动人们走上新的、更高效的道路。席尔瓦说，AlphaGo的好处之一就是鼓励人类棋手去质疑这项历史悠久、传统深厚的技艺旧有的智慧，并做出新的尝试。败给AlphaGo之后，柯洁研究了计算机的走法，开辟思路。随后，他在与人类对手的对弈中连胜22场，即便以他的水平，这也是个令人赞叹的成就。说到底，监督学习是可以人机双向进行的。■



Economic and financial indicator

High-net-worth individuals

Total HNWI wealth came to \$63.5trn last year

The global number of high-net-worth individuals (HNWIs) grew by 7.5% to 16.5m last year, according to the 2017 World Wealth Report by Capgemini, a consulting firm. HNWI have at least \$1m in investable assets, excluding their main home, its contents and collectable items. Total HNWI wealth came to \$63.5trn last year, with the highest proportion concentrated in the Asia-Pacific region. The expansion of wealth in the Asian-Pacific slowed to 8.2% year-on-year though, partly owing to declines in the performance of stockmarkets in China and Japan. For global HNWI wealth to reach over \$100trn by 2025, Asian wealth (the biggest source of new futures) will need to increase by about 9.4% a year. ■



经济与金融指标

高净值人士

全球高净值人士的总资产去年增至63.5万亿美元

咨询公司凯捷（Capgemini）发布的《2017全球财富报告》显示，去年全世界高净值人士（HNWIs）的数量增加了7.5%，达到1650万人。高净值人士是指剔除主要住所及住所内的物品和收藏品之后，至少还拥有价值100万美元可投资资产的人。去年这些人士的总资产增长至63.5万亿美元，其中亚太地区占比最高。不过该地区的财富年增速放缓至8.2%，部分原因是中国及日本股市走低。全球高净值人士的财富若要在2025年突破100万亿美元，亚洲的财富（未来新增财富的最大来源）将需要每年增长约9.4%。





Deregulation in America

A cost-benefit analysis

Donald Trump's regulatory policy is a strange mix of thoughtful and dangerous

CONSPIRACY theorists who support President Donald Trump fulminate against the so-called “deep state” that is trying to thwart him. The federal bureaucracy of Washington, they believe, is the main source of resistance. But this claim exaggerates the influence of bureaucrats and fails to do justice to Mr Trump’s achievements. The president may not have repealed Obamacare or passed tax reform, but he has overseen, as he promised, a historic slowdown in rule-writing by federal agencies. Since Mr Trump’s inauguration, the flow of new rules has slowed by about 60%.

Is this an achievement to be proud of? The number of rules is a crude gauge of the burden of red tape. But it belies a much deeper shift in regulatory philosophy. The Trump administration claims that it will no longer use regulations as a substitute for legislation; that the effects of new rules will be more rigorously assessed; and that the burden on business will be reduced. Two of these goals are sensible. One is dangerous.

Start with executive overreach. When Congress blocked Barack Obama’s proposed laws, he wrote rules instead. The most significant example is the Clean Power Plan (CPP), which aimed to reduce carbon emissions. Mr Obama’s Environmental Protection Agency (EPA) penned the plan on dubious legal authority. Last week, Scott Pruitt, Mr Trump’s climate-change-denying EPA chief, started the long process of unwinding it.

This newspaper laments Republicans’ shameful denial of scientific facts, and despairs at the unwillingness of Congress to act to address climate change. Yet the argument that Mr Obama stretched the boundaries of his legal authority has merit. Neither the CPP nor Mr Obama’s other flagship

environmental rule, which concerns the regulation of waterways, has ever come into effect, because each was stayed by the courts. Either or both could yet be struck down completely.

Mr Trump, who wants to change Senate rules to force through his agenda, is an unlikely guardian of America's constitution. The true test of whether he is committed to limiting executive rule-making will come when Congress refuses to comply with his agenda on, say, trade policy. After all, Mr Obama came to office determined to pare back the powers of the presidency, but then changed course when Congress frustrated him. And the early signs are not good. Having failed to repeal Obamacare, Mr Trump promised last week to "[use] the power of the pen" to implement health reform.

The second supposed advance is towards more rigorous analysis of the effects of regulations. The Obama administration tended to take too rosy a view of the benefits of government intervention. For example, it tried to boost wages by greatly expanding the number of workers eligible for overtime pay. This defies economic logic; it is a bit like raising the minimum wage, but only on Fridays.

Under Mr Trump, such folly is less likely. That is partly because there is less regulation happening to begin with. It is also because the office in the White House responsible for vetting agencies' analyses, whose career staff are more cautious than other bureaucrats, has gained influence. That is welcome. The Treasury's proposals regarding Dodd-Frank, Mr Obama's flagship financial reform, have been encouragingly thoughtful.

It is the third part of Mr Trump's regulatory agenda that is worrying. The administration is measuring its success by how much it can reduce regulatory costs to firms, while seeming to ignore the benefits to consumers and citizens that might be lost along the way. Republicans' use of Congress's right of review to repeal 14 rules issued late in Mr Obama's

presidency was not based on a careful consideration of costs and benefits, so much as on an insistence that the rules were too burdensome for businesses. That attitude could wreak havoc with environmental regulation, which imposes the biggest costs but also brings the biggest rewards. Even diehard libertarians should worry when the administration weakens rules governing the leaching of coal ash into groundwater, or permits the use of pesticides that may impair children's brain development.

| *Rules for regulators*

Maximising benefits to society is too lofty a goal for regulators. Yet the goal must not simply be to please firms, either. Instead, regulators should identify and correct obvious market failures, and promote competition.

With that in mind, we propose a litmus test for Mr Trump's regulatory overhaul: his approach to antitrust policy. This is one area in which regulators have been too lax, allowing many firms to gain market power. If Mr Trump beefs up antitrust enforcement, ignoring the complaints of bosses, it will signal that his administration is implementing a considered regulatory philosophy. If, however, he weakens it, it will be a sign that his real goal is to govern in the name of business. ■



美国放松监管

成本效益分析

特朗普的监管政策是慎重和危险的奇特混合

支持特朗普总统的阴谋论者严厉谴责试图阻挠他的所谓“深层国家”。他们认为，华盛顿的联邦官僚机构是阻力的主要源头。但这一说法夸大了官僚机构的影响力，也未对特朗普的成就做出公正的评判。特朗普也许确实还没有废除奥巴马医改，税收改革也尚未获批，但正如他所承诺的那样，在他的监督下，联邦机构制定法规的速度出现了历史性的放缓。自特朗普就任总统以来，新法规出台的速度已经降低了约60%。

这是个值得骄傲的成就吗？法规数量是衡量监管繁冗与否的一个粗略标准，但它掩盖了更深层次的监管哲学的转变。特朗普政府声称不会再用监管法规作为立法的替代品，并将更严格地评估新法规的影响，减轻企业的负担。这三个目标中有两个是明智的，一个是危险的。

从行政越权说起。当国会阻止奥巴马提出的法案时，他转而制定了法规。最突出的例子是旨在减少碳排放的《清洁电力计划》（CPP）。该计划由奥巴马任内的环境保护署（EPA）执笔，其法律权威性令人生疑。上周，特朗普政府的环保署署长、否认气候变化的斯科特·普鲁伊特（Scott Pruitt）开始了撤销该计划的漫长过程。

本刊哀叹共和党人否认科学事实的可耻行径，对国会不愿采取行动应对气候变化感到失望。不过，认为奥巴马超越其法定权利的观点确有理据。无论是《清洁电力计划》还是奥巴马的另一项涉及水路监管的重要环保法规都未能实施，因为法院均裁决暂停执行。这两项计划之一或是全部都有可能被完全废除。

特朗普想要改变参议院的规则以强行通过自己的提案，他不太可能是美国宪法的捍卫者。他是否真的致力于限制行政法规，要等到国会拒绝通过其提案（比如贸易政策方面的提案）之时才能检验。毕竟，奥巴马上任后曾

决心削减总统的权力，但在国会受挫后，他又改变了方向。特朗普的早期迹象并不乐观。废除奥巴马医改的计划失败后，上周他承诺将“（动用）行政力量”实施医疗改革。

第二个我们假定会发生的进步是更严谨地分析法规的影响。奥巴马政府往往对政府干预的好处过于乐观。例如，它想要通过大幅增加有资格领取加班费的工人数量来提高工资水平。这有悖经济逻辑——有点像提高最低工资标准却仅限于周五。

特朗普政府做出这种蠢事的可能性要小一些。这在一定程度上是因为监管本身就少了。还有一个原因是白宫负责审查各机构分析报告的办公室获得了一定的影响力，它的专业职员比其他官员更谨慎。这一点是受欢迎的。财政部针对奥巴马最重要的金融改革《多德-弗兰克法案》（Dodd-Frank）给出的提案是深思熟虑的结果，令人鼓舞。

令人担忧的是特朗普监管目标的第三部分。本届政府通过计算它能为公司减少多少监管成本来衡量自己的成功，但似乎忽视了在此过程中可能伤害消费者和公民的利益。共和党人利用国会的审查权废除了奥巴马任期后期颁布的14项法规，并没有仔细考虑成本和收益，只是坚称这些法规让企业负担太重。这种态度可能会严重损害环境监管：环境监管会产生最多的成本，但也会带来最大的回报。一旦政府放松了对煤灰浸入地下水的监管规定，又或者允许使用可能损害儿童大脑发育的杀虫剂，即便是死硬派的自由主义者也应该感到担心。

| 监管机构的准则

对于监管机构来说，实现社会福利最大化是一个过高的目标。不过，它们的目标也绝不应该仅仅是取悦企业。相反，它们应该发现并纠正明显的市场失灵，并促进竞争。

考虑到这一点，我们在此提出对特朗普监管改革的试金石：他的反垄断政策。这是一个监管过于宽松的领域，让许多公司获得了市场支配力。如果特朗普无视老板们的抱怨，加强反垄断执法，就表明他的政府正在实施一

种经过深思熟虑的监管理念。但如果他削弱了反垄断监管，那就说明他真正的目标是代表商界治理国家。 ■



Military planning

The other side has a vote

Illusions about the future of warfare have a lot to answer for

THIS is not really a book about the future of warfare, with all that might imply in terms of exotic technologies that will transform not only the character of war, but, some believe, even its very nature. Lawrence Freedman does indeed discuss the impact of cyber-attacks, artificial intelligence and machine learning on the conflicts of the future. But that is not his main purpose. The clue is in the title. The author, arguably Britain's leading academic strategist, examines how ideas about how future wars could be fought have shaped the reality, with usually baleful results.

In the middle of the 19th century, a generation after Waterloo, the classical ideal of warfare, seemingly epitomised by Napoleon but derived from the ancient Greeks and the Romans, still held sway. Wars would be short and victors would achieve their (usually) limited political aims. Maximum effect with the first blow was crucial, preferably achieved by forcing an adversary into a "battle of annihilation".

Prussia's defeat of France at the battle of Sedan in 1870 and the surrender of Napoleon III showed how it should be done. Prussian military organisation and tactical genius, embodied by Helmuth von Moltke, had demonstrated the classical ideal in a modern context. Prussia's success spawned imaginative works, such as the fictional tale of "The Battle of Dorking", published in England the following year, depicting a successful invasion. Almost equally imaginative war plans drawn up by general staffs across Europe warned how a nation lacking in preparedness could be quickly defeated by a competent aggressor (usually expected to be Prussia/Germany). Little attention was paid to the problem the Prussians had after Sedan of subduing a population that did not accept the verdict of the

battlefield.

Even as people's wars were replacing the "cabinet" wars of the past, the belief in swift, clean victories became ever more baked into concepts of future war. In particular, the German general staff before the first world war, led by the victor of Sedan's nephew, Helmuth von Moltke the younger, was in the grip of short-war illusion. This was not for lack of evidence to the contrary: the history books available to them could have shown how rare it was for single battles or brilliant generals to be decisive. Most wars have been wars of attrition, settled by which side had more staying power through the ability to apply men and materiel. Nearly all the belligerents in 1914 believed they would be fighting a short war, until they found they weren't.

Even after that experience, belief in the possibility that wars between great powers could be decisive and quick endured. By restoring mobility and manoeuvre to the battlefield, tanks and planes would revive the classical ideal. National resistance movements fighting on after defeat would be ruthlessly crushed. Once again, an idea about the future of war made a real war not just imaginable but attractive. And just as before, despite the early successes of the Germans in Russia and the Japanese at Pearl Harbour, the near-inevitable defeat of both by more powerful coalitions demonstrated the folly of those ideas.

Today, the same wishful thinking is as stubborn as ever. The so-called revolution in military affairs (RMA), begun in the 1980s, brought together a cluster of new technologies that, as the author puts it, "collected, processed, fused and communicated information with those that applied military force". These included digital networks, fast data links, sensors and precision guidance using GPS or lasers.

Initially developed to give NATO commanders the ability to destroy

numerically superior Warsaw Pact tank formations without having to resort to nuclear weapons, their devastating effectiveness was not fully understood until the first Gulf war in 1991. Cruise missiles snaked through Baghdad streets on their way to their targets, and videos showed laser-guided bombs exploding with pin-point accuracy. This seemed to announce the advent of a form of warfare that combined the best of the classical ideal with the promise of minimal casualties (even of the adversary, whose forces could be destroyed without the mass killing of civilians).

But once again, the future of war defied those who had come to believe that wars could be quick and relatively painless for those with superior technology and doctrine. The Iraq war and its aftermath came as another salutary shock. Although Iraq's army quickly succumbed to "shock and awe", the RMA was little help against a brutal insurgency in which the main battleground was cities and the enemy's weapons were suicide-bombers and improvised explosive devices.

Today, advocates believe that another technological advance could fundamentally change the character of war. Unmanned systems equipped with artificial intelligence and varying degrees of autonomy suggest a future of war in which machines take the brunt of the fighting and make decisions at hyper-speed. Cyber-weapons that blind and disable the enemy's own systems could become more important than physical violence in determining outcomes.

Will these technologies make war more likely by making it more acceptable? Sir Lawrence is sceptical. The bar for interstate wars between major powers will, mercifully, remain high thanks to the deterrent of nuclear weapons. On current trends, most wars will be civil wars in weak states, or "hybrid" wars in which cyber-disruption, false information and infiltration are the weapons of choice. Fighting is more likely to be in big

cities than in open terrain, because that is where most people live. The battle of Mosul is a reminder of how lethal and destructive urban warfare remains for both fighters and civilians.

But even this is uncertain: the one thing that Sir Lawrence is sure of is that predictions of future war rarely get it right. His message to policymakers is to beware those who tout “the ease and speed with which victory can be achieved while underestimating the resourcefulness of adversaries”. Anybody who thinks otherwise should read this book. ■



军事规划

岂能一战定乾坤

人们对未来战争的幻想为祸不浅

《战争的未来：一部历史》其实并不是一本关于战争未来的书，尽管书中谈到了新奇科技。这些技术不仅会改变战争的特点，一些人认为它们甚至会改变战争的本质。劳伦斯·弗里德曼（Lawrence Freedman）确实讨论了网络攻击、人工智能以及机器学习等对未来战争的影响，但这不是他的主旨。主旨已经显现在书名中。作者可谓英国顶尖的学术战略家，在本书中，他探讨了有关未来战争方式的理念如何塑造了现实，且通常都带来了恶果。

十九世纪中叶，即滑铁卢战役发生约30年后，经典的战争理念仍然占据主导。该理念的代表人物看似是拿破仑，但其鼻祖却是古希腊人和古罗马人。这种理念认为，战争会很快结束，胜者会实现他们（一般而言）有限的政治目的。先发制人带来的最大效应至关重要，而将对手逼入“歼灭战”则是实现这种效应最理想的方式。

在1870年的色当会战中，普鲁士击败法国并俘虏了拿破仑三世，展示了歼灭战应有的打法。普鲁士的军事组织以及赫尔穆特·冯·毛奇

（Helmuth von Moltke）实施的天才战术展现了近代背景下的经典战争理念。普鲁士的胜利催生了许多富有想象力的作品，比如翌年在英格兰出版的、描述一场成功入侵的虚构小说《杜金战役》（The Battle of Dorking）。欧洲各国总参谋部也起草了几乎同样富有想象力的作战计划，警告称国家若疏于战备可能会被强敌（通常被设定为普鲁士/德国）快速击败。然而很少有人关注色当会战后普鲁士人面对的问题——如何制服拒不接受战争败局的民众。

即便人民战争开始替代过去的“内阁”战争，对速战速胜的笃信却愈加融入到未来战争的构想中。第一次世界大战前，由色当战役获胜者的侄子小毛奇（Helmuth von Moltke the younger）领导的德国总参谋部更是深陷于速

决战的幻想之中。之所以如此，并不是因为他们缺乏反面证据——这些德国参谋官读过的历史书籍已表明，仅凭一场单独的战役或者一位杰出将领就决定胜局的战例极其罕见，大部分战争都是消耗战，拼的是哪一方更有持久力，能持续投入人力物力。1914年，几乎所有交战国在发现真相前，都相信自己打的会是一场速决战。

甚至在经历了一战之后，人们仍然相信大国之间的战争有可能会速战速决。随着坦克和飞机令战场重现灵活性和机动性，经典战争理念将因此复兴；战败一方发起的全民反抗斗争将被无情地镇压。关于未来战争的观点再一次让真正的战争不仅可以想象，甚至还充满吸引力。但就像之前一样，尽管德国和日本分别在俄罗斯和珍珠港取得了早期胜利，却都几乎不可避免地被更强大的联盟打败，再一次证明了这些观点的愚蠢。

时至今日，同样的妄想还和以前一样根深蒂固。20世纪80年代开始的所谓“新军事变革”（RMA），用作者的话说，“将一套收集、加工、整合以及传输信息的新科技与运用军事力量的新科技结合在一起”。这些新科技包括数字化网络、快速数据链、传感设备以及使用GPS或激光的精确制导。

开发这些新科技最初是为了让北约指挥官们不必动用核武器就能摧毁数量上占优的华约坦克编队。但直到1991年第一次海湾战争，新科技的毁灭性效果才被世人充分认知。巡航导弹迂回穿越巴格达的街道上空，最终命中攻击目标；视频显示激光制导的炸弹精准爆炸。这似乎宣布了一种新的战争形式的出现：既包含经典战争理念的精粹，又有望尽将伤亡降到最低。后者甚至也适用于敌方，因为可以在不大规模杀伤平民的情况下摧毁敌军。

这让一些人开始相信，对于拥有更先进的科技和理念的一方来说，战争可以速战速决并且相对轻松，然而之后的战争再一次令他们的想法落空。伊拉克战争及其余波又是一记当头棒喝。虽然伊拉克军队很快屈服于“震慑战术”，然而对于主战场在城市、敌人的武器是自杀炸弹和简易爆炸装置的残酷叛乱，“新军事变革”鲜有帮助。

今天，支持者相信新一轮技术进步将从根本上改变战争的特性。配备人工智能并且具备不同程度自主性的无人操纵系统让人联想到这样一种战争未来：机器在战斗中首当其冲，并以超高速做出决策。比起肉搏战，搅乱并致敌方系统瘫痪的网络武器在决定战争结果方面会变得愈发重要。

如果这些新科技让战争变得更能被接受，那么它们会增加战争的可能性吗？对此，劳伦斯爵士表示怀疑。感谢核武器的威慑力，大国之间发生战争的门槛仍然会很高。按照目前的趋势，大部分战争还会是弱国的内战，或者“混合”战。在混合战中，网络破坏、虚假情报以及渗透活动是首选武器。战斗更有可能发生在大城市而不是旷野，因为大城市人员密集。摩苏尔战役就是一个警示，它提醒人们城市战对士兵和平民都依然是致命和毁灭性的。

但即使这些也都是不确定的。劳伦斯唯独确信一件事：人们对未来战争的预测很少言中。他给决策者的寄语是提防那些鼓吹“能又快又轻松地获胜，却低估对手智谋”的人。任何持不同想法的人都应该看看这本书。■



Tax havens

Buried treasure

Vast wealth is salted away offshore. But whose? And where?

SWITZERLAND, which developed cross-border wealth-management in the 1920s, was once in a league of its own as a tax haven. Since the 1980s, however, tax-dodgers have been spoiled for choice: they can hide assets anywhere from the Bahamas to Hong Kong. The percentage of global wealth held offshore has increased dramatically. But it has been hard to say how much that is, and who owns it.

Few offshore centres used to disclose such data. But in 2016 many authorised the Bank for International Settlements (BIS) to make banking statistics publicly available. Using these data, a new study by Annette Alstadsaeter, Niels Johannesen and Gabriel Zucman, three economists, concludes that tax havens hoard wealth equivalent to about 10% of global GDP. This average masks big variations. Russian assets worth 50% of GDP are held offshore; countries such as Venezuela, Saudi Arabia and the United Arab Emirates climb into the 60-70% range. Britain and continental Europe come in at 15%, but Scandinavia at only a few per cent.

One conclusion is that high tax rates, like those in Denmark or Sweden, do not drive people offshore. Rather, higher offshore wealth is correlated with factors such as political and economic instability and an abundance of natural resources.

Proximity to Switzerland also remains a good indicator. But assets held there have declined since the financial crisis (see chart), whereas those in Hong Kong grew sixfold from 2007 to 2015. The territory now ranks second behind Switzerland. Mr Zucman attributes this to foreign pressure on Swiss banks following recent scandals, coupled with a surge of wealth in Asia.

Accounting for offshore holdings suggests wealth inequality is even greater than was thought. In Britain, France, and Spain the top 0.01% of households stash 30-40% of their wealth in tax havens. In Russia, most of it goes there. In America, the share of wealth held by the richest 0.01% is as high today as in early 20th-century Europe. Including offshore data increases the wealth share of the super-rich.

Yet plenty of data are still missing. A few big centres, including Panama and Singapore, still do not disclose these statistics. The BIS data also cover only bank deposits, not the securities in which most offshore wealth is held. Researchers made estimates to plug the gap, but their figures are likely to be conservative.

Mr Zucman thinks tax havens should be forced to be more transparent, and that institutions that facilitate tax evasion should face stiffer penalties. Fines are often seen as the cost of doing business and are small compared with profits. Threatening to withdraw banking licences would be a stronger deterrent. “There’s a strong demand from all over the world for tax-evasion services,” he says. “Without large enough sanctions, there will always be a supply to meet that demand.” ■



避税天堂

埋藏的财富

离岸财富数额巨大。但这些财富属于谁？藏在哪里？

瑞士在上世纪20年代就发展起了跨境财富管理业务。作为避税天堂，它曾一度独步天下。然而，到了80年代之后，避税者拥有了太多的选择：从巴哈马到香港，他们可以在任何地方隐藏资产。全球离岸财富的比例急剧上升，但很难说清楚这些财富有多少、为谁所有。

过去，离岸中心很少披露此类数据。但在2016年，许多离岸中心准许国际清算银行（BIS）公开其银行统计数据。利用这些数据，安妮特·阿斯特达塔（Annette Alstadsaeter）、尼尔斯·约翰尼森（Niels Johannesen）和加布里埃尔·祖克曼（Gabriel Zucman）这三位经济学家在一项新研究中得出结论称，避税天堂囤积的财富大约相当于全球GDP的10%。这个平均值掩盖了各国之间的巨大差异。俄罗斯存放在海外的资产相当于该国GDP的50%；在委内瑞拉、沙特阿拉伯和阿联酋等国，这个数字攀升至60%至70%。英国和欧洲大陆国家的数字为15%，而斯堪的纳维亚地区只有几个百分点。

一个结论是，像丹麦或瑞典那样的高税率并不会让人们把财富转移到离岸中心。相反，更高比例的离岸财富与政治和经济的不稳定以及自然资源丰富等因素有关。

邻近瑞士依然是一个很好的指标。但自金融危机以来，存放在瑞士的资产已经减少（见图表），而存放在香港的资产在2007年至2015年间增长了六倍。目前香港的排名仅次于瑞士。祖克曼认为，这是因为在近年的丑闻之后外国对瑞士的银行施加了压力，而亚洲财富猛涨也是一个原因。

若把离岸财富考虑在内，则财富的不平等比人们以为的还要严重。在英国、法国和西班牙，最富有的0.01%的家庭把自己30%至40%的财富藏匿到了避税天堂。在俄罗斯，大部分财富都转移到了那些地方。在美国，如

今最富有的0.01%的人口拥有的财富比例和上世纪初欧洲的一样高。算上离岸数据，超级富人的财富占比还会更高。

然而仍有大量数据缺失。巴拿马和新加坡等几个大离岸中心仍不披露这些统计数字。国际清算银行的数据也只包括银行存款，不包括证券，而大多数离岸财富都以证券持有。研究人员用估计数字填补了这块缺失，但他们的数字可能较为保守。

祖克曼认为应该迫使避税天堂变得更透明，而为逃税提供便利的机构应该面临更严厉的处罚。但罚款往往被视为做生意的成本，而且相比利润只是一小部分，因此威胁撤销银行牌照会更有威慑力。“世界各地对避税服务都有强烈的需求，”他说，“没有足够严厉的制裁，就总会有供给来满足这种需求。”■



China's currency

Tricky troika

The yuan's internationalisation stalls and may not pick up soon

ON OCTOBER 18TH, President Xi Jinping presided in Beijing over the most important political event in five years. At the Communist Party's 19th congress much will be made of the triumphs achieved in nearly four decades of reform and opening up. So expect a glossing over of one part of that process where progress has largely stalled: the "internationalisation" of China's currency, the yuan.

This seems odd. Just a year ago, the yuan became the fifth currency in the basket that forms the IMF's Special Drawing Right (SDR). This marked, in the words of Zhou Xiaochuan, China's central-bank governor, in a recent interview with *Caijing*, a financial magazine, "historic progress".

Symbolically, China's monetary system had been awarded the IMF's seal of approval. A further boost to prestige was the announcement in June this year that some Chinese shares would be included in two stockmarket benchmarks from MSCI.

Yet the yuan's international reach has in fact fallen in the past two years. It has regained its ranking as the world's fifth most active for international payments, after slipping to sixth in 2016. But its share of this market has slipped from 2.8% in August 2015 to 1.9% now (see chart). Use of the yuan in global bond markets over this period has fallen by half, as companies have instead raised funds within China. In Hong Kong, the largest offshore market, yuan deposits have plunged by 47% from their peak in December 2014. Of the foreign-exchange reserves held by the world's governments, just 1.1% are in yuan, compared with 64% for the dollar.

The constraints on the internationalisation of the currency are largely self-

imposed—and in many cases predated admission to the SDR. A minor devaluation of the yuan in August 2015, intended to make the currency more flexible, was botched. This led to speculation about further falls in the yuan's value, and forced the central bank to tighten capital controls and spend foreign-exchange reserves to prop it up.

Since January this year, China's reserves have been growing again. But stringent capital controls remain in place. In his interview Mr Zhou called for a renewed drive to free up China's financial system, citing a "troika" of targets: increased foreign trade and investment; a more market-based exchange rate; and a relaxation of capital controls. He said there was a "time window" for this. If missed, the cost of reform would be higher in the future.

Few observers, however, take Mr Zhou's comments as official policy. In office since 2002, he is expected to be replaced next year. He represents one side of a continuing debate. In September two capital-control rules were indeed eased, but foreign traders tended to share the view of Mitul Kotecha of Barclays, that the move was purely cosmetic. In the words of Eswar Prasad, an economist at Cornell University and author of "Gaining Currency", a book about the yuan, "what the government giveth, the government can taketh away." Most foreign investors are all too aware of that.

So the currency's international advance is unlikely to resume soon. More likely is a gradual opening of yuan markets. One avenue is to standardise systems such as the China International Payment System, which processes cross-border payments. Another is to expand the Bond Connect and Stock Connect programmes that link Chinese markets to Hong Kong. A third involves China's intense diplomatic drive to push its "Belt and Road Initiative", involving massive investments in infrastructure to boost transport, trade and investment links between China and Central Asia,

Europe and Africa.

However, David Woo of Bank of America Merrill Lynch argues that none of this is likely to lead to a big surge in foreign holdings of Chinese financial assets. That will depend on the liberalising measures Mr Zhou is advocating, as indeed does the future shape of the Chinese economy. “There isn’t a single country,” Mr Zhou argued, “that can achieve an open economy with strict foreign-exchange controls.”

But his apparent belief that measures already taken, such as joining the SDR basket, have set the yuan on a remorseless path towards internationalisation has been contradicted by the experience of the past two years. The party’s watchword remains “stability”. And whatever the benefits of capital-account liberalisation, it would bring a measure of unpredictability. In a battle between openness and control, Mr Xi is likely to favour control. ■



中国货币

前路不明的三驾马车

人民币国际化进程停滞，可能不会很快恢复

十月十八日，习近平主席在北京主持召开五年一次的最重要的政治会议。中共十九大将大加颂扬改革开放近40年所取得的胜利。因此，改革开放过程中一个大体上已停滞不前的方面估计会被含混带过，那就是人民币的“国际化”。

这似乎很奇怪。就在一年前，人民币成为国际货币基金组织（IMF）“特别提款权”（SDR）货币篮子中的第五种货币，中国央行行长周小川近期接受《财经》杂志采访时称之为“历史性进展”。就象征意义而言，这代表中国的货币体系已得到国际货币基金组织的正式认可。今年6月，摩根士丹利资本国际（MSCI）宣布将一些中国股票纳入其两个股票市场基准指数，这进一步提升了中国货币体系的地位。

然而，人民币的国际影响力在过去两年实际上有所下降。2016年，人民币在国际支付最活跃货币的排名中下滑至第六位，今年重新升至第五。但人民币在国际支付市场上的份额已从2015年8月的2.8%下降到现在的1.9%（见图表）。在此期间，全球债券市场上的人民币使用量下降了一半，因为很多公司选择了在中国国内融资。在香港这个最大的人民币离岸市场，人民币存款从2014年12月的高点下跌了47%。在世界各国的外汇储备中，只有1.1%是人民币，而美元为64%。

人民币国际化的制约因素主要是由中国自己造成的，而且有些因素在人民币加入SDR之前就已存在。2015年8月旨在提高人民币灵活性的小幅贬值实施不当，导致市场猜测人民币将继续贬值，央行被迫收紧资本管制、支出外汇储备以维持人民币稳定。

今年1月以来，中国的外汇储备再次增长，但严格的资本管制仍然存在。周小川在采访中指出，需要新的推动力来开放中国的金融体系，并提到了

“三驾马车”的目标：增加贸易投资对外开放、提高汇率市场化程度和放松资本管制。他说，改革存在一个“时间窗口”，错过了时机，未来改革的成本可能会更高。

不过，很少有观察人士视周小川的言论为官方政策。周小川于2002年就任，预计将在明年交棒。围绕人民币国际化的问题一直有不同的意见，周小川代表了其中的一派。9月，两项资本管制规定确实有所放松，但外国贸易商倾向于认同巴克莱银行（Barclays）的米图尔·科特查（Mitul Kotecha）的观点，即这一举动纯粹是表面文章。用《人民币的崛起》（Gaining Currency）一书的作者、康奈尔大学的经济学家埃斯瓦尔·普拉萨德（Eswar Prasad）的话来说，就是“政府能给你什么，也就能拿走什么”。大多数外国投资者对此都再清楚不过了。

因此，人民币的国际化进程不可能很快恢复。更可能的是逐渐开放人民币市场。一种途径是规范系统，如处理跨境支付的中国国际支付系统。另一种是扩大连接中国大陆和香港市场的债券通和沪港通、深港通。第三种与中国外交强力推动的“一带一路”倡议有关。该倡议涉及大规模投资基础设施，以促进中国与中亚、欧洲及非洲的交通、贸易和投资联系。

然而美银美林的大卫·吴（David Woo）认为，这些都不会导致外资持有的中国金融资产大幅增长。这将取决于周小川倡导的自由化措施以及中国经济未来的状况。周小川说，“世界上没有任何一个国家能在外汇管制很严重的情况下实现开放型经济。”

周小川显然认为，已经采取的如加入SDR货币篮子的措施已经使人民币义无反顾地走上了国际化的道路，然而过去两年的经验却与他的看法相矛盾。党的口号仍然是“稳定”。而无论资本账户自由化有何好处，都会带来一定的不可预测性。在开放与控制的拉锯中，习近平很可能会站在控制的一方。■



Schumpeter

The nuclear option

America's politicians try to control Chinese firms abroad. It is a dangerous game

WARS are fought with weapons, but also with money. To understand the global balance of power in the coming decades, it helps to pay attention to the commercial subplot of the North Korean crisis. For the first time, America is attempting to use its full legal and financial might to change the behaviour of Chinese companies and banks, which it believes are propping up North Korea by breaking UN and American sanctions. Some American politicians have concluded that, as China's firms have integrated with the global economy, they have become more vulnerable to Uncle Sam's wrath. America has potent weapons, but the trouble is that China can retaliate in devastating fashion.

North Korea is highly dependent on China. Some 60-90% of its trade is with its northern neighbour. China's state-run energy giant, CNPC, is thought to have sold it oil in recent years—and is the parent of PetroChina, which has depositary receipts listed in New York. North Korean banks and firms operate in China, and it is likely that Chinese banks have dealt with them or their proxies.

After months of American pressure, on September 21st China's central bank was reported to have told the country's lenders to stop writing new business with North Koreans. But America's Treasury is still on the warpath. On September 26th it blacklisted 19 North Korean bankers working in China and eight North Korean firms. In private it is excoriating China's largest lenders, which own \$125bn of assets in America, equivalent to 14% of their total capital. On September 28th a Senate committee demanded an ever tougher crackdown on Chinese banks.

Such extraterritorial reach by American regulators (and courts) is a feature of international business. Misdeeds anywhere can be punished, if the firm in question issues securities in America, has a subsidiary there or makes electronic transactions in dollars. America has pursued eight of Europe's biggest 50 companies by market value for breaking sanctions in the past decade, and 18 of them for corruption. After the attacks of September 11th 2001 America stepped up efforts to police the global dollar payments system. It aggressively enforced sanctions against Iran. European financial firms faced \$13bn of related fines and France's BNP Paribas and Britain's Standard Chartered almost lost their American licences, which would probably have put them out of business.

Yet until a year ago, big Chinese firms were exempt, at least informally. America probably worried about starting a trade war. Sanctions in 2013 on four small Chinese firms that traded with Iran met a furious response from China's foreign ministry. In some cases Uncle Sam's relaxed attitude was obvious. In 2015 China Construction Bank's New York office was found by the Federal Reserve to have deficient anti-money-laundering processes but was forgiven. In 2014-15 Agricultural Bank of China's New York office processed over \$100bn of payments without adequate controls. It got a token \$215m fine. When PetroChina listed in New York in 2000, it sidestepped sanctions by transferring assets in Sudan to CNPC, according to the memoirs of Hank Paulson, a Goldman Sachs banker who was later treasury secretary.

Now China Inc would appear to be a sitting duck. Hundreds of firms have securities listed in America. There is lots of graft in China and it is a large trading partner not only of North Korea but of Iran, Syria and Cuba, which also face American sanctions. A sharp change of mood was signalled in March when Wilbur Ross, the commerce secretary, announced a \$1.2bn fine on ZTE, an IT company which had done business with Iran and North Korea. Huawei, a rival, is under scrutiny for a possible breach of American

trade controls on Iran and Syria. While China may hope that its recent order to its banks may calm things, there is a fever in Washington to punish its firms, both for patriotic reasons and because protectionists are newly influential.

China's banks run large businesses in dollars as well as in yuan, which has made them especially vulnerable to American pressure. The four largest—Agbank, Bank of China, CCB, and ICBC—have \$940bn of dollar liabilities, including debt and deposits raised from international markets. If America excluded them from its financial system, they would face big problems as global investors shied away. China's central bank might need to help fund them. For American lawmakers they are thus a tempting target—especially since America's big banks, with only \$54bn of loans in China and few liabilities in yuan, hardly need China.

| *Taking it to the brink*

Yet China, no stranger to the dark arts of bullying firms for geopolitical ends, has other means of retaliation. In 2009, for example, BP was warned to abandon an offshore oil project near Vietnam. If it did not, the word was, all of its contracts in China would be reconsidered and China would be unable to guarantee the safety of its staff, according to "Asia's Reckoning", a new book by Richard McGregor. Today General Motors and Apple together make \$20bn of profits a year in China. Fining them heavily or prohibiting their operations would hit American interests hard. China could escalate by putting pressure on its autonomous territory of Hong Kong to punish large American banks based there.

North Korea is a geopolitical flashpoint and a humanitarian catastrophe. But it also highlights a faultline in the world's business architecture that will cause problems for decades to come. It is almost inconceivable that China will accept the extraterritorial reach of America's legal and financial system in the same way that America's allies in Europe, and Japan, have

done.

Perhaps America will later decide to limit its reach. For its part, China is erecting defences to avoid the long arm of Uncle Sam, such as its own cross-border payments system, which it began around a decade ago, but this will take years. Until then, simmering tension and the risk of mutually assured financial destruction are bound to continue. The only consolation is that commercial war does not necessarily come with a mushroom cloud. ■



熊彼特

同归于尽

美国政客试图控制中国海外企业，这可是场危险的游戏

打仗需要武器，也要烧钱。要了解未来几十年全球力量的格局，关注朝鲜危机的商业支线剧情会有帮助。美国首次试图利用自身全部的法律和金融实力来改变中国企业和银行的行为，因为它认为中国公司和银行为了支持朝鲜，违反了联合国和美国的制裁决议。一些美国政界人士认为，随着中国企业融入全球经济，它们变得更容易受到山姆大叔怒火的冲击。美国有强大的武器，但麻烦的是，中国可以用破坏性的方式展开报复。

朝鲜高度依赖中国，该国约60%至90%的贸易都与中国展开。外界认为，中国国有能源巨头中国石油天然气集团公司近年来一直向朝鲜出售石油。该集团是中石油的母公司，中石油在纽约有上市的存托凭证。朝鲜的银行和公司在华经营，中国的银行很可能与它们或它们的代理有业务往来。

在美国施压几个月之后，9月21日，有报道称中国央行已命令本国的贷款机构停止和朝鲜展开新业务。但美国财政部的怒火未消。9月26日，美国将19名在中国工作的朝鲜银行人员和八家朝鲜企业列入黑名单。私下里，美国不断斥责中国最大的一些贷款机构——它们在美国拥有1250亿美元的资产，相当于其总资本的14%。9月28日，参议院的一个委员会要求对中国的银行实行更严厉的制裁。

美国监管机构（和法院）的这种域外管辖是国际商务的一个特点。涉事公司在任何地方犯错都有可能受到惩罚，只要它在美国发行证券、有子公司，或以美元计价进行电子交易。过去十年中，美国以违反制裁为由追查了欧洲市值最高的50家公司中的八家，以腐败为由追查了另外18家。

“9·11”恐怖袭击事件之后，美国全面加强了对全球美元支付系统的监督力度，还积极实施对伊朗的制裁。欧洲金融公司面临130亿美元的相关违规罚款，法国巴黎银行和英国渣打银行差点失去了美国牌照。一旦失去牌照，它们可能会因此停业。

但直到一年前，大型中国企业还没有受到相关调查和惩罚，至少没有正式进行。这可能是因为美国担心引发贸易战。2013年，美国制裁了四家与伊朗有商业往来的中国小企业，中国外交部反应激烈。在某些情况下，山姆大叔的态度明显较为放松。2015年，美联储认定中国建设银行纽约分行反洗钱流程不健全，但放了它一马。2014至2015年，中国农业银行纽约分行处理了超过1000亿美元的付款，但缺乏足够的合规控制，被象征性地罚款2.15亿美元。美国前财政部长、前高盛银行家汉克·保尔森（Hank Paulson）在回忆录中称，中石油于2000年在纽约上市时，把在苏丹的资产转移给了母公司而免受制裁。

而现在中国企业仿佛瓮中之鳖。数百家中国企业在美国发行证券。中国贪污严重，而且除朝鲜外，中国还是伊朗、叙利亚和古巴的主要贸易伙伴，这些国家都是美国的制裁对象。3月，商务部长威尔伯·罗斯（Wilbur Ross）宣布对与伊朗和朝鲜有业务往来的IT公司中兴通讯发出12亿美元的罚单，表明美国在态度上发生了急剧转变。中兴的竞争对手华为也因可能违反了美国对伊朗和叙利亚的贸易制裁而正受到调查。中国也许希望最近向本国银行发出的指令能够平息事态，但华盛顿刮起了要求严惩中国企业的的风潮，背后既有爱国主义因素，也因为保护主义者开始发挥影响力。

中国的银行在人民币业务之外还有大量的美元业务，这使它们特别容易受到美国施压的影响。中国的四大银行——农业银行、中国银行、建设银行和工商银行——拥有共计9400亿美元的美元负债，包括国际市场上的债务和存款。如果美国把中国的银行从其金融体系中排除出去，它们将因全球投资者流失而面临严峻形势，中国央行可能就需要出手相助。因此对美国议员而言，中国的银行是一个诱人的目标——特别是因为美国的大银行在中国只有540亿美元的贷款，人民币计价的债务也很少，因而几乎不需要中国。

| 临近战争边缘

然而，中国深谙为地缘政治目的而欺凌企业的法门，自有其他的报复手段。例如，英国石油公司（BP）曾在2009年被要求放弃越南附近的一个离岸石油项目。根据理查德·麦克格雷戈（Richard McGregor）在新书

《亚洲的较量》（Asia's Reckoning）中所述，有报道称，如果该公司不从，它在中国的所有合同将被重新考虑，中国也将无法保证其员工的安全。如今，通用汽车和苹果公司每年在中国的利润合计达200亿美元，对它们施以重罚或禁止它们开展业务将严重影响美国的利益。中国还可以进一步升级报复，对香港特别行政区施压，以惩罚那里的美国大银行。

朝鲜是一个地缘政治危机导火索和人道主义灾难地，但它也突显出全球商业架构中存在着一道将在未来几十年引发问题的裂痕。难以想象中国会和日本及美国在欧洲的盟友一样，接受美国法律和金融体系的域外管辖。

也许美国以后会决定限制自己的域外管辖。至于中国方面，为避开山姆大叔的长臂，它正在建立防御措施，例如大约十年前开始的跨境支付体系，但这耗日持久。在那之前，日益激化的紧张局势和两国在金融上相互摧毁的风险势必持续。唯一的安慰是，商战中不一定会升起蘑菇云。 ■



Economic and financial indicators

Metal prices

China's crackdown on air pollution has driven a surge in metal prices

The Economist's metal-price index has risen by 40% since the start of 2016, although it still remains 33% below its peak a decade ago. A surge in prices over the past few months has been driven in part by China's crackdown on air pollution, as well as by reform of its industrial sector. Aluminium, which makes up over two-fifths of our index, has been particularly affected. China produces about half of the world's supply; In August Shandong province ordered the closure of 3.2m tonnes of aluminium-smelting capacity. Prices spiked to over \$2,000 a tonne for the first time since 2014. The price of copper has also surged, partly as a result of supply disruptions at mines in Indonesia and Chile. ■



经济与金融指标

金属价格

中国遏制空气污染，推动金属价格飙升

自2016年年初以来，《经济学人》金属价格指数上升了40%，不过仍比十年前的峰值低33%。过去几个月之所以出现价格猛增，部分是由于中国遏制空气污染的努力，该国工业部门的改革也是原因之一。占本刊指数比重超过五分之二铝尤其深受影响。中国生产的铝大约占世界总供应量的一半；8月，山东省下令关闭320万吨的炼铝产能。自2014年以来，铝的价格首次冲破每吨2000美元。铜价也急剧上涨，一定程度上是因为印尼和智利的铜矿供应中断。 ■



Architecture

Crooked timber

A new book shows what happens when ambitious plans encounter the buzzsaw of politics and greed

HIS name may not be familiar, but Reinier de Graaf's architecture practice, the Office of Metropolitan Architecture (OMA), designed the CCTV building in Beijing and the Prada Foundation in Milan. Its co-founder Rem Koolhaas is a classic "starchitect". Mr De Graaf is known in professional circles for his bleakly humorous lectures on architecture as a social act.

His first book—part essay-collection, part diary—is thus something of a revelation. It covers some familiar ground, such as the frictions between the utopian tendencies in 20th-century architecture and the realities of real estate and realpolitik. But he has produced an original and even occasionally hilarious book about losing ideals and finding them again.

In the early part of the 21st century architects were again given the opportunity to create master plans for whole districts rather than single buildings, in a way they had not been since the 1960s or 1970s. At the book's core are diary entries describing his travails in designing such plans for London, Dubai and, especially, Moscow.

In the Russian capital, Mr De Graaf and his team are drawn by the idea of revisiting the Naukograd—the special urban parks for research and development that sustained the scientific prowess of the Soviets. Invited to sit on the council that was ostensibly organising the design competition he was taking part in, he initially declined, saying it would be unethical. As he slowly realised the competition did not operate under normal rules, he accepted the position, to get closer to winning the project he and his team had worked so hard on. Mr De Graaf leads his team through bewildering

negotiations, and the process gradually unravels into farce as building begins without an agreed master plan.

One of the underrated skills of the architect is the ability to observe not only urban scenarios but individuals. In 2013 Mr De Graaf called the Russian client representative only to hear hurried apologies—and sirens in the background. The next day the news described another raid by agents investigating fraud on the project. Over the next months he looked on wryly as the grand vision was slowly trashed and key figures were indicted. Comparing democratic systems with authoritarian ones, he wonders “which is more time-consuming: our lengthy procedures to arrive at decisions or their lengthy procedures to undo them.” Meanwhile he notes that while Donald Trump the president railed against inept governments, Donald Trump the property developer played them expertly to win permits and subsidies: “If indeed the public sector is dysfunctional then Trump is the monster it created.”

Mr De Graaf cannot give easy answers to the tough questions about architecture’s public purpose; there are none. He is better at skewering lazy ideas, like the fad for internet-connected buildings, and at highlighting the ideological struggles over the built environment. He deftly shows that architecture cannot be better or more pure than the flawed humans who make it. ■



建筑

曲木不成材

一本新书向我们展现，当宏伟的蓝图遭遇政治和贪欲的锯齿时，发生了什么

赖尼尔·德·格拉夫（Reinier de Graaf）这个名字也许不太耳熟，但此人所在的大都会建筑事务所（OMA，全称Office of Metropolitan Architecture）设计了北京的中央电视台大楼和米兰的普拉达基金会（Prada Foundation）总部。这家事务所的联合创始人雷姆·库哈斯（Rem Koolhaas）是一位典型的“明星建筑师”。而德·格拉夫则以他充满冷幽默的、有关“建筑是一种社会行为”的演讲在建筑圈闻名。

因此他的第一本书——部分是杂文汇编，部分是日记——像是一本启示录。书中讨论了一些常见的话题，例如20世纪建筑的乌托邦倾向与房地产的实际状况及现实政治之间的摩擦。不过他这本讲述失去理想及重拾理想的作品独出机杼，甚至偶尔还令人捧腹大笑。

二十一世纪早期，建筑师们又一次获得了为整个地区创建总体规划的机会，而不是像上世纪六七十年代以来那样，只能设计独栋建筑。在作为本书核心的一篇篇日记中，他讲述了自己为伦敦、迪拜，特别是莫斯科设计总体规划时的艰辛。

在俄罗斯首都，德·格拉夫和他的团队被重建科学城（Naukograd）的概念吸引。科学城是城市里用于研发的特别园区，苏联的强大科技实力正是靠它们所维系。他参加了科学城的设计竞赛，又收到了竞赛委员会的邀请，希望他加入该委员会。表面上看，比赛就是由这个委员会组织的，因此一开始他拒绝了，说这么做有违道德。后来他慢慢意识到该竞赛并不是按一般规则操作的，于是又接受了邀请，以求离赢得这个他和团队倾注了大量心血的项目更近一步。他带领着团队经历了让人凌乱的各种谈判，而这个过程逐渐变成了一场闹剧，因为总体规划还没有达成一致项目就开工了。

德·格拉夫被低估的技能之一是他不仅会观察城市景观，还会观察人。2013年，他致电俄罗斯客户代表，却只听到对方匆忙地道了声歉，背景里传来警笛声。第二天，新闻报道称调查该项目欺诈行为的探员又一次发动了突击搜查。之后几个月里，他苦笑着目睹宏伟蓝图慢慢被扔进垃圾筒，项目的关键人物纷纷被起诉。他比较民主制度与威权制度，想知道“哪一种制度更耗费时间：是我们做出决定的冗长流程，还是他们撤销决定的冗长流程”。同时他还指出，总统特朗普怒斥各地政府无能之时，地产开发商特朗普却为获得许可证和补贴而将其玩弄于股掌：“如果说公共部门确实功能失调，那么特朗普就是它创造出来的怪兽。”

对于和建筑的公共目的相关的棘手问题，德·格拉夫无法给出简单的答案——也没有简单的答案。他更善于讽刺那些懒惰的设计，比如对联网建筑的狂热，也很好地点出了围绕着已建成环境所展开的意识形态斗争。他巧妙地向读者展示，建筑不可能比那些建造它们的、有缺陷的人类更好或更纯粹。■



Free exchange

Wearied science

New ideas are getting harder to find—for now

WERE there far fewer undiscovered ideas out there than in our more primitive past, how would people know? This is not an idle question; decoding the mysteries of nature, from atmospheric pressure to electricity to DNA, allowed people to bend the natural world to their will, and to grow richer in the process. A dwindling stock of discoverable insights would mean correspondingly less scope for progress in the future—a dismal prospect. And some signs suggest that the well of our imagination has run dry. Though ever more researchers are digging for insights, according to new research, the flow of new ideas is flagging. But that uncovering new ideas is a struggle does not mean that humanity is near the limits of its understanding.

The development of new ideas—meaning scientific truths or clever inventions—allows economies to grow richer year after year. Adding more workers or machinery to an economy boosts GDP, but only for a while. Applying ever more men with hoes to the cultivation of a field will generate diminishing returns in terms of crop yields, for instance; wringing more from the soil eventually requires the use of better seed-stock or fertiliser. Unless humanity finds new ways to do more with the same amount of labour and capital, growth in incomes peters out to nothing.

Dwindling growth in incomes is not a bad description of what has happened in much of the industrialised world in recent decades. Meagre rises, in turn, lead some to conclude that there are simply not many breakthroughs left to be uncovered, of the sort that lifted living standards during the Industrial Revolution. That, for instance, is the view of Robert Gordon, an economist at Northwestern University, whose bleak book, “The

Rise and Fall of American Growth”, reckons that the era of economic revolution is behind us.

Is it? A recent paper by Nicholas Bloom, Charles Jones and Michael Webb of Stanford University, and John Van Reenen of the Massachusetts Institute of Technology, provides relevant evidence. Though striking an agnostic position as to whether humanity has used up all its eureka moments, they nonetheless conclude that new ideas are getting more expensive to find. The authors consider four different case studies, within which they compare research “inputs” (such as the money spent on researchers and lab equipment) and outputs. The number of transistors that can be squeezed onto a microchip has doubled with reassuring regularity for half a century, every two years or so—a phenomenon known as Moore’s Law (after Gordon Moore, a founder of Intel). Yet this success has been achieved by pouring more and more resources into the effort over time. The research productivity of each scientist participating in the battle to cram in transistors has correspondingly tumbled.

Much the same is true in other fields of inquiry, such as efforts to raise crop yields and extend life. As the authors acknowledge, squeezing oranges dry is not a problem if new oranges keep arriving: ie, if new lines of research appear even as others are exhausted. Yet they reckon that, across the economy as a whole, the notion that the cost of ideas is rising holds true. Since the 1930s, the effective number of researchers at work has increased by a factor of 23. But annual growth in productivity has declined (see chart).

| *Not the only fruit*

Despair is premature, however. The effort to find new, growth-boosting ideas is not necessarily hopeless, just complicated. Whether herding more researchers into the laboratory raises growth might depend on how intensively the resulting brainstormings are used, for example. Across the global economy, many countries have yet fully to exploit ideas already in

use by firms at the frontier of scientific knowledge. The problem, in other words, is not that oranges are in short supply or are already squeezed dry, but rather that of the ten workers at the juice bar, only one has learned to do the squeezing. Investments in education and training, to expand the share of workers that can use new ideas, or in the quality of management, to improve how effectively ideas are applied within firms, would do wonders for growth, even if the world's scientists are idly scratching their heads.

Analysing the supply side of the innovation equation in isolation can also be misleading. The demand for new ideas, and, correspondingly, the incentive to tackle difficult questions, also matters. In his analysis of the Industrial Revolution, Robert Allen, an economic historian then at Oxford, sought to explain why it started in Britain rather than anywhere else. Supply-side factors, such as improved literacy and stronger property rights, certainly played a part. But it was the demand for labour-saving innovation, prompted by Britain's relatively high wages at the time, which gave tinkerers a strong incentive to develop and hone the steam engine and its applications.

Put differently, researchers are often like the drunken man searching for his keys under the streetlight, because that is where the light is. Until some pressure is applied to encourage him to look elsewhere, the search will often prove fruitless. It is easy to see why firms might take a lackadaisical approach to some research questions. Disappointing wage growth across advanced economies is a deterrent to the invention and use of labour-saving innovations. Persistently high rates of profit give big firms plenty of money to plough into fancy research labs, but also suggest that the competitive pressures which might prompt them to exploit the resulting discoveries are weak.

The accumulation of knowledge is in some ways a burden. The more is known, the more researchers must absorb before they can add to the stock

of human knowledge—or the more they must collaborate with other researchers to combine their areas of expertise. But the incomplete exploitation of currently available knowledge is in some way reassuring. It suggests that people are underperforming relative to their potential: both in how they use available ideas and in how they uncover new ones. ■



自由交流

科学进步乏力

新想法日益难觅——至少目前如此

假如较之人类更原始过去，未被发掘的新想法少了很多，那么要如何获得它们？这可不是个无聊的问题：正是由于破解了从气压、电，到DNA等大自然的奥秘，人们才得以驾驭自然界，并在过程中变得富有。如果可以探求的真知灼见越来越少，那么未来进步的空间也将相应减少，这样的前景令人沮丧。而且有迹象表明我们的想象力已经枯竭。新研究显示，尽管挖掘新知的研究人员越来越多，新想法的涌现却愈见乏力。但是，获得新发现越来越难，并不意味着人类已经接近其知性的极限。

新想法（即科学真理或巧妙的发明）的发展让经济体日渐富裕。在一个经济体中增加更多的工人或机械可以提高GDP，但这种增长只能持续一段时间。例如，不断让更多人拿着锄头去耕作，农作物收成的收益会递减；要从土地得到更多回报，最终还是得使用更好的种苗或肥料。如果人类不能找到新方法利用同等数量的劳动力和资本实现更多，那么收入增长就会逐渐减少至零。

收入增幅逐渐萎缩这一说法还算贴切地描述了大部分工业化国家近几十年来的现实情况。增幅之微小又让一些人得出结论：已经不再有多少类似工业革命期间提高了人类生活水平的那种突破可供人类发掘了。美国西北大学经济学家罗伯特·戈登（Robert Gordon）就持此观点，他的《美国经济增长的兴衰》（*The Rise and Fall of American Growth*）一书笔调阴郁，认为经济革命的时代已一去不复返。

果真如此吗？斯坦福大学的尼古拉斯·布鲁姆（Nicholas Bloom）、查尔斯·琼斯（Charles Jones）和迈克尔·韦伯（Michael Webb）以及麻省理工学院的约翰·范·里宁（John Van Reenen）最近在共同发表的一篇论文中给出了相关证据。尽管对于人类是否已经耗尽了所有的顿悟时刻这一点他们表示不得而知，但他们得出结论称获得新想法的代价越来越高。几

位作者考虑了四个不同的案例，用于比较研究的“投入”（比如花在研究人员和实验室设备上的资金）和产出。半个世纪以来，微芯片上的晶体管数量以每两年翻一番的速度稳定增长，这个现象称为摩尔定律（以英特尔创始人之一戈登·摩尔的名字命名），但这种增长得以维持有赖于越来越多的资源被投入其中。而每个参与晶体管密度之战的科学家的研究生产力也相应下降了。

其他研究领域基本也是如此，比如提高农作物的产量和延长寿命。正如作者们指出，如果有新的橘子不断提供补充，那么榨干现有的橘子就不是个问题，也就是说，如果有新的研究出现，那么其他的枯竭了也没所谓。不过他们认为，纵观整个经济，发掘新想法成本上升的看法是正确的。20世纪30年代以来，“实际研究人员”数量【译注：在这篇论文中，这个数字从研发开支推算而来】增加了23倍，但他们的生产力年增长率却呈下降趋势（见图表）。

| 橘子不是唯一的水果

然而，现在就绝望为时过早。努力寻求促进增长的新想法并不一定无望，只是很复杂。比如说，让更多研究人员进入实验室是否能促进增长，可能取决于对他们的头脑风暴成果利用的程度。从全球范围看，许多国家都还没有充分利用那些科学前沿企业已在应用的创意。换句话说，问题不是橘子供应不足或是已被榨干，而是果汁吧的十名员工中只有一人学会了榨汁。投资于教育和培训以扩大能利用新想法的工人的比重，或者投资于提高管理质量以令想法在企业内部得到更有效的应用，都是能带来增长的灵丹妙药，即便全世界的科学家都在徒劳地苦思冥想。

孤立地分析“创新方程式”的供给面也可能误入歧途。对新想法的需求也很重要。相应地，解决困难问题的动力也一样。经济史学家罗伯特·艾伦（Robert Allen）在牛津大学工作期间曾经分析工业革命，试图解释为何这场革命始于英国而不是其他任何地方。识字率提高和产权保护加强等供给面上的因素肯定起到了一定的作用。但正是由于当时英国相对较高的工资水平引发了对节省劳动力的创新的需求，才让喜欢鼓捣发明的人有了很强的动力来开发和改进蒸汽机及其应用。

换句话说，研究人员往往像在路灯下找钥匙的醉汉——只因那里有光亮。如果不给点压力鼓励他们去别的地方找找看，这样的寻找往往徒劳无功。企业可能对某些研究课题无甚热情，原因不难想见。发达经济体的工资增幅令人失望，阻碍了人们去发明和应用可节省劳动力的创新。持续的高利润率让大公司有大量资金投入先进研究实验室，但也表明它们面临的竞争压力不足，而这种压力原本可能会促使它们充分利用这些实验室的成果。

知识的积累在某种程度上是一种负担。知识越多，研究人员在能够为人类知识库添砖加瓦之前必须吸收的东西也越多，或者他们必须更多地与其他研究人员合作以互补专长。但目前已有的知识尚未得到充分利用这一点在某种程度上令人心安。这表明，不论是在对现有想法的利用上，还是在开发新想法方面，人们都还没有充分发挥潜力。■



Internet infrastructure

Pipe dreams

Technology companies are building their own undersea fibre-optic networks

WHEN Cyrus Field, an American businessman, laid the first trans-Atlantic cable in 1858, it was hailed as one of the great technological achievements of its time and celebrated with bonfires, fireworks and 100-gun salutes. Alas, the reason for the festivities soon went away. Within weeks the cable failed.

On September 21st the completion of another trans-Atlantic cable was welcomed with much less ado. But it is remarkable nevertheless: dubbed *Marea*, Spanish for “tide”, the 6,600km bundle of eight fibre-optic threads, roughly the size of a garden hose, is the highest-capacity connection across the ocean. Stretching from Virginia Beach, Virginia, to Bilbao, Spain, it is capable of transferring 160 terabits of data every second, the equivalent of more than 5,000 high-resolution movies. It is jointly owned by Facebook and Microsoft.

Such ultra-fast fibre networks are needed to keep up with the torrent of data flowing around the world. In 2016 traffic reached 3,544 terabits per second, roughly double the figure in 2014, according to TeleGeography, a market-research firm. And demand for international bandwidth is growing by 45% annually. Much traffic still comes from internet users, but a large and growing share is generated by big internet and cloud-computing companies syncing data across their networks of data centres around the world.

These firms used to lease all of their bandwidth from carriers such as BT and Level 3. But now they need so much network capacity that it makes more sense to lay their own dedicated pipes, particularly on long routes

between their data centres. The Submarine Telecoms Forum, an industry body, reckons that 100,000km of submarine cable was laid in 2016, up from just 16,000km in 2015. TeleGeography predicts that a total of \$9.2bn will be spent on such cable projects between 2016 and 2018, five times as much as in the previous three years.

Owning a private subsea fibre-optic network has several advantages, including more bandwidth, lower costs, and reduced delay, or “latency”. Having access to multiple cables on different routes also provides redundancy. If a cable is severed—by fishing nets, sharks, or an earthquake, among other things—traffic can be rerouted to another line. Most important, however, owning cables gives companies greater say over how their data traffic is managed and how equipment is upgraded. “The motivation is not so much saving money. It’s more about control,” says Julian Rawle, a submarine cable-industry expert.

Some people worry that owning the pipes that carry their customers’ data will give big tech firms even more power than they already have, likening the situation to Amazon’s owning the roads on which its packages are delivered and the lorries that carry them. Others fret that conventional network operators may struggle to adapt their business models, as companies such as Facebook are moving onto their turf. “Within the next 20 years,” predicts Mr Rawle, “the whole concept of the telecom carrier as the provider of the network is going to disappear.” ■



互联网基础设施

深海织梦

科技公司正在打造自己的海底光纤网络

当美国商人塞勒斯·菲尔德（Cyrus Field）在1858年敷设第一条横跨大西洋的电缆时，人们盛赞它是当时最伟大的科技成就之一，他们用篝火、烟花和100响礼炮来庆祝。然而好景不长，不过几周，电缆便损坏失灵了。

今年9月21日，又一条跨大西洋电缆完工。这次人们的欢庆方式要低调得多，但这并不影响它是一项非同凡响的成果：这条名为“马雷亚”（Marea，西班牙语“潮汐”的意思）的电缆是目前容量最大的跨大西洋通信线路。它全长6600公里，由8条光纤线路组成，和花园用的水管差不多粗细。它从美国弗吉尼亚州的弗吉尼亚海滩（Virginia Beach）延伸至西班牙的毕尔巴鄂（Bilbao），每秒可以传输160Tb的数据，相当于5000多部高分辨率的电影。这条电缆由Facebook和微软共有。

为了跟上世界范围内涌动的数据洪流，人们需要这种超高速光纤网络。根据市场调研公司TeleGeography的数据，2016年通信流量达到每秒3544Tb，大约是2014年时的两倍。对国际带宽的需求也在以每年45%的速度增长。相当一部分通信流量仍然来自互联网用户，不过大型互联网和云计算公司在它们遍布世界的数据中心网络之间进行的数据同步也占了很大的比例，这一比例还在不断增长。

这些公司过去通常是从英国电信（BT）和美国Level 3之类的运营商那里租赁自己所用的全部带宽。但现在它们对网络容量的需求非常庞大，因此敷设自己的专用线路变得更加合理，尤其是在它们相隔甚远的各个数据中心之间敷设线路。行业机构海底电信论坛（Submarine Telecoms Forum）估算，2016年敷设的海底电缆达10万公里，而2015年仅有1.6万公里。据TeleGeography预测，2016年至2018年间，总计会有92亿美元花在这类电缆项目上，是之前三年的五倍之多。

自有海底光纤网络有几个好处，包括更多的带宽，更低的成本，还能减少延迟。使用不同线路的多条电缆还能提供备用路径：如果一条电缆因渔网、鲨鱼、地震等原因断裂，通信可切换到另一条电缆上。不过最重要的是，拥有自己的电缆后，公司在数据传输的管理和设备升级等方面就有了更大的话语权。“这么做的动机主要不是为了省钱，更多是为了控制。”海底电缆业专家朱利安·罗尔（Julian Rawle）表示。

有人担心，拥有了传输用户数据的线缆后，大科技公司的影响力将如虎添翼，这就好比配送亚马逊包裹的卡车、供卡车行驶的道路也都归亚马逊所有。另一些人则担忧，在被Facebook这类公司入侵地盘时，传统的网络运营商可能难以调整自己的商业模式。罗尔预计，“不出20年，电信运营商作为网络供应商的整个概念将消失。”■



American shipping

All at sea

How protectionism sank a country's entire merchant fleet

IN APRIL 1956 the world's first container ship—the *Ideal X*—set sail from New Jersey. A year later in Seattle the world's first commercially successful airliner, Boeing's 707, made its maiden flight. Both developments slashed the cost of moving cargo and people. Boeing still makes half the world's airliners. But America's shipping fleet, 17% of the global total in 1960, accounts for just 0.4% today.

Blame a 1920 law known as the Jones Act, which decrees that trade between domestic ports be carried by American-flagged and -built ships, at least 75% owned and crewed by American citizens. After Hurricane Irma, a shortage of Jones-Act ships led President Donald Trump on September 28th to waive the rules for ten days to resupply Puerto Rico. This fuelled calls to repeal the law completely.

Like most forms of protectionism, the Jones Act hits consumers hard. A lack of foreign competition drives up the cost of coastal transport. Building a cargo ship in America can cost five times as much as in China or Korea, says Basil Karatzas, a shipping consultant. And the cost of operating an American-flagged and -crewed vessel is double that of foreign ones, reckons America's Department of Transportation.

Inflated sea-freight rates push most cargo onto lorries, trains and aircraft, even though these are pricier and produce up to 145 times as many carbon emissions. So whereas 40% of Europe's domestic freight goes by sea, just 2% does in America. Lacking overland routes, Alaska, Guam, Hawaii and Puerto Rico are hardest hit. Hawaiian cattle ranchers, for instance, regularly fly their animals to mainland America. A recent report by the Government

Development Bank for Puerto Rico found that the Jones Act inflated transport costs for imports to twice the level of nearby islands.

Jones-Act shipowners retort that the rules are to help producers, not consumers. Rail firms lobbied for the 1920 law, out of fear that an excess of foreign ships from the first world war was flooding the market. National security was also cited. German submarine warfare, it was argued, showed the need for a merchant fleet built and crewed by Americans. But the law has virtually wiped out American shipping. Between 2000 and 2016 the fleet of private-sector Jones-Act ships fell from 193 to 91. Britain binned its Jones-Act equivalent in 1849. Its fleet today has over three times the tonnage of America's. Marc Levinson, an economic historian (and former journalist at **The Economist**) notes that the laws also made American container lines less able to compete on international routes. Drawn by profits at home they underinvested in their foreign operations, and fell behind their foreign rivals because they lacked the same scale.

Recognising the harm to their domestic fleets, countries from Australia to China are loosening the rules protecting their fleets. Not America. In January, the Obama administration tried to get rid of all exemptions to the Jones Act. Mr Trump overruled that decision in May, but has said any further waivers will be hard because of the influence in Congress of lobbyists from the sailors' unions and shipowners. Yet deregulation is part of his platform. The Jones Act would be a good place to start. ■



美国航运

海路茫茫

保护主义如何击沉了整个国家的商业船队

一九五六年四月，全球第一艘集装箱船“理想X号”（Ideal X）从新泽西州起航。一年后，世界首款取得商业成功的客机波音707在西雅图首飞。这两大进展大幅削减了货运和客运的成本。今天，全世界一半的民航客机仍由波音制造，但美国的航运船只数量从1960年时的占全球17%跌至如今的仅占0.4%。

这都要怪1920年通过的一部法律：《琼斯法案》（Jones Act）。该法案规定，美国国内港口之间贸易的货物必须由美国注册、美国建造的船只运载，船只所有权至少有75%归属美国公民，至少75%的船员为美国公民。飓风“艾尔玛”过后，由于符合琼斯法案规定的船只不足，总统特朗普于9月28日宣布搁置《琼斯法案》十日，以便为波多黎各提供援助。这引发了彻底废除该法案的呼声。

与绝大多数保护主义一样，《琼斯法案》令消费者遭受了重大影响。缺乏外来竞争导致沿海运输成本上升。航运咨询顾问巴兹尔·卡拉扎斯（Basil Karatzas）说，在美国建造一艘货船的成本可高达中国或韩国的五倍之多。美国交通部估计，在美国注册、雇用美国船员的船只运营成本是外国船只的两倍。

过高的海运费用将大部分货运业务推向了卡车、火车和飞机，虽然这些货运方式价格更贵，产生的碳排放也高达海运的145倍。因此，在美国只有2%的国内货运走海路，而在欧洲为40%。阿拉斯加、关岛、夏威夷和波多黎各缺乏陆上货运线路，受到的影响最为严重。举例来说，夏威夷的牧场主得定期将牲畜空运至美国大陆。波多黎各政府开发银行

（Government Development Bank for Puerto Rico）最近的一份报告发现，《琼斯法案》将该国的进口运输费用推高至周边岛国的两倍。

符合《琼斯法案》规定的船只的船东反驳说，该法案是为了帮助生产者而不是消费者。铁路公司在1920年为该法案游说，他们担心因一战而来的大量外国船只充斥市场。国家安全也被引为原因。有人提出，德国的潜艇战表明有必要规定国内商船必须由美国人建造并担任船员。但该法案实际上摧毁了美国的航运业。2000年至2016年间，符合法案规定的私营船只从193艘减至91艘。英国在1849年废除了与《琼斯法案》相当的法律，其船队的吨位如今已是美国的三倍以上。经济史学家马克·莱文森（Marc Levinson，《经济学人》前记者）指出，该法案也造成美国的集装箱船运输公司缺乏国际竞争力。受国内利润吸引，这些企业在海外业务中投入不足，因不具备同等规模而落后于海外对手。

澳大利亚、中国等国家认识到保护性法规对国内航运业的伤害，正在放松相关规定。美国却不为所动。今年1月，奥巴马政府曾试图取消《琼斯法案》的所有豁免规定。5月，特朗普否决了这一决定，但也表示，由于海员工会和船东的游说代表对国会的影响，任何进一步的豁免都会很难实现。然而放松监管是特朗普竞选政纲的一部分，《琼斯法案》会是个不错的切入口。■



Inside Saudi Aramco

Behind the veil

The world's biggest oil company has a good story to tell, if it can disentangle its image from that of the kingdom

IF SAUDI ARAMCO is a state within a state in Saudi Arabia, then the blandly named Oil Supply Planning and Scheduling (OSPAS) is its deep state. To enter it, you pass tight security at Aramco's suburban-style headquarters in Dhahran, in the east of the kingdom. The transition is eye-opening. Suddenly, English is the common tongue even among Saudi "Aramcons", as its workers are known. Female employees, their faces uncovered, lead meetings of male colleagues. The crisp banter is common to engineers everywhere. A toilet break is called a "pressure-relief" exercise.

Deep within, OSPAS is even further removed from the kingdom outside. The few executives with clearance to enter call it the "nerve centre" of the world's largest oil company. Using 100,000 sensors and data points on wells, pipelines, plants and terminals, it directs every drop of oil and cubic foot of gas that comes out of the kingdom (10% of the world's oil supply), monitors it on giant screens as it heads to ports and power stations, and tracks oil tankers as they load. Well managers in the desert outback wait daily for OSPAS to tell them what to do. "It's not just pretty graphics," an executive says, purring appreciatively over the 70-metre web of data flashing on the wall.

Because Aramco has all its "upstream" oil-and-gas operations in one country, it says it can justify investing big sums—and a lot of computer capacity—on such technology, because it helps cut costs. "ExxonMobil operates in 40-plus countries. It just can't do that," the executive adds, before apologising lest he appear to bad-mouth a client and partner, one of Aramco's American founding former shareholders.

Such comparisons will become more pertinent as Aramco opens itself up for an initial public offering (IPO). Until recently it was just as cloistered from outside scrutiny as the kingdom itself, giving it more of a mystique than a good reputation. Last month it invited *The Economist* for a visit. It only partially lifted its veil; its finances remain off-limits to everyone except the government, its only shareholder. Affable executives dodge almost every attempt to wheedle out useful ways of comparing the firm with its listed peers (it has no peers, they dissemble).

But despite the hermeticism, Aramco has a good tale to tell. Even as its rivals have retrenched owing to low prices, it has stuck to long-term plans, investing heavily in technology, training and the future of oil. Its long-term approach may help explain one mystery. For decades, Saudi Arabia's declared oil reserves have confounded the industry; since 1989 they have remained suspiciously constant at around 260bn barrels—a dozen times those of Aramco's nearest listed rival (see chart). As if to rub it in, Aramco says the kingdom has a whopping 400bn further barrels of resources that could one day become reserves.

These reserves are under audit ahead of the IPO, and executives are loth to discuss the process. However, they argue that whereas other companies have to go far to find new reserves, Aramco can keep them constant simply by better stewardship of its existing fields. Amin Nasser, the chief executive, says the company's recovery rates—the share of oil recouped from what is available in a field—average about 50%, but rise as high as 70%, compared with a global average of about 33%. It does this by maintaining the pressure of its wells over the long term through gas re-injection and other means. Raising recovery rates on average to 70% would add 80bn barrels to reserves, an executive says. That is four times ExxonMobil's latest total.

Unlike big listed companies, which scrapped growth plans when the price

of oil slumped in 2014-16, Aramco has also been able to keep on investing because of its low costs, Mr Nasser says. Increasing natural-gas output is now the main focus, but it has also raised oil production in some areas. This is visible at the vast Shaybah field in Saudi Arabia's blisteringly hot Empty Quarter, where Aramco last year upped oil output by 250,000 barrels a day (b/d) to 1m b/d, inaugurated a facility to process natural-gas liquids (pictured) and laid 650km of new pipelines across a mountain range of red sand dunes. (Aramco also set out to repopulate the surrounding desert with oryx, gazelle and ostrich hunted almost to extinction. They are now reproducing, although the first ostrich eggs to fertilise sadly cooked in the heat.)

Its second focus is technology. Whereas some of its peers admit that they squandered the chance to invest in big data during the oil boom before 2014, Aramco has no such regrets. Last year it inaugurated its home-grown "TeraPowers" technology, which uses 1trn pixel-like computational cells to simulate the flow of hydrocarbons through 500m years of geological time, enabling it to model oilfields in granular detail. From Dhahran it can remotely direct drilling of horizontal wells in Shaybah, steering a drill-bit through miles of rock to within a few feet of its target. (Royal Dutch Shell recently boasted of using similar remote-drilling technology in Argentina.) To train young employees in understanding the subsurface, Aramco has a 3D virtual-reality "cave" in Dhahran, which shows the filigree of wells 1,500 metres below the surface of Shaybah, as if from a submarine.

Third, as Saudi Arabia's most attractive employer, Aramco has less difficulty than its Western peers in attracting millennial recruits (born between around 1980 and 1996) who are turning away from the oil and gas industry. It has kept up spending on international scholarships during the slump. It plans to raise the share of women in the workforce from 25% to 40%. Its chief engineer and head of human resources are both female. Saudi labour laws still apply, however: female Aramcons may not stay overnight at an

oilfield.

Aramcos pride themselves on a Westernised culture handed down from their American forefathers before nationalisation in 1980. This makes them confident they can handle the listing. “From the way [Aramco] was built, from the beginning I would say it was ready for an IPO,” Mr Nasser says. The main change, he adds, will be issuing quarterly results.

But that underplays the challenges ahead. For one thing, Aramco is not master of its destiny. The future of the IPO, such as the decision on where and when to list, is in the hands of the government shareholder, represented by Muhammad bin Salman, the crown prince. Domestic political tension and external frictions with Qatar risk delaying the IPO until 2019—and further muddying the waters.

The potential valuation is also contentious. MBS, as the crown prince is known, has said he believes Aramco is worth \$2trn, though many analysts think that is over-ambitious. To improve its chances, the kingdom is leaning toward a listing on the New York Stock Exchange rather than in London, because America has deeper pools of capital. However, that would expose Aramco to legal risks it would prefer to avoid. In order to bring in Chinese investors, the kingdom is also considering issuing some shares in Hong Kong.

However strong Aramco may be upstream, its lower-margin refining and petrochemicals divisions will drag down the valuation. Aramco has some intriguing plans to mitigate this, hoping in the next few years to build a plant with new technology to turn crude oil directly into petrochemicals—in essence, leap-frogging refineries. But this is untested.

In sum, the IPO is more for the kingdom’s benefit than Aramco’s. It could have drawbacks—exposing the firm to investors with short time horizons

or to activists hostile to fossil fuels. But the Aramcons appear determined to make the most of it. Executives argue that oil's future is bright, even if electric cars and cleaner fuels emerge. Low costs mean there is no danger Saudi oil will become a "sunset industry", says Mohammed al-Qahtani, head of its upstream division. A listing will make Aramco "the envy of the rest of the world". ■



探秘沙特阿美 面纱背后

如能将自我形象与沙特王国脱离，这家世界最大的石油公司将大有可为

如果说沙特阿美石油公司（Saudi Aramco）是沙特阿拉伯的国中之国，那么名字平淡无奇的“石油供应规划与调度中心”（以下简称 OSPAS）就是该公司的“隐秘政府”。在沙特王国东部的达兰市（Dhahran），平平无奇的沙特阿美总部内，你必须经过严密的安检才能进入 OSPAS。一旦进入，风格的突变令人大开眼界。转眼之间，英语成了通用语言，即使是人称沙特籍“阿美人”的员工们也用英语交流。女员工不蒙面纱，带领男同事开会讨论问题。工程师们的逗趣说笑随处可见。上厕所被称为“减压”行动。

深入内部来看，OSPAS 更是远远有别于外面的王国。少数有权限进入其中高管把它称为这家世界最大石油公司的“神经中枢”。通过安装在油井、输油管、炼油厂及码头的十万个传感器和取值点，OSPAS 调配着沙特王国出产的每滴石油和每立方英尺天然气（占全球石油供应量的 10%）的去向，在巨型屏幕上监控油气输向港口及发电厂，追踪油轮装运原油。位于沙漠腹地的油井管理人员每天等候 OSPAS 的命令行事。“这可不只是些好看的图表。”面对密密麻麻闪烁的 70 米长的数据墙，一位高管轻声赞叹。

由于公司所有的“上游”油气业务都在沙特，沙特阿美表示对上述技术投入巨额资金及大量计算能力是合理的做法，因为这有助降低成本。“在 40 多个国家开展上游业务的埃克森美孚就不能这样做。”这位高管补充道。随后他表示歉意，以免自己好像是在说这家公司的坏话。这家美国公司是沙特阿美的客户和合伙人，也是其前创始股东之一。

随着沙特阿美准备首次公开募股（IPO）而对外公开其面目，这种比较会变得更加重要。直到最近，这家公司还像沙特王国本身那样隐秘隔绝，让外人难以了解，而这带来的是一种神秘感而非良好声誉。上月，该公司邀请《经济学人》参观访问。但这也只是揭起了面纱的一角，财务情况仍是禁地，只对沙特政府也就是它唯一的股东披露。高管们和蔼可亲，但无论

记者如何尝试打探有用的信息来比较沙特阿美和其上市的同业，他们总是顾左右而言他，敷衍着说自家公司无人可比。

尽管如此讳莫如深，沙特阿美还是有精彩故事可讲。在对手因油价下跌而减少投资之时，沙特阿美仍坚持实施长期规划，大力投资石油方面的技术、培训和未来储量。这种长远战略有助于解释一大谜团。数十年来，沙特阿拉伯宣称的石油储量一直令业界困惑：自1989年以来它们奇异地保持在每年约2600亿桶的水平——是与沙特阿美最接近的上市对手的十多倍（见图表）。仿佛是要火上浇油似的，沙特阿美表示，沙特还有惊人的4000亿桶资源有待勘探，这些最终将成为其石油储量。

这些储量数字正在接受IPO前的审计，高管们对此过程不愿多谈。但他们认为，其他公司必须四处探寻新储量，沙特阿美却只需改善对现有油田的操作便可保持储量稳定。首席执行官阿敏·纳瑟尔（Amin Nasser）表示，公司的采收率（开采出的石油占油田地质储量的比例）平均为50%左右，但最高达70%，相比之下，全球的平均水平约为33%。沙特阿美通过天然气回注及其他方法来长期保持油井压力，从而获得高采收率。一位高管说，如果把平均采收率提高至70%，将增加800亿桶的石油储量。这是埃克森美孚最新总储量的四倍之多。

纳瑟尔表示，2014年至2016年油价下滑期间，大型上市油企纷纷放弃了扩展计划，而沙特阿美由于成本低，仍能持续投资。公司如今着重提高天然气产量，同时也在一些地区提高了石油产量。在热浪如火的沙特鲁卜哈利沙漠（Empty Quarter），广阔的谢巴赫油田（Shaybah）印证了这一切。沙特阿美去年把那儿的石油日产量提高25万桶，达到100万桶，同时启用了处理液化天然气的新设施（见上图），并且跨越连绵的红沙丘铺设了650公里长的新管道。（沙特阿美还着手在周围沙漠中恢复剑羚、瞪羚及鸵鸟等几乎被猎杀灭绝的种群数量。它们目前正在繁殖中，但首批受精待孵的鸵鸟蛋不幸被热浪烤熟了。）

沙特阿美的第二个重心是技术。一些同行承认浪费了大好时机，没在2014年前的石油繁荣期投资大数据，而沙特阿美没有这样的遗憾。去年，该公

司启用了自己研发的“TeraPowers”技术，使用一万亿像素的计算单元来模拟油气在五亿年地质时间内的流动，从而对油田状态精细建模。公司可以在达兰远程控制位于谢巴赫的水平油井，操作钻头穿越几英里的岩石到达距离目标几英尺的范围内。（皇家荷兰壳牌公司最近也宣称在阿根廷运用类似的远程钻探技术。）为培训年轻员工了解地质状况，沙特阿美在达兰设有一个3D虚拟现实“洞穴”，以潜艇般的视角呈现谢巴赫地面以下1500米深处油井的细致构造。

第三点，作为沙特阿拉伯最具吸引力的雇主，沙特阿美在吸引对油气行业不感兴趣的千禧世代（在1980年左右至1996年间出生）这方面没有西方同行那么困难。它在油价低迷期间仍保持资助国际奖学金。公司计划提高女性在员工队伍中的比例，从目前的25%提高至40%。其总工程师及人力资源部总监均为女性。不过还是会遵循沙特的劳动法：沙特阿美的女员工不能在油田过夜。

在1980年国有化之前，由美国先辈建立的西化的文化在公司里传承下来，阿美人以此为傲。这使他们自信能处理好此次上市。“从（沙特阿美）创建的方式看，我认为公司一开始就准备好上市了。”纳瑟尔说。主要变化将在于发布季度业绩报告，他补充道。

然而，这淡化了未来的挑战。一方面，沙特阿美无法主宰自身命运。这次IPO的安排（例如在何时何地上市）掌握在以王储穆罕默德·本·萨勒曼（Muhammad bin Salman）为代表的政府股东手上。国内政局紧张加上与卡塔尔的外部摩擦可能导致IPO推迟至2019年进行，并使局势更加复杂。

潜在估值也备受争议。人称MBS的王储曾表示相信沙特阿美价值两万亿美元，但许多分析师认为那是高估了。为争取高价上市，沙特倾向在纽约证券交易所而非伦敦上市，因为美国的资本更为雄厚。但这样会使沙特阿美面对原本希望避免的法律风险。为吸引中国的投资者，沙特也正考虑在香港发行部分股份。

无论沙特阿美的上游业务有多强大，其低利润的炼油及石化部门还是会拉低估值。沙特阿美已有多个耐人寻味的计划来缓解问题，寄望未来几年建成一家工厂，用新技术把原油直接转化为石化产品——实质上就是跳过炼油这一步。但这还未经验证。

总的来说，这次IPO更多是出于沙特王国的利益，而不是为了沙特阿美。它可能带来不利影响——令该公司面临短线投资者或反化石燃料人士的攻击。但沙特阿美似乎信心坚定地要充分利用这次上市的机会。高管们认为，虽然电动汽车和更清洁的燃料渐渐浮现，石油业仍然前景光明。上游业务主管穆罕默德·卡塔尼（Mohammed al-Qahtani）说，低成本意味着沙特石油不会成为“夕阳产业”。上市将令沙特阿美成为“全球艳羡的对象”。■



Economic and financial indicators

Economic outlook

The Economist's latest poll of forecasters, October



经济与金融指标

经济前景

《经济学人》10月对各家预测机构的最新调查



Free exchange

Think again

The teaching of economics gets an overdue overhaul

ECONOMISTS can be a haughty bunch. But a decade of trauma has had a chastening effect. They are rethinking old ideas, asking new questions and occasionally welcoming heretics back into the fold. Change, however, has been slow to reach the university economics curriculum. Many institutions still pump students through introductory courses untainted by recent economic history or the market shortcomings it illuminates. A few plucky reformers are working to correct that: a grand and overdue idea. Overhauling the way economics is taught ought to produce students more able to understand the modern world. Even better, it should improve economics itself.

The dismal science it may be, but economics is popular on campus. It accounts for more than 10% of degrees awarded at elite universities each year, by one estimate, and many more students take an introductory class as part of their general-education requirements. Teachers of such courses aim to grab the attention of their glassy-eyed audience, to acquaint students with the basics of the subject and, ideally, to equip them to apply economic reasoning to the real world. Economics teaches that incentives matter and trade-offs are unavoidable. It shows how naive attempts to fix social problems, from poverty to climate change, can have unintended consequences. Introductory economics, at its best, enables people to see the unstated assumptions and hidden costs behind the rosy promises of politicians and businessmen.

Yet the standard curriculum is hardly calibrated to impart these lessons. Most introductory texts begin with the simplest of models. Workers are paid according to their productivity; trade never makes anyone worse off;

and government interventions in the market always generate a “deadweight loss”. Practising economists know that these statements are more true at some times than others. But the all-important exceptions are taught quite late in the curriculum—or, often, only in more advanced courses taken by those pursuing an economics degree. Other disciplines are also taught simply at first. New physics students learn mechanics through models stripped of all but the simplest elements. The risk is low, however, that a student who drops a physics course will think he lives in a frictionless vacuum.

Students pay \$300 or more for textbooks explaining that in competitive markets the price of a good should fall to the cost of producing an additional unit, and unsurprisingly regurgitate the expected answers. A study of 170 economics modules taught at seven universities found that marks in exams favoured the ability to “operate a model” over proofs of independent judgment.

The CORE project (for Curriculum Open-access Resources in Economics) seeks to change all this. It sprang from student protests in Chile in 2011 over the perceived shortcomings of their lessons. A Chilean professor, Oscar Landerretche, worked with other economists to design a new curriculum. He, Sam Bowles, of the Santa Fe Institute, Wendy Carlin, of University College London (UCL), and Margaret Stevens, of Oxford University, painstakingly knitted contributions from economists around the world into a text that is free, online and offers interactive charts and videos of star economists. That text is the basis of economics modules taught by a small but growing number of instructors.

“The Economy”, as the book is economically titled, covers the usual subjects, but in a very different way. It begins with the biggest of big pictures, explaining how capitalism and industrialisation transformed the world, inviting students to contemplate how it arrived at where it is today.

Messy complications, from environmental damage to inequality, are placed firmly in the foreground. It explains cost curves, as other introductory texts do, but in the context of the Industrial Revolution, thus exposing students to debates about why industrialisation kicked off when and where it did. Thomas Malthus's ideas are used to teach students the uses and limitations of economic models, combining technical instruction with a valuable lesson from the history of economic thought. "The Economy" does not dumb down economics; it uses maths readily, keeping students engaged through the topicality of the material. Quite early on, students have lessons in the weirdness in economics—from game theory to power dynamics within firms—that makes the subject fascinating and useful but are skimmed over in most introductory courses.

Teaching the CORE curriculum feels like doing honest work, says Rajiv Sethi, of Barnard College, who contributed to the CORE textbook. Academic economists do not hide from students the complications they grapple with in their own research. Homa Zarghamee, also at Barnard, appreciates having to spend less time "unteaching", ie, explaining to students why the perfect-competition result they learned does not actually hold in most cases. A student who does not finish the course will not be left with a misleading idea of economics, she notes.

| *Esprit de CORE*

Early results are promising. Assessments at UCL found that CORE students performed better in subsequent intermediate courses than non-CORE counterparts. Anecdotally, at least, students seem more engaged in CORE courses and graduate assistants less pained by the prospect of teaching them.

The hopes for CORE are much more ambitious than simply providing non-economists exposed to the material with a clearer idea of what economics is all about. The new curriculum may also help departments retain

students drawn to economics as a way to understand the world's great challenges, and not simply as a place to play with elegant models. That could mean, eventually, a broader array of perspectives within economics departments, bigger and bolder research questions—and fewer profession-shaking traumas in future. ■



自由交流

重新思考

经济学教学迎来迟来的变革

经济学家这群人有时会高傲自大，不过十年来的创伤让人洗心革面。他们已开始反思旧观念，提出新问题，偶尔还会欢迎离经叛道者重回阵营。然而这种改变久久未能抵达大学的经济学课堂。很多院校仍旧通过导论课向学生灌输知识，而课程的内容丝毫未受近年的经济史以及这段历史彰显的市场缺陷的影响。一些勇敢的改革者正在努力修正这个问题——这是一个重大的尝试，也早该被提出。彻底改变经济学的教学方法应该会培养出更能理解现代社会的學生，甚至应该会提升经济学学科本身。

经济学或许沉闷，但在大学校园中却很受欢迎。一项估算显示，精英大学每年授予的学位中，经济学方向的占比超过10%。还有更多的学生为了满足通识教育的要求而修习一门经济学导论课。这些课程的教师力求抓住那些目光涣散的学生的注意力，努力让学生了解经济学的基本知识，最好还能让他们在现实世界中应用这些理论。经济学告诉人们，激励很重要，权衡不可避免，而尝试解决从贫困到气候变化的各种社会问题的天真举动可能会产生意料之外的后果。在最好的情况下，经济学导论能够让人们看出，在政客和商人给出的美好许诺的背后，存在着未被言明的假设和隐性成本。

然而标准化的经济学课程几乎没有做什么调整来传授这些知识。大多数导读类教科书都以最简单的模型开篇：工人的报酬与其生产率挂钩；贸易总是让人受益；政府对市场的干预总会造成“无谓损失”。实践派经济学家明白，这些说法只在某些时候是正确的。但那些十分重要的例外却在课程相当靠后的阶段才被提及，或者常常只在攻读经济学学位的学生修读的高级课程中出现。其他学科一开始教的内容也很简单，比如物理学专业的新生就是通过只保留了最简单元素的模型来学习力学的，但一个中途退出这门课的学生不太可能会以为自己生活在一个无摩擦的真空中。

学生们花300美元或更多的钱买来的教科书这样写道：在竞争性市场中，商品的价格应该会降到再生产一件商品所需的成本的水平。而毫不意外地，学生们只会机械地重复标准答案。对七所大学的170个经济学教学模块的研究发现，在考试中，具备“操作一个模型”的能力的学生比显示出独立判断能力的学生更容易拿到好分数。

一个名为CORE的项目力图改变所有这些问题。CORE是“Curriculum Open-access Resources in Economics”的缩写，意为“经济学开放资源课程”。它源于2011年智利学生因其经济学课程中存在的缺陷而发起的抗议。智利教授奥斯卡·兰德雷切（Oscar Landerretche）同其他经济学家合作设计了一套新的课程。他和圣达菲研究所（Santa Fe Institute）的萨姆·鲍尔斯（Sam Bowles）、伦敦大学学院（UCL）的温迪·卡琳（Wendy Carlin）、牛津大学的玛格丽特·斯蒂文斯（Margaret Stevens）一道，将世界各地经济学家的供稿精心汇编成一本免费的在线教科书，其中包含交互式图表和明星经济学家的视频。该教材已成为一些教学模块的基础，讲授它的教师还不多，但在不断增加。

这本教材名字很简洁，就叫《经济》，涵盖的也是常规主题，不过讲解的方式非常不同。它首先着眼于最为广阔的全局，解释了资本主义和工业化如何改变了世界，邀请学生思索世界何以发展成今天的状貌。从环境破坏到不平等，各种棘手的复杂问题在课本中稳稳地占据最突出的位置。和其他导读类教材一样，这本书也讲解了成本曲线，不过是在工业革命的背景之下。这样一来，学生们就接触到了工业革命为何在彼时彼地发生的辩论。该书利用托马斯·马尔萨斯（Thomas Malthus）的理论来让学生了解经济学模型的用处和局限，将技术指导与经济思想史中宝贵的一课结合了起来。《经济》并没有降低经济学课程的难度：数学的应用在其中俯拾皆是，它是通过材料的话题性来保持学生的兴趣。学生们很早就学习了经济学中稀奇古怪的理论，例如博弈论和公司内的权力动态等等。这些内容让经济学这门学科既引人入胜又很实用，而它们在大多数导读课程中都被草草带过了。

巴纳德学院（Barnard College）的拉吉夫·赛蒂（Rajiv Sethi）说，教授

CORE课程感觉是在做一项诚实的工作。他也参与编写了这本教科书。学术经济学家不向学生隐瞒自己在研究中遭遇的复杂难题。同在巴纳德学院的霍玛·扎加梅（Homa Zarghamee）庆幸自己不需要花太多时间让学生“忘记所学”，也就是向他们解释为什么他们学到的完全竞争在大多数情况下都不成立。她指出，学生就算没能完成课程的学习，也不会带着对经济学的错误理解离开。

| CORE的精神

该项目取得了喜人的初步成果。伦敦大学学院经评估发现，参加CORE项目的学生在随后中级课程中的表现优于没参加的学生。至少有传闻称，学生们对CORE课程更感兴趣，而研究生助教们想到以后要教这些课程也不会那么痛苦。

CORE项目可不只是为了让学习这些材料的非经济学家对经济学的要义有更清晰的认识，人们对其寄予的希望要比这高远得多。这套新课程也许还能帮助经济系留住那些想来这里理解世界面临的重大挑战而不只是摆弄优雅模型的学生。最终，这会让经济系内充满多种观点的争鸣，研究人员也可能会去探究更重大、更大胆的问题，未来撼动这个职业的创伤或许也会减少。■



American economic history

A dance to the markets of time

How America's pilgrims made progress

BHU SRINIVASAN'S new book, "Americana", is a delightful tour through the businesses and industries that turned America into the biggest economy in the world. Not only is the book written in a light and informative style, it is cleverly constructed. Each chapter has a theme—tobacco, cotton, steam, oil, bootlegging, mobile telephones and so on—and these themes are organised to lead the reader through a chronological history of the American economy.

Along the way, there is plenty of surprising detail. Until the first world war, for example, the Busch family (who produced Budweiser beer) held a big annual celebration for the Kaiser's birthday. Bill Levitt, the builder who pioneered the post-1945 shift to suburban living, was one of many who refused to sell homes to African-Americans. To finance their new company, Apple Computer, Steve Jobs and Steve Wozniak respectively sold a VW minibus and a Hewlett-Packard calculator.

But Mr Srinivasan, himself an immigrant who became an entrepreneur, never lets the detail interfere with the bigger picture. As he notes, European settlement in America was originally driven by commercial imperative. In 1606 the British chartered the Virginia Company of London as a profit-seeking operation; an early version of "venture capital". The pilgrims on the *Mayflower* (pictured) were backed by English financiers.

Commerce played a decisive part in setting the course of American history. The first settlers struggled but eventually a lucrative business was found; growing and exporting tobacco in the southern states. But the early planters developed a taste for luxuries, placing them in debt to English creditors.

That proved to be one source of resentment towards the colonial power; another irritation was British efforts to earn some revenue after the expense of the Seven Years' War (1756-63), which ended French attempts to control the continent. The result, inevitably perhaps, was the American war of independence.

The plantation economy developed in the southern states, and the initial political dominance of Virginia (which provided four of America's first five presidents) ensured the continued survival of slavery in the newly independent country. By 1860 auction prices suggested that the collective value of American slaves was \$4bn at a time when the federal government's annual budget was around \$69m. That explains both why southern slaveowners, many of whom had borrowed against their slaves as collateral, would never give up the practice, and why a financial settlement of the issue was out of the question.

The resulting civil war hastened the industrialisation of the northern states, which owed their victory, in part, to their greater economic strength. In the late 19th century American companies were able to exploit the economies of scale that came from trading over a continent-wide country. This allowed them to overtake their British and German rivals.

In time, the growth of these industrial giants, or trusts as they were known, led to another political spat, as a Republican president, Theodore Roosevelt, tried to challenge monopoly power. It was under the first Roosevelt that America pulled decisively away from a laissez-faire approach, setting up the Pure Food and Drug Act and the Federal Meat Inspection Act to protect consumers. A much bigger shift occurred under his relative, Franklin Roosevelt, who pursued aggressive policy intervention and established a welfare system in the course of the Great Depression.

As Mr Srinivasan observes, American capitalism has always had a strong input from the state: the tariffs that shielded industry in the 19th century; the military expenditure that helped develop radio, satellites and the internet; farm subsidies; the federal guarantees for bank deposits and home loans; and so on. “It was an endlessly calibrated balance between state subsidies, social programmes, government contracts, regulation, free will, entrepreneurship and free markets,” he writes. In short, American economic history is more complex than some ideologues seek to portray it; this excellent book gives readers a fully rounded picture. ■



美国经济史

与市场合拍的舞蹈

赴美朝圣者的进程

布·斯里尼瓦桑（Bhu Srinivasan）的新书《美国史》引领读者回顾了让美国成为世界最大经济体的工商业发展。这是一次愉悦的旅程。本书笔调轻松、内容翔实，而且构思巧妙。每一章都有一个主题——烟草、棉花、蒸汽、石油、制贩私酒和移动电话等，这些主题的编排是为引导读者了解美国经济的编年史。

在这趟旅程中，读者会获知许多令人惊讶的细节。例如，直到第一次世界大战爆发之前，生产百威啤酒的布希家族每年都会隆重庆祝德国皇帝的生日。建筑商比尔·莱维特（Bill Levitt）在1945年后引领了搬往郊区居住的潮流，却也是拒绝将房子卖给非裔美国人的众多房产商之一。为了筹钱创办苹果电脑公司，史蒂夫·乔布斯卖掉了自己的大众小巴，史蒂夫·沃兹尼亚克（Steve Wozniak）卖掉了一台惠普计算器。

但斯里尼瓦桑（本身是移民，而后成为一名企业家）从不会让细节影响对全局的描绘。他指出，欧洲对美洲的殖民最初是由商业上的迫切需求所驱动。1606年，伦敦弗吉尼亚公司（Virginia Company of London）获英王特许从事营利性运作——一种早期版本的“风险资本”。“五月花”号上的朝圣者（如图）是由英国的金融资本家资助的。

在确定美国历史的走向上，商业起了决定性的作用。第一批殖民者举步维艰，但最终找到了一门利润丰厚的生意——在南方各州种植烟草并出口。但早期的种植者爱上了奢侈品，这让他们欠了英国人的债。这一点最终成为了他们怨恨英国殖民统治的根源之一。而另一个刺激因素是，英国经过开支不菲的“七年战争”（1756年至1763年），终于让法国控制美洲大陆的企图落空，此后英国力图从殖民地赚回一些收入。这可能无可避免地导致了美国独立战争的爆发。

在南部各州发展起来的种植园经济以及弗吉尼亚州最初的政治主导地位（美国前五任总统中有四位出自该州）确保了奴隶制在美国这个新独立的国家中继续存在。到1860年，拍卖价格显示美国奴隶的价值总计40亿美元，而当时联邦政府的年度预算约为6900万美元。从中可看出为什么南方奴隶主（其中许多人抵押奴隶来贷款）绝不会放弃奴隶制，而且这个问题不可能通过财政手段来解决。

在由此引发的内战中，北方取得的胜利部分要归功于其较强的经济实力。而内战又加速了北方各州的工业化进程。19世纪末，美国公司得以利用在整个美洲大陆开展贸易的规模经济。这使它们能够超越英国和德国的对手。

随着时间的推移，这些工业巨头（被称为“托拉斯”）的发展引发了又一次政治争端：共和党总统西奥多·罗斯福（Theodore Roosevelt）试图挑战垄断势力。在这第一位罗斯福总统的任内，美国果断摒弃了放任主义的做法，制定了《纯净食品与药品法案》（Pure Food and Drug Act）和《联邦肉类检验法案》（Federal Meat Inspection Act）以保护消费者。而在他的亲戚富兰克林·罗斯福（Franklin Roosevelt）任内发生的变化还要大得多：这位总统推行积极的干预政策，并在经济大萧条期间建立起了福利制度。

正如斯里尼瓦桑指出的，美国的资本主义一向都有来自政府的强有力的投入：19世纪时保护工业的关税、帮助发展了广播、卫星和互联网的军费开支、农业补贴、联邦对银行存款和住房贷款的担保等等。他写道：“这是国家补贴、社会项目、政府合同、监管、自由意志、企业家精神和自由市场之间不断校准的平衡。”总之，美国经济史比一些思想家试图描绘的更为复杂，这部优秀的著作为读者展现了一幅完整而全面的图景。■



Schumpeter

Big tech, big trouble

What if large tech firms were regulated like sewage companies?

THREE-QUARTERS of Americans admit that they search the web, send e-mails and check their social-media accounts in the bathroom. That is not the only connection between tech and plumbing. The water and sewage industry offers clues to the vexed question of how to regulate the Silicon Valley “platform” firms, such as Alphabet, Amazon and Facebook. The implications are mildly terrifying for the companies, so any tech tycoons reading this column might want to secure a spare pair of trousers.

In America and in Europe a consensus is emerging that big tech firms must be tamed. Their dominance of services such as search and social media gives them huge economic and political clout. The \$3trn total market value of America’s five biggest tech firms (Apple and Microsoft are the other two) suggests that investors believe they are among the most powerful firms in history, up there with the East India Company and Standard Oil.

Trustbusters in need of instant gratification want to break up the companies, but this might make their services less useful (imagine having ten social-media accounts), and network effects might mean that one of the tiddlers would grow dominant again. Others want tech firms to license their patents for nothing, as AT&T was required to do in 1956. This might create startups tomorrow, but will not stop firms exploiting monopolies today.

An alternative is to regulate these companies like utilities—monopolies with high market shares that provide an essential service from which it is expensive for consumers to switch. Here, the water industry is relevant, particularly the concept of a regulated asset base (RAB). It emerged in the

1990s when Britain was privatising its water firms, borrowing elements from American regulation. It is an acronym that few in Silicon Valley are aware of. But from these obscure origins RAB frameworks are now common in Europe and Latin America, used to regulate at least \$400bn-worth of power, airport, water and telecoms assets.

The idea is that the monopolist's profits should not exceed the level that a competitive market would allow. That means estimating the cost to an imaginary new entrant of replicating the incumbent's assets (this is the RAB) and calculating the profits the newcomer would make if its returns matched its cost of capital. The actual monopoly's earnings should not exceed this amount. Safeguards are added to ensure the utility is run efficiently, keeping costs low. Regulators review the framework every few years.

How might utility-style regulation work for Silicon Valley firms? Consider a thought experiment with Facebook. Its 1.3bn users pay nothing, but give it their data and control over the adverts they see. Facebook then sells advertisers targeted access to its users, pulling in \$27bn last year. Imagine that the service were "unbundled", giving users control. All would own their data and could choose whether to sell them to advertisers. They would also have to pay Facebook a fee to compensate it for the cost of creating and operating the network.

The big question is how much compensation—profits—Facebook and other firms would deserve if they were treated as utilities. It is possible to get a rough idea. Assume a cost of capital of 12%—a high figure to reflect the risk inherent in tech firms' models. Estimating their RABs is harder. They have some physical assets such as data centres, but unlike utilities their main resources are not pylons, pipes and property, but software and ideas that they create or acquire by buying rivals. Only some of these intangibles appear on their balance-sheets; the vast sums spent on research and

development (R&D) do not. But you can reconfigure their balance-sheets as if all their R&D in the past had been recognised as an asset with a 20-year life. Alphabet and Facebook would have a combined RAB of \$160bn. If their returns were capped at 12%, operating profits would fall by 65% and 81% respectively.

If their services were unbundled, users would benefit. Using figures from 2016, the average Facebook user would pay \$15 a year to the firm for its return on its RAB, but they would pocket \$23 from selling advertisers their data and the right to be advertised to. A Google user would pay \$37 a year to Google, but collect \$45 from advertisers. Those are fairly small sums, but richer users with particularly valuable data could make much more.

| *Bog standard*

Regulating tech like water would cause an outcry among investors and in Silicon Valley. Yet some of the objections do not stack up. Essential investment would still happen—a guaranteed 12% return is a handsome reward. The firms could invest in new technologies that would remain outside the regulated utility. It would be possible to work out which assets sit abroad and exclude them from the RAB, or to reach arrangements with foreign regulators.

This approach would have shortcomings, though. Tech moves at the speed of light compared with conventional utilities. It was only five years ago that investors worried that Facebook would struggle with the shift to mobile phones. Regulators would be clumsy at coping with rapid change. And a RAB methodology would not resolve the incendiary issue of whether tech platforms should be responsible for what they publish.

Despite such problems, tech bosses should view regulation as utilities as a long-term risk. They have two defences. First, to bundle their services so tightly that it is impossible for outsiders to isolate the products that are

monopolies and work out their profits and assets. Amazon is a master here. It is unclear how much it makes or has invested in e-commerce (where it is dominant), videos (where it is a challenger), or food (where it is a new entrant).

The second defence is to lobby Washington. The lesson from America's veteran oligopolists—airline, telecoms and health-care companies—is that you can manipulate and dance around the regulatory system to ensure high profits. For tech firms, financial obfuscation and cronyism are the most effective ways to ensure their monopoly profits do not go down the drain. ■



熊彼特

大科技公司，大麻烦

如果像监管污水处理公司那样监管科技巨头，会怎样？

四分之三的美国人承认他们会在卫生间里上网搜索、发电子邮件，或查看社交媒体账号。这可不是科技与水管之间唯一的联系。如何监管诸如Alphabet、亚马逊及Facebook这样的硅谷“平台”公司是一个棘手的问题，而供水及污水处理行业为此提供了借鉴。这种借鉴会让这些公司轻度受惊，因此任何正在阅读本文的科技大亨可能都需要准备一条毛巾擦擦冷汗。

在美国和欧洲，人们正达成一项共识，那就是必须“驯化”大型科技公司。大公司在搜索及社交媒体等服务上的主导地位给它们带来了巨大的经济和政治影响力。上述三家公司再加上苹果和微软，美国这五大科技巨头的总市值达3万亿美元，这表明投资者相信它们与东印度公司和标准石油公司一样，位居史上最强公司之列。

那些追求一时之快的反垄断者想要肢解这些大公司，但这可能会令它们提供的服务变得不那么有用（试想你有十个社交媒体账号）。同时，网络效应可能会让某家小公司重新成长为垄断者。另一些人希望科技公司准许其他公司免费使用它们的专利，就像1956年对AT&T要求的那样。这种做法也许会在未来产生许多新公司，但却不能阻止现有的科技公司利用自己的垄断地位。

另一种做法就是像监管公用事业那样监管这些公司。公用事业公司是拥有高市场份额的垄断企业，提供最重要的生活服务，消费者如果要切换到别家代价很高。其中水务行业可以提供很好的借鉴，特别是“监管资产基数”（regulated asset base，以下简称RAB）这个概念。20世纪90年代，英国对水务公司实行私有化，从美国的监管中借鉴了部分元素，这一概念应运而生。RAB这个缩写在硅谷还鲜为人知。尽管起源不甚显赫，但RAB机制目前在欧洲和拉丁美洲大行其道，监管着价值至少4000亿美元的电

力、机场、水务以及电信等领域的资产。

RAB的理念是垄断企业的利润不应超过一个竞争市场允许的水平。也就是说，假设现在有一家新公司要进入一个垄断行业，它若要取得和现有公司一样的资产水平（即RAB），估计需要付出多少成本？然后再计算这家新公司赚取的回报若要达到其资本成本，利润额需为多少？而现有的这家垄断公司的收益不应超过这个数目。另外还会增加一些措施以确保这家公司高效运转，同时维持低成本。监管机构每隔几年就会重新审查这个机制。

公用事业型的监管如何施加于硅谷企业？用Facebook做一个假想试验。13亿用户在免费使用Facebook的同时，也将他们的数据和看什么广告的控制权交给了Facebook。之后Facebook便让广告主可以对其用户精准投放广告，去年以此吸金270亿美元。试想如果这项服务是“非捆绑”的，控制权在用户自己手里。所有人都拥有自己的数据，并且可以选择是否将它们卖给广告主。不过他们同时也必须向Facebook付费，以补偿它建立及运营网络的成本。

但关键问题是，如果把Facebook等公司当作公用事业公司来对待，那么它们应得的补偿（即利润）是多少？我们可以知道个大概。假定资本成本为12%——这个高数值是为体现科技公司经营模式中固有的风险。估算它们的RAB要更困难一些。这类公司也有一些数据中心之类的有形资产，但与公用事业公司不同的是，它们的主要资源不是电塔、管道或房产，而是软件和创意——或是由它们自己创造，或是通过收购竞争对手获得。这些无形资产只有一部分会出现在它们的资产负债表里，而花在研发上的巨额费用并不在其中。但是如果将它们过去所有的研发成本认定为一笔有效期为20年的资产，你就可以重构它们的资产负债表。Alphabet和Facebook的RAB加在一起应该有1600亿美元。如果把它们收益率限定为12%，那它们的营业利润会分别下降65%和81%。

假设它们的服务为非捆绑式的，那么受益的将会是用户。根据2016年的数据，Facebook用户人均每年需要向该公司支付15美元以实现该公司RAB的

收益，但通过向广告主出售数据以及授予对方向自己推送广告的权利，他们会有23美元的进账。谷歌用户每年需要向谷歌人均支付37美元，却可以从广告主那里得到45美元。这些都是很小的数目，但是那些拥有尤其宝贵的数据的富有用户收入会多得多。

| 常规做法

如果像监管水务一样监管科技，势必会在投资者和硅谷中引发强烈抗议。不过其中一些反对的理由站不住脚。必要的投资还会继续，毕竟12%的稳赚收益还是很不错的回报。公司可以投资于仍处于监管范围之外的新科技。它们也会琢磨出将哪些资产配置在海外并将其排除在RAB之外，或者与国外的监管部门达成协议。

然而该方法也有缺陷。和传统的公用事业相比，科技企业几乎是以光速在变化。仅仅五年前，投资者还在担心Facebook能否成功向移动端转移。面对日新月异的变化，监管部门常常手忙脚乱。而单靠一个RAB机制无法解决那个轻易就能引发争议的问题：科技平台是否应该对其发布的内容负责？

尽管存在这些问题，科技公司的大佬们还是应该将这种公用事业型监管视为一项长期风险。他们有两招来防御。第一，将他们的各项服务牢牢捆绑在一起，让局外人无法将那些垄断产品剥离开来并计算出它们的利润和资产。亚马逊就精于此道。人们不清楚它在其主导的电子商务领域、发起挑战的视频领域或新近进军的食物领域究竟分别赚了多少钱、投资了多少钱。

第二招是对联邦政府进行游说。美国老牌寡头垄断企业（如航空、电信以及医疗保健等公司）提供的经验是，你可以通过操纵监管系统和在其中闪躲腾挪来保证高利润。对科技公司来说，财务上的模糊处理以及裙带关系是保证它们的垄断利润不付诸东流的最有效方式。■



Green bonds

Bounding along

Questions about standards bedevil a fast-growing young market

WHEN Donald Trump announced America's withdrawal from the Paris climate agreement on June 1st, he spelled out that it would no longer contribute to the Green Climate Fund. This is a UN initiative to use rich countries' money to bring climate finance to developing ones. But even if the fund were going swimmingly, public-sector finance would only be able to provide a small part of the cash needed by poor countries, and indeed the world.

Private markets, however, are mobilising—notably that for “green bonds”, which tie the proceeds of bond issues to environmentally friendly investments. The market started a decade ago with issues from municipalities and multilateral development banks, worth just a few hundred million dollars annually.

By 2016 issuance had grown to \$97bn, of which \$32bn came from China alone; SEB, a Swedish bank, reckons volumes may hit \$125bn this year. Public-sector issuers together accounted for only around 30% of the total last year. The largest portion, over 35%, was issued by financial institutions; around 20% came from other companies. Investor demand, too, is booming. Zurich Insurance, a Swiss insurer, has already invested over \$1.2bn in green bonds, with plans to reach \$2bn; BlackRock and other asset managers have set up dedicated green-bond funds.

As for the proceeds, over 40% is used to finance clean energy; nearly 25% buildings and industry; and over 10% transport. But definitions of what counts as “green” vary widely. Initially, this judgment was made by the World Bank's environment department, or, for some of the first private

issues, by the issuer itself.

Over 130 of the world's largest banks and asset managers have since signed up to the Green Bond Principles, guidelines that specify what is green, stipulate reporting requirements and recommend the use of external reviewers. One option is certification offered by the Climate Bonds Initiative (CBI), an NGO. Others opt to get a second opinion from a specialised environmental consultancy such as Vigeo Eiris, or from a large auditor like EY or KPMG. The CBI reckons 85% of bonds issued in 2017 have undergone an external review.

Standards still vary widely, however. China's central bank, for instance, has its own standards for the Chinese market. Unlike the Principles or the CBI, for example, it regards investments in "clean coal" as green. India and ASEAN, a club of South-East Asian countries, are also working on their own rules. The WWF, a conservation NGO, has warned that the lack of a single standard opens up the risk of "greenwashing". Doubts about standards were highlighted recently when Lombard Odier, an asset manager, launched a climate-bond fund. It has set up its own assessment process and excluded a quarter of "green" bonds, citing insufficient reporting.

Progress is being made, however. Sean Kidney, head of the CBI, points out that China wants to harmonise its standards more closely with global ones. The Green Bond Principles are constantly refined, with the latest version due out this month. Credit-rating agencies are venturing into the business. Both Moody's, last year, and S&P Global, this April, have launched green-evaluation services. These resemble the conventional credit ratings the firms offer in that they will grade bonds on a scale of greenness rather than give a yes-no ruling. If they win market share, a binary judgment on what counts as "green" could evolve into a more nuanced debate on degrees of environmental impact. ■



绿色债券

踉跄前行

关于标准的问题困扰着快速增长的年轻市场

6月1日，唐纳德·特朗普宣布美国退出巴黎气候协议，明确表示不再为绿色气候基金投款。这一基金是联合国利用富裕国家的钱来为发展中国家提供气候融资的一项举措。但即使该基金运转顺利，公共部门也只能为贫穷国家乃至世界提供所需现金的一小部分。

不过，私人市场正在动员起来，特别是将债券发行收益与环保投资相结合的“绿色债券”。市场十年前就开始出现市政和多边开发银行发行的债券，不过价值仅为每年几亿美元。

到2016年，此类债券发行量已经达到970亿美元，其中320亿美元来自中国；瑞典的北欧斯安银行（SEB）估计今年发行量可能达到1250亿美元。公共部门发行人合计仅占去年总额的30%左右。最大的一块超过35%，是由金融机构发行的，另有约20%来自其他公司。投资者的需求也十分火热。瑞士保险公司苏黎世保险对绿色债券的投资已经超过12亿美元，并计划达到20亿美元。贝莱德等资产管理公司已经建立了专门的绿色债券基金。

至于债券收益，超过40%的收益用于清洁能源融资，近25%用于建筑和工业，超过10%用于运输。但是，对到底什么是“绿色”的定义相去甚远。这个判定最初是由世行的环境部门作出，或是在一些私人发行中由发行人本身作出。

世界上最大的银行和资产管理公司中已经有130多家签署了“绿色债券原则”，这一指南规定了什么是绿色，规范了报告要求，并建议使用外部审核者。一个选择是由非政府组织气候债权倡议组织（CBI）提供的认证。其他人则选择从Vigeo Eiris等专业环境咨询公司，或安永和毕马威等大型审计公司处获得第三方意见。CBI认为，2017年发行的债券中有85%经过

外部审查。

然而，标准之间依然差异很大。例如，中国央行对中国市场有自己的标准。与“原则”或CBI不同的是，它将“洁净煤”投资视为绿色。印度以及东南亚国家组成的东盟也正在制定自己的规则。非政府环境保护组织世界自然基金会（WWF）已经警告说，缺乏单一标准将会带来“洗绿”的风险。自从最近资产管理公司朗巴德·欧迪埃（Lombard Odier）推出了气候债券基金，对于标准的质疑日益凸显。该基金建立了自己的评估流程，并以“报告不足”为由排除了四分之一的“绿色”债券。

不过进展还是有的。CBI负责人肖恩·基德尼（Sean Kidney）指出，中国希望让自己的标准更贴近全球标准。“绿色债券原则”在不断完善，最新版本将于本月推出。信用评级机构也在进军此业务。穆迪去年推出了绿色评估服务，标准普尔也于今年4月跟进。和这些公司提供的常规信用评级一样，他们将按照绿色水平对债券进行分级，而不是做简单的“是/否”判定。如果它们能够赢得市场份额，对何为“绿色”的二元判断可能会演变成一个更为微妙的关于环境影响程度的争论。■



China's economy

Biting the bullet

The government sets its sights on building Chinese dominance in new industries

IN RECENT days China set the record for the world's fastest long-distance bullet train, which hurtled between Beijing and Shanghai at 350kph (217mph). This was a triumph of industrial policy as much as of engineering. China's first high-speed trains started rolling only a decade ago; today the country has 20,000km of high-speed track, more than the rest of the world combined. China could not have built this without a strong government. The state provided funds for research, land for tracks, aid for loss-making railways, subsidies for equipment-makers and, most controversially, incentives for foreign companies to share commercial secrets.

High-speed rail is a prime example of the Chinese government's prowess at identifying priority industries and deploying money and policy tools to nurture them. It inspires awe of what it can accomplish and fear that other countries stand little chance against such a formidable competitor. Yet there have also been big industrial-policy misses, notably the failure to develop strong car manufacturers and semiconductor-makers. China is rolling out a new generation of industrial policies, directed at a range of advanced sectors, raising worries that it will dominate everything from robotics to artificial intelligence. That result is far from preordained.

Industrial policy is a touchy topic. In continental Europe and, especially, Asia, many have faith in the government's ability to steer companies into industries they might otherwise shun. In America and Britain, faith tends to be supplanted by deep doubts. Governments, after all, have a lousy record in picking winners in fast-evolving markets. Yet most countries try to support some industries, usually through a mixture of infrastructure, tax

breaks and research funding. What differs is the stress they lay on such measures.

China is unique in the breadth and heft of its industrial policy. For years the government concentrated on modernising what it classified as nine traditional industries such as shipbuilding, steelmaking and petrochemical production. In 2010 seven new strategic industries, from alternative energy to biotechnology, also became targets. And two years ago it announced its “Made in China 2025” scheme, specifying ten sectors, including aerospace, new materials and agricultural equipment, which are now at the heart of its planning. The various plans overlap; cars, for example, have appeared in every iteration. The result is a wide-ranging approach in which the government tries to shape outcomes in important parts of the economy, new and old.

The “Made in China” plan, its latest industrial-policy craze, is derived in part from Germany’s “Industry 4.0” model, which focuses on creating a helpful environment through training and policy support but leaves business decisions to companies. China’s version is much more hands-on. By the start of this year, officials had established 1,013 “state-guided funds”, endowed with 5.3trn yuan (\$807bn), much of it for “Made in China” industries. In August the Ministry of Industry and Information Technology unveiled a manufacturing-subsidy programme, spread across as many as 62 separate initiatives. Most contentiously, the government has laid out local-content targets for the various “Made in China” sectors (see chart). One plan features hundreds of market-share targets, both at home and abroad. “Clearly, this is no mere domestic exercise,” the EU Chamber of Commerce in China warned in a report this year.

The targets also illustrate one of the facets of Chinese industrial policy that has so angered foreign companies and governments: the disguising of state support. The World Trade Organisation (WTO) strictly limits local-content

rules. But China's market-share targets are primarily contained in semi-official documents, such as a blueprint published by the Chinese Academy of Engineering. So the government can claim that these are simply industry reports, not official targets. But in the Chinese system the line between government-backed industry estimates and official guidelines is easily blurred.

Similarly, foreigners have long complained that China hides much of its illegal state aid. Since 2011 America has formally requested information about more than 400 unreported Chinese subsidies. "China learned how to game the system," says Tim Stratford, a former American trade official responsible for dealings with China. "The WTO is not designed to deal effectively with a huge economy that has, as the core of its development strategy, industrial policies across a wide range of sectors." Frustrations at the WTO's inadequacy in restraining China have led the American government to look at other mechanisms (see next story).

Foreign competitors see China as a well-oiled machine and worry that they will lose business not just in China but around the world. Export powerhouses such as South Korea and Germany feel most exposed (see chart). But in fact the Chinese government's record in promoting specific industries is patchy. Since the 1970s it has tried to develop semiconductors. But of the \$145bn-worth of microchips China consumed in 2015, only a tenth were truly domestic; foreign technology remains superior. The car industry, too, has disappointed. To manufacture in China, foreign firms must take local partners. The government hoped this would lead to knowledge transfers. Instead, local firms, insulated from head-on foreign competition, have milked the joint ventures for profits and innovated little.

Moreover, in their zeal, local governments can go overboard. Some worry that "Made in China" sectors will end up facing gluts, like "old" industries where China is now cutting overcapacity, such as steel and coal. The

Mercator Institute of China Studies, a Berlin-based research group, counted that, by late 2016, nearly 40 local governments had opened or planned robotics parks. The central government estimates that China will need nearly 150bn yuan-worth of robots over the next few years. According to the Mercator tally, local targets add up to roughly five times as much.

Yet when four factors—foreign technology, domestic abilities, market demand and government money—come together, Chinese industrial policy can be ruthlessly effective. The boom in high-speed rail began in 2004 when the government offered lucrative contracts to foreign engineering companies such as Germany’s Siemens and Japan’s Kawasaki so long as they shared their know-how. Some resisted at first, but eventually the lure of China’s vast market won them over, especially when they saw competitors getting a slice of it. With their prodigious engineering skills, born from years of trying to develop high-speed rail themselves, Chinese companies soon absorbed the technology. After a decade of laying tracks on an unprecedented scale, they have improved on it.

That success cannot be replicated in all ten of the “Made in China” sectors, not least because foreign companies are more guarded about sharing their secrets. But it would be rash to bet against China’s succeeding in at least a few of them. ■



中国经济

咬紧牙关

中国政府决心在新兴产业建立主导地位

前不久，中国创下了世界最快长途子弹头列车的记录：北京和上海之间的高铁时速达到每小时350公里（217英里）。这不仅是工程技术的胜利，也是中国产业政策的胜利。中国十年前才开始首次运行高速列车，如今全国高铁里程达两万公里，比世界其余地区高铁里程的总和还多。没有强大的政府，中国不可能有这样的成就。政府为高铁科研提供资金，为铁道建设提供用地，为亏损铁路提供援助，为设备制造商提供补贴，最具争议的做法是给外国公司提供激励，让它们分享商业秘密。

在确定优先发展的行业并部署资金和政策工具加以培育这方面，中国政府有杰出的能力，高铁就是一个典型的例子。这令人对于中国的潜力心生敬畏，也让人担心在面对这样强大的竞争对手时其他国家几乎没有胜算。不过，中国在产业政策方面也出现过重大败绩，特别是未能培育出强大的汽车和半导体制造企业。中国正针对一系列先进行业推出新一代产业政策，一些人开始担忧它将主导从机器人到人工智能等各个新兴行业。但结果如何还远未可知。

产业政策是一个敏感的话题。在欧洲大陆和亚洲，尤其是后者，人们相信政府能够引导企业进入它们原本可能会回避的行业。而在美国和英国，这种信心往往被深深的疑虑取代。毕竟，那里的政府在快速演变的市场中挑选赢家方面记录不佳。然而大多数国家都会尝试支持一些行业的发展，通常会通过建设基础设施、给予税收减免，以及提供研究经费等措施来实现。区别在于这些措施的实施力度。

中国的产业政策在广度和力度上是独一无二的。多年来，政府集中力量在它划定的九大传统产业中实现现代化，包括造船、炼钢和石化。2010年，从新能源到生物技术的七大新兴战略产业也成为了重点发展目标。两年前，中国政府宣布了“中国制造2025”计划，指明十个发展领域目前处于

政府规划的核心，航空航天、新材料和农机装备位列其中。各时期的发展计划之间有所重叠，比如汽车在每一代计划中都有出现。结果是全盘发展——政府试图在各个重要经济领域都带来改变，不论是传统还是新兴产业。

“中国制造2025”计划是中国最新的热点产业政策，在某种程度上借鉴了德国的“工业4.0”模式。德国模式的重点是通过培训和政策支持创造有益的环境，但由企业自行做出商业决策，而在中国的版本中，政府的介入要直接得多。截至今年初，官方已建立了1013个“政府引导基金”，规模达5.3万亿元（8070亿美元），其中大部分用于“中国制造2025”的十大产业。8月，工信部公布了制造业补贴计划，涵盖多达62个独立的项目。最具争议的是，政府已经为“中国制造2025”的各个行业制定了国产化目标（见图表）。有一项计划列出了数百个国内外市场目标份额。“显然这并不仅仅是场国内的行动。”中国欧盟商会在今年的一份报告中如此警告道。

这些目标也显现了中国产业政策中令外国企业和政府甚为恼火的一点：掩盖国家的扶持。世贸组织（WTO）严格限制国产化规则。但中国的市场份额目标主要见于半官方文件，比如中国工程院发布的发展蓝图。因此政府可以声称这些只是行业报告，而非官方目标。然而在中国的体制下，受政府支持的行业预测和官方指导方针之间很难划清界限。

同样，外国企业和政府长期以来一直抱怨中国隐瞒了大部分非法的国家援助。2011年以来，美国已正式要求中国提供400多笔未公布的补贴的信息。“中国学会了如何钻贸易体系的空子，”曾负责中美贸易的美国官员夏尊恩（Tim Stratford）说，“世贸组织的体制无法有效应对这样一个以广泛产业政策为发展战略核心的巨大经济体。”世贸组织制约中国的能力不足，美国政府对此深感懊恼，开始考虑其他机制。

在外国竞争对手的眼里，中国是一部运转良好的机器。它们担心自己在中国乃至全世界都会丢了生意。韩国和德国这样的出口大国感受到的威胁最大（见图表）。但实际上，中国政府在推动具体行业时，表现有好有坏。20世纪70年代以来，中国一直努力发展半导体产业。但在2015年中国消费

的价值1450亿美元的微芯片中，只有十分之一真正属于国产，国外技术依然领先。汽车业也令人失望。要在中国生产汽车，外国企业必须要有本土合作伙伴。政府希望这可以促进知识转移。然而，本土企业通过合作避免了与国外企业的正面竞争，只顾从合资企业中获利，创新成果却寥寥。

而且，热情高涨的地方政府也可能会做过头。有人担心“中国制造2025”的十大行业最终会面临产能过剩的局面，就像钢铁和煤炭等中国正着力削减过剩产能的“老”行业一样。据柏林的墨卡托中国研究中心（Mercator Institute of China Studies）统计，到2016年底，将近40个地方政府已经开启或计划开启机器人产业园。中央政府估计，未来几年中国将需要价值近1500亿元的机器人。而据墨卡托统计，各地机器人产业目标加起来大约是这个数字的五倍之多。

然而当外国技术、国内能力、市场需求和政府资金这四大因素相结合之时，中国的产业政策就可能所向披靡。高铁的快速发展始于2004年，当时政府向德国西门子和日本川崎重工（Kawasaki）等外国工程公司提供了丰厚的合同，条件是这些公司分享高铁专有技术。有些公司一开始是拒绝的，但最终因中国庞大市场的诱惑改变了态度，特别是看到竞争对手尝到甜头之后。有了外国公司多年努力自行开发高铁积累起来的大量工程技术，中国企业很快就将其吸收为己用。经过十年规模空前的建设，它们还对高铁技术做出了改进。

高铁的成功无法在“中国制造2025”所有十个行业中复制，尤其是因为现在国外企业对分享机密技术变得更谨慎了。但断言中国不会在其中至少几个行业中取得成功，那就太过轻率了。■



Economic and financial indicators

Trade-weighted exchange rates

The yen soared in 2016, acting as a haven during a year of geopolitical turmoil

A country's trade-weighted exchange rate is an average of its bilateral exchange rates, weighted by the amount of trade with each country. In trade-weighted terms the yen soared in 2016, acting as a haven during a year of geopolitical turmoil. Sterling is currently at a ten-month low, partly because of the euro's strength: the euro area accounts for 45.4% of Britain's trade-weighted exchange rate. The US dollar has plunged as uncertainty has grown over whether President Donald Trump will deliver on tax reform and infrastructure spending. The euro is a bright spot: it has been boosted by improving economic growth and the defeat of populists in elections this year in the Netherlands and France. ■



经济与金融指标

贸易加权汇率

2016年日元飙升，在地缘政治充满动荡的一年里充当了避风港

一个国家的贸易加权汇率是其双边汇率的平均值，这个值受该国与各贸易伙伴国之间的贸易量比重加权。按贸易加权计算，2016年日元飙升，在地缘政治充满动荡的一年里充当了避风港。英镑目前的汇率处于十个月来的低点，部分原因是欧元走强：欧元区的比重占到了英国贸易加权汇率的45.4%。特朗普是否会实行税改并投资基建这一点愈发不明朗，美元因此大跌。欧元表现抢眼：经济增长好转，加上今年荷兰和法国大选中民粹主义受挫，提振了欧元。 ■



Loyalty schemes

Forsake all others

If you want loyalty, get big data

THOSE of a cynical bent might think Tom Stuker a glutton for punishment. Over the years, Mr Stuker has flown more than 18m miles (29m kilometres) on United Airlines, a carrier not always renowned for treating its passengers tenderly. Mr Stuker may possess the world's most impressive frequent-flyer account. Over the past half-decade he has averaged over 1m miles a year with United.

Mr Stuker is extreme in his devotion. But engendering customer loyalty is something that nearly all firms strive for. Most fail. The average American household belongs to 28 loyalty schemes. The country is home to 3.8bn scheme memberships in total, according to Colloquy, a research firm, up from 2.6bn in 2012. More than half of these accounts go unused.

Frequent-flyer programmes, introduced in the 1970s, were the first examples of modern loyalty schemes. They proved to be a clever bit of marketing. Flyers value plane seats highly, so a free one feels like a substantial reward. But airlines can give away unsold berths at little incremental cost, because the jet would fly whether they are filled or not. Air miles are also sold to third parties, such as credit-card firms, which then use them to reward their own customers. For airlines, profit margins on frequent-flyer programmes can be 30-40%, says Pranay Jhunjunwala of the Boston Consulting Group (BCG), a consultancy, compared with 10% on flights in general.

Schemes like these are an example of “earn and burn” rewards, in which customers are rewarded for their purchases at a flat rate, whether a free flight for every 20,000 miles flown or a complimentary mochaccino for

every nine swigged. According to Capgemini, another consultancy, nearly all firms with a loyalty scheme use this model.

Because they are so easy to implement, they are often used defensively. Many firms start a programme only because their competitors have one, says Steve Grout of Collinson Group, a loyalty consultancy. But they are so common that they end up generating little fidelity. Often “the market returns to stasis,” argued Lena-Marie Rehn of the Ludwig-Maximilians University in a paper published in 2016. Some 77% of earn-and-burn schemes fail in one way or another within the first two years, according to Capgemini.

The best programmes, in contrast, get highly personal. Customers of Starbucks, for example, are encouraged to pay for their daily dose of caffeine using a smartphone app, which they pre-load with cash. (An estimated \$1.2bn is deposited in Starbucks’s loyalty account.) This allows the firm to harvest reams of data on its patrons, including what they drink, at which stores and at what time of day—perhaps even whether it is sunny or raining when they choose a particular beverage. This information is then used to target members of the scheme with individual offers.

If that sounds a touch intrusive, Starbucks’s customers do not seem to mind. In its latest results in July, the firm boasted 13.3m active members. Over a third of its sales in America come through its reward programme. Customers tend to be happier handing over personal information when they get personalised offers in return, says Javier Anta, another BCG consultant. Some 97% of purchases at Kroger, an American grocery firm, are reported to be made by loyalty-card holders, who receive individual offers based on their shopping habits. Such data can be among the most valuable things a firm owns. When Caesars Entertainment, a casino group, went bankrupt in 2015, auditors valued its loyalty database at \$1bn, more even than its property on the Las Vegas strip.

If data are the grist for the loyalty mill, then you might assume that the online giants would be running the best schemes. Yet this is not necessarily the case. Take Amazon. “Their philosophy is not good,” says one loyalty consultant (who asked not to be identified). “The amount they spend on promotions is insane.” Rather than offering across-the-board discounts, he says, Amazon would be much better served by designing and targeting customised promotions for particular shoppers as part of a loyalty scheme.

As Starbucks has shown, many advances in the loyalty industry are driven by mobile technology. For a start, it allows firms to use location information to send well-targeted, real-time offers. And storing scores of cards in an e-wallet, rather than having to wedge them into a purse, encourages shoppers to use them. A quarter of people who abandoned schemes did so because they did not offer a smartphone app, according to Colloquy. Smartphones are also increasing the number of ways in which customers can garner rewards. Some restaurants, for example, offer points for those posting photos of their meals on Instagram, or for “checking in” on Facebook. The only limit, it seems, will be customers’ desire to protect privacy.

Airlines, for their part, have been slow to keep up. Still, they have the odd card up their sleeves. In 2011, after Mr Stuker passed the 10m-mile mark, United Airlines named one of its jumbo jets after him. Even Starbucks would struggle to match that level of personalisation. ■



客户忠诚计划

忠贞不渝

想要客户忠诚，先获取大数据吧

那些喜欢冷嘲热讽的人也许会说汤姆·斯图克（Tom Stuker）是受虐狂。多年来，斯图克乘坐美联航的班机飞行超过1800万英里（2900万公里），而这可不是一家一贯以“善待”乘客闻名的航空公司。斯图克可能持有世界上最惊人的常飞旅客账户。过去五年间，他平均每年乘坐美联航班机飞行100多万英里。

斯图克的忠诚只是极端个例。但培养客户的忠诚度几乎是每个公司都孜孜以求的事情。然而它们大多数都不成功。平均而言，一个美国家庭会参加28项客户忠诚计划。根据市场调研公司Colloquy的数据，美国的客户忠诚计划会员总数从2012年的26亿升至现在的38亿。但超过半数的会员账户未被使用。

上世纪70年代推出的常飞计划开创了现代客户忠诚计划的先河。事实证明这是一个营销妙招。乘客认为飞机座位价值很高，因此一个免费座位就像是一份丰厚的奖励。但是航空公司可以赠送未售出的座位而不用增加什么成本，因为飞机不管是否满员都会起飞。飞行里程还会被出售给诸如信用卡公司等第三方，再由第三方奖励给自己的客户。波士顿咨询公司的普拉纳·金君瓦拉（Pranay Jhunjunwala）表示，对航空公司来说，常飞计划的利润率可达30%至40%，而航班总体的利润率是10%。

这类计划实施的是“积分兑换”奖励——顾客以非优惠价格购买商品或服务后就会得到奖励，比如飞满两万英里可获得一次免费飞行，或是喝九杯摩卡就能获赠一杯。据凯捷咨询公司（Capgemini）的说法，几乎所有推出客户忠诚计划的公司都采用这种模式。

由于这类计划非常易行，公司纷纷以此作为防御手段。很多公司启动计划仅仅是因为竞争对手有这样的计划，客户忠诚方面的咨询公司柯林森集团

（Collinson Group）的史蒂夫·格劳特（Steve Grout）表示。但这些计划太平平无奇，因而收效甚微。慕尼黑大学（Ludwig-Maximilians University）的莉娜-玛丽·瑞能（Lena-Marie Rehn）在2016年发表的一篇文章中指出，“这个市场归于停滞”。根据凯捷提供的数据，差不多77%的积分兑换计划推出不出两年便这样或那样地失败了。

相比之下，最优的客户忠诚计划是高度个性化的。比如，星巴克鼓励顾客使用预存现金的智能手机应用来为每天的咖啡付费。（星巴克客户忠诚计划的账户中约有12亿美元的预存款。）这样，公司便得以收集大量的老顾客信息，包括他们在一天中的什么时间在哪家店喝了什么，甚至可能包括他们选择某种饮品时是晴天还是下雨。之后，公司再用这些信息为会员提供个性化的优惠。

就算这听上去有点侵犯隐私，但星巴克的顾客似乎并不介意。公司在7月公布的最新业绩报告显示，活跃会员多达1330万人。星巴克在美国超过三分之一的销售额来自其奖励计划。波士顿咨询的另一位顾问哈维尔·安塔（Javier Anta）表示，顾客若能得到个性化优惠作为回报，他们往往更乐于交出个人信息。据称，美国食品零售商克罗格（Kroger）有97%的购买来自会员。该公司根据顾客的购物习惯向他们提供个性化的优惠。这类数据可能是公司最有价值的财富之一。2015年博彩集团凯撒娱乐（Caesars Entertainment）破产时，审计师对其忠诚客户数据库估价10亿美元，甚至超过了它在拉斯维加斯大道上的房产的价值。

如果数据是培养客户忠诚度的利器，那么你可能会认为互联网巨头最擅长经营此类计划。然而事实未必如此。亚马逊就是个例子。“他们的理念并不高明，”一位不愿透露身份的客户忠诚度咨询顾问表示，“他们在促销上花那么多，真是疯了。”他说，假如亚马逊不是全面撒网式地提供折扣，而是为特定顾客设计并推送量身定制的促销，将此举作为客户忠诚计划的一部分，那它得到的好处会大得多。

如星巴克所示，移动科技从许多方面推动了客户忠诚业务的发展。首先，公司可使用定位信息向顾客发送精准的实时优惠。而顾客只需将一堆忠诚

卡存进电子钱包，不必再把皮夹子塞得鼓鼓囊囊，这鼓励了他们频繁使用这类卡。据Colloquy提供的数据，那些放弃客户忠诚计划的人中，有四分之一是因为商家未提供智能手机应用。智能手机还增加了顾客获得奖励的途径，比如一些餐馆会向在Instagram上晒单、或在Facebook上签到的顾客提供积分。而唯一的瓶颈似乎就是顾客想保护自己的隐私。

至于航空公司，这方面一直进展缓慢。不过，它们也自有奇招妙计。2011年，当斯图克的飞行里程超过1000万英里时，美联航将一架大型喷气式客机以他的名字命名。这样的“私人订制”水平，就连星巴克也难以望其项背。 ■



International litigation

Courtly competition

Other countries want a slice of London's financial-litigation business

LOFTILY as they may disdain the profit motive, Britain's judges are, on a national level, money-spinners. English law is often specified as the one under which commercial contracts are to be interpreted and enforced. And disputes often end up being heard in British courts. But, like any business, the law is competitive, and other jurisdictions want to snatch a share of this market. London is mounting its defences.

It has several hard-to-beat advantages: the use of English; a reputation for fairness; the centuries of precedent that lend predictability. Richard Caird, a partner at Dentons, a global law firm, notes that a foreign company can expect an impartial decision in an English court, even if it is pitted against a British firm. Over 70% of cases in the English commercial courts involve a foreign party. In 2015, Britain had a £3.4bn (\$5.2bn) positive balance of payments on legal services.

One way for other financial centres, such as Dubai and Singapore, to compete is by becoming hubs for arbitration—by agreeing to abide by the decision of a tribunal, disputants can bypass courts entirely. But as Philip Rubens of Teacher Stern, a law firm in London, points out, such tribunals create no binding precedent. Financial firms often want their day in court.

So Singapore and Dubai, in the UAE, have also set up special commercial courts. The Netherlands, France and Kazakhstan have similar plans. Mostly, these courts will conduct cases in English and apply internationally accepted laws. Singapore and Dubai have even hired judges retired from London and other jurisdictions.

So far, however, they have attracted little international business. Since its establishment in 2015, no case has been heard in the Singapore International Commercial Court based on a contractual agreement between the parties to hear a case there, though proceedings have been transferred from other Singapore courts. Most cases heard in the Dubai International Financial Centre Courts after they opened to foreign litigants in 2011 have had UAE links.

Nor is London complacent. Judges conducted a survey of big users of the commercial courts, such as lawyers and bosses at financial institutions. One consequence was the creation in 2015 of the “Financial List”. Litigants in financial disputes, generally with over £50m (\$65m) at issue, can apply to have their cases heard on the list, by judges with expertise in financial law.

Some new procedures have been introduced for Financial List cases. In ordinary commercial courts, for example, different parts of a trial are heard by different judges. On the Financial List, one judge hears the entire case. The jury is out on whether the new system improves justice. Litigants had hoped Financial List cases would be faster. But Vaninna Etori, an adviser to the Chancellor of the High Court, notes that the sort of cases that appear on the Financial List would typically be expedited anyway. Ultimately, as Mr Rubens points out, its success will depend on how many Financial List cases are overturned on appeal.

Dubai and Singapore are unlikely to make much of a dent in London’s dominance. Its courts’ reputation has been built over many years, and the forces of inertia stop people from changing contract terms. Mr Caird notes that the true threat to Britain’s courts will be its departure from the EU. He questions whether financial institutions that move operations to the continent as a result of Brexit will still use British courts. Brexiteers worry about the influence of European judges on British affairs after Brexit.

Maybe they should worry about continental European judges snapping up the valuable cases. ■



国际诉讼

法庭争锋

其他国家想从伦敦的金融诉讼业务中分一杯羹

英国的法官也许很清高，对谋求利润不屑一顾，但从整个国家的层面来说，他们可是摇钱树。英国法律经常被指定为解释和执行商业合同的依据。纠纷往往最终在英国法庭审理。但就像任何业务一样，法律产业也有竞争，其他司法辖区也想抢占这个市场的份额。伦敦正在加紧防御。

伦敦有几个别处难以企及的优势：使用英语；其公平之名享誉世界；几个世纪以来的判例制度使判决具有可预测性。德同国际律师事务所

（Dentons）的合伙人理查德·凯尔德（Richard Caird）指出，即使诉讼对手是英国公司，外国企业也可指望英国法庭作出公正的裁决。英国商事法院审理的案件中有70%以上涉及外方。2015年，英国在法律服务上的国际收支顺差达34亿英镑（52亿美元）。

迪拜和新加坡等其他金融中心要与伦敦竞争，可以通过成为仲裁中心来实现——争议当事人如同意遵守仲裁庭的裁决，就可以完全绕过法院。但正如伦敦Teacher Stern律师事务所的菲利普·鲁本斯（Philip Rubens）指出的那样，仲裁庭不会创造有约束力的先例。金融企业常常还是希望在法庭上解决问题。

所以新加坡和阿联酋的迪拜也设立了特别商事法院。荷兰、法国和哈萨克斯坦也有类似的计划。这些法院大多用英文审理案件，运用国际公认的法律。新加坡和迪拜甚至聘请了伦敦和其他司法辖区的退休法官。

然而，到目前为止，这些法院并未吸引到多少国际业务。自2015年成立以来，新加坡国际商事法院（SICC）没有审理过任何由当事人双方书面协定提交该法院审议的案件，不过其他新加坡法院向SICC移交了一些案件。迪拜国际金融中心法院（Dubai International Financial Centre Courts）于2011年向外国诉讼人开放以来，审理的案件大部分都涉及阿联酋的企业。

伦敦也没有固步自封。法官们调研了商事法庭的主要使用者，包括金融机构的律师和老板等，取得的成果之一是2015年创建的“金融案件列表”（Financial List）。金融纠纷中的诉讼人可以申请将其案件加入列表，由具有金融法专业知识的法官审理。这类案件涉及的金额通常都超过5000万英镑（6500万美元）。

针对这一列表已经引入了一些新的审理程序。例如，在普通的商事法庭中，案件各部分由不同的法官审理，而列表中的案子是由一位法官审理全案。新制度是否有助司法公正尚无定论。诉讼人本希望纳入列表的案件能更快得到审理。但高等法院衡平法庭法官的顾问瓦宁娜·埃图里（Vaninna Ettori）指出，能上列表的案件一般本来就会加快审理。最终，如鲁本斯指出的那样，新制度成功与否将取决于有多少列表案件的判决会在上诉时被推翻。

迪拜和新加坡不太可能对伦敦的统治地位有实质性威胁。英国法院的声誉是多年积累而来，而人们出于惯性也不会轻易改变合同条款。凯尔德指出，真正威胁英国法院的是英国脱欧。他怀疑，因英国脱欧而将业务迁至欧洲大陆的金融机构是否会继续选择英国的法院。脱欧支持者则担心脱欧之后欧洲法官对英国事务的影响。也许他们真正应该担心的是欧洲大陆的法官会抢走涉案金额高昂的案件。 ■



Protein-rich diets

Feed as well as food

As demand for protein grows, what people eat matters. So does what gets fed to animals

BETWEEN now and 2050 the planet's population is expected to rise by a third, from 7.6bn to 9.8bn. Those extra mouths will need feeding, and not just with staples. As people grow richer, their demand for protein rises, particularly for meat and fish. Beef consumption in Asia, for example, is expected to jump by 44% over the next decade alone.

Raising animals to be eaten already has huge effects on the world's environment. The number of farm animals soared during the 20th century. More than 20bn chickens, 1.5bn cattle and 1bn sheep are alive today. A quarter of the world's land is used for grazing them. They consume 30% of the world's crops. They guzzle water—you need about 15,000 litres of the stuff to produce a kilo of beef, compared with only 1,500 litres for a kilo of maize or wheat. And their eructations do nothing for the climate. Livestock are responsible for 14.5% of all anthropogenic greenhouse gases, according to the UN Food and Agriculture Organisation (FAO).

How then may the planet be fed sustainably? One set of answers revolves around convincing people to put different things on their plates.

Vegetarians have the simplest solution of all, but try telling people in sub-Saharan Africa that they should stick to cassava. Encouraging people to eat more fish rather than more meat is a better answer. Human consumption of fish has now overtaken that of beef, and aquaculture accounts for half of all the fish people eat. But almost 90% of wild stocks are fished either at or beyond their sustainable limits. And farmed fish, particularly salmon, are often fed on smaller fish that themselves are caught at sea. A fashionable idea is for Westerners to eat more insects, which contain up to three times as much protein as beef and already form an integral or supplementary part

of up to 2bn people's diets, according to the FAO. But for that to happen, many will have to get over the "yuck" factor.

Another set of answers involves using technology to create artificial protein. Investors such as Bill Gates and Richard Branson have backed artificial-meat startups that grow beef and poultry from animal cells. Tyson Foods, a meat processor, is an unlikely fan of plant-based proteins. Scientists are also looking at genetic modifications to animals—to increase the muscle of cattle or to reduce infections among farmed fish.

Innovations such as these have enormous potential, if they can be industrialised and win over wary consumers. But changing what humans eat is not the only route to feeding a growing population more sustainably. Another, less obvious, approach is to alter what animals themselves eat. It is here that technology may have the biggest impact soonest.

One source of improvement lies in the more efficient use of crops to feed animals. The proliferation of mills that process grain into feed is helping in places such as sub-Saharan Africa, for example. Data-intensive farming is helping improve agricultural yields of feed crops like soyabeans by carefully monitoring the use of water and fertiliser.

| *Eat shit and diet*

A more radical approach is to change animals' diets. Efforts to reduce the amount of fish meal used in aquaculture have already paid dividends. In 1990 90% of salmon feed used in Norway was fish meal, but by 2013 greater use of plant matter had reduced that figure to 30%. More can be done. At most 20% of protein in grains fed to animals is converted to edible protein; the rest is turned into waste products. Cargill, an agricultural giant, broke ground this year on the world's largest gas-fermentation facility, in partnership with Calysta, a Californian firm that makes feed out of natural gas. After feeding bacteria called methanotrophs with methane, they can be

turned into protein pellets for fish and livestock. Insects are also an option. Flies and maggots can be raised on manure and organic waste, instead of grains, and then fed to cattle, chicken and fish.

The FAO has warned that by 2050 the planet will need to produce 70% more food than it did in 2009. The idea of chomping on more bugs and eating lab-grown meat may capture the imagination. But the path to food sustainability also runs through animals' stomachs. ■



富含蛋白质的食谱

饲料与食物

随着人们对蛋白质需求的增长，吃什么变得很重要。给动物喂什么也同样重要

从现在到2050年，全球人口预计将增长三分之一，从76亿增至98亿。这些新增人口需要养活，且不能光靠主粮。随着人们越来越富裕，蛋白质尤其是肉类和鱼类的需求上升。例如，仅在未来十年，亚洲的牛肉消费量预计就将增长44%。

饲养肉用动物已对世界环境产生了巨大的影响。二十世纪，农场动物（家禽家畜）数量剧增。目前全球有超过200亿只鸡、15亿头牛和10亿只羊。饲养这些禽畜占用了世界上四分之一的土地，消耗了全世界30%的农作物。它们还大量消耗水资源——每生产一公斤牛肉大约需要1.5万升水，而生产一公斤玉米或小麦只需1500升。这些动物的暖气也对气候毫无益处。联合国粮农组织称，牲畜造成了14.5%的人为温室气体。

那么，怎样才能可持续地为人类提供食物？有一套应对方案围绕着说服人们吃不同的食物展开。素食者的解决办法最简单，不过试试告诉撒哈拉以南非洲的人们应该只吃木薯会怎样。更好的答案是鼓励人们多吃鱼而不是多吃肉。人类对鱼类的消费量现在已超过牛肉，而这些鱼有一半来自水产养殖。然而，近90%的野生鱼类的捕捞量已达到或超过了可持续的限度。养殖鱼类，特别是三文鱼，经常被喂食从海里捕获的小鱼。一个时兴的想法是让西方人多吃昆虫。昆虫的蛋白质含量是牛肉的三倍，而且根据粮农组织的数据，昆虫已经成为20亿人饮食中不可或缺的部分或他们的补充食物。但要实现这一点，许多人将必须克服“恶心”的感觉。

另一系列答案涉及到运用技术来创造出人工蛋白质。比尔·盖茨和理查德·布兰森（Richard Branson）等投资者都资助了人造肉方面的创业公司，这些公司通过动物细胞培育牛肉和禽肉。出乎意料的是，肉类加工企业泰森食品公司（Tyson Foods）也是植物性蛋白质的支持者。科学家们也在研究针对动物的基因改造技术，以提高牛的肌肉量或减少养殖鱼类的感

染。

如果这样的创新能够工业化并赢得谨慎的消费者的支持，它们就有巨大的潜力。但是，要以更可持续的方式养活日益增长的人口，改变人类的饮食并非唯一途径。另一个不那么显而易见的方法是改变动物的饲料。正是在这方面，技术可能会以最快的速度产生最大的影响。

一个改进的途径是更高效地利用农作物来饲养动物。例如，在撒哈拉以南非洲等地，把谷物加工成饲料的工厂数量激增，对这些地区很有助益。通过仔细监测水和化肥的使用，数据密集型农业能帮助提高大豆等饲料作物的产量。

| 奇特饲料

更激进的方法是改变动物的饲料。减少水产养殖中对鱼粉的用量已经产生回报。1990年，挪威90%的三文鱼饲料是鱼粉，但到2013年，植物性饲料用量的提高使这一数字降至30%。还有更多办法。在用来饲养动物的谷物中，最多只有20%的蛋白质转化为可食用蛋白质，剩下的则变成废物。农产品巨头嘉吉（Cargill）今年破土开建世界最大的天然气发酵工厂，合作伙伴是用天然气生产饲料的加州企业Calysta。用甲烷喂养被称为甲烷氧化菌的细菌，可将它们转化为喂养鱼和家畜的蛋白颗粒。昆虫也是一个选择。苍蝇和蛆可以用粪便和有机废物饲养而无需谷物，然后再把它们喂给牛、鸡和鱼。

粮农组织警告说，到2050年，地球将需要生产出比2009年多70%的食物。大口嚼虫子和啃人造肉的想法可能会让人浮想联翩，但食物可持续性还需要靠改造动物的胃来实现。 ■



Cargill

Middleman to the world

Can the privately held epitome of Big Agriculture satisfy a public hungry for more information about food?

ANGLERS love a record catch. Fish farmers, too. So when a salmon bred and raised near this village at the head of a Norwegian fjord was pulled out of captivity earlier this year weighing a sumo-sized 17kg, it was cause for jubilation. “It was fantastic,” says Einar Wathne, head of aquaculture at Cargill, the world’s biggest food-trading firm. Not only was it produced in 15 months, one-fifth faster than usual, it also looked and tasted good. Mr Wathne’s Norwegian colleagues celebrated by eating it sashimi-style shortly after its slaughter.

Cargill is a company usually associated with big boots rather than waders. America’s largest private company has built a reputation after 152 years of existence as middleman to the world, connecting farmers with buyers of human and animal food everywhere. Through a trading network that spans 70 countries (and that includes scores of ports, terminals, grain and meat-processing plants and cargo ships), it supplies information and finance to farmers, influences what they produce based on the needs of its food-industry customers, and connects the two.

Its purchase of EWOS, a Norwegian fish-food company, in 2015 for \$1.5bn was its first big foray into aquaculture. It was the second-biggest acquisition in Cargill’s history. That made it quite a splash for David MacLennan, Cargill’s chief executive since 2013, who took over the company just as a dozen fat years in the agriculture industry had drawn to a close. He is now fishing for future sources of growth.

The firm’s foray into the salmon business should help in two ways. First, it

is part of Cargill's attempt to expand into higher-value markets. One of its traditional mainstays, the trading of bulk agricultural commodities, has struggled since the end, in around 2013, of a China-led commodities supercycle. The firm has also suffered from a recent slump in demand for grains for biofuels. Consumption of farmed fish across the world has boomed, meanwhile, partly at the expense of beef, pork and other meats. Fish feed is its highest-cost component, and more efficient ways of feeding are key to the salmon industry's growth.

Second, Cargill can learn via the salmon-feeding business how to deal with increasingly picky consumers. Mr Wathne notes that salmon is a "premium" product, so consumers want to know not just where it came from, but where what it is fed on comes from. Fishermen of wild salmon, a well-connected bunch, are keen to turn public opinion against the farmed kind. That battle could make Cargill better at handling traceability in more established parts of its food business, such as meats.

Cargill faces a particularly hard task building trust with increasingly information-hungry consumers. To its critics the company epitomises the faceless character of "Big Agriculture", with boots that trample on the environment, animal welfare, and on small farmers. "I recognise that we are big, and because we are privately owned and because we are primarily business-to-business...it is harder to have that transparency," says Mr MacLennan. "We want to be more well known."

Some of his eight predecessors would have spluttered over his idea of more disclosure, which involves wider use of social media, more interviews and more engagement with NGOs. Since generations of Cargill and MacMillan families built the company up from a regional grain trader, born in Iowa in 1865, into a global giant, it has kept out of the limelight, preferring to leave that to the customers whose branded products it provides ingredients for, such as McDonald's Chicken McNuggets and Danone's baby formula. Its

taste for privacy has not always served it well; the title of a book published in 1995, “Invisible Giant”, sums up Cargill’s sinister reputation in the eyes of anti-globalists. “In the absence of information people will make up their own story,” Mr MacLennan says.

Private ownership has given Cargill room to take a long-term view, but had also enabled management to get away with subpar performance in a business with 150,000 employees and revenues of \$110bn. Before Mr MacLennan and his finance chief, Marcel Smits, launched a management reshuffle and streamlined the company in 2015, its weak returns would have been a red rag to an activist investor had it been a public company, says Bill Densmore of Fitch, a ratings agency.

The cost-cutting that has ensued, and a recent upswing in demand for American meat that particularly favoured Cargill, has pushed returns higher than those of its main listed rivals, Archer Daniels Midland and Bunge (see chart). Yet Craig Pirrong, an expert on trading companies at the University of Houston, says private ownership constrains Cargill’s ability to raise capital to invest in fixed assets as it expands and moves upmarket. Mr MacLennan says he has sought since 2013 to introduce “a bit of more of a public-company culture”. He stresses, though, that there is “no intention of going public”.

The big traders largely squandered the commodities boom of the past decade. Returns languished despite an unprecedented surge in demand for agricultural products, such as cereals, chicken and fish. In that time, Mr MacLennan says, farmers invested in new soil-mapping technologies to improve yields, better seeds and more storage facilities. An ability to hold on to grain until market conditions are favourable has given farmers clout in their relationship with the traders. New entrants, such as China’s own trading powerhouse, COFCO, and Glencore, an Anglo-Swiss firm, are also making the competition more cut-throat. Meanwhile, a series of bountiful

harvests in North and South America in recent years has produced record stocks of grain, reducing prices.

To diversify Cargill's sources of revenue, Mr MacLennan has sold \$2bn-worth of assets since 2015, such as a second-tier American pork business, and invested \$3.5bn in more value-added products, such as cooked meats, branded chicken, animal nutrition and food ingredients. Some current and former Cargill employees think such investments may be opportunistic, rather than enduring. If supply disruptions—bad weather, say, or a trade war between America and China—raised the volatility of food prices again, they expect Cargill to pour its capital back into bulk commodities. Though remaining committed to agriculture, Mr MacLennan rejects that idea. “If we were to do that, it would be a failure,” he says.

Moving closer to the consumer brings new sources of complexity. These include understanding widespread public rejection of genetically modified organisms (GMOs). Though Cargill handles huge cargoes of GM corn and soyabeans, it has recently had some of its non-GM ingredients certified by an NGO which verifies that food is not bioengineered. This has angered the pro-GMO farmers that it serves.

Cargill is also making bets on early-stage technology. In August it took a share in a “meatless-meat” company, Memphis Meats, that produces beef, chicken and duck out of the cells of living animals, rather than from carcasses. This represents a potential insurgency against the conventional meat industry. Cargill is also co-investing with Calysta, a Silicon Valley startup, in a factory costing up to \$500m that will produce up to 200,000 tonnes of fish food, known as FeedKind, made out of bacteria fed on methane. It is a novel approach to reducing the amount of freshly caught seafood, such as anchovies, in fish food, but is untested at scale.

Like counterparts facing upheaval in other industries, Cargill worries that

the supply of food from farm to table is being disrupted. As Richard Payne of Accenture, a consultancy, puts it, the threat for traders is that farmers at one end of the supply chain use more technology to handle their own pricing, financing and logistics, and retailers at the other end of the chain, under pressure from tech-led firms such as Amazon, squeeze food manufacturers and their suppliers. Still, one-and-a-half centuries of business has taught Cargill not to get caught in the middle. ■



嘉吉公司

面向全世界的中间商

这家私营的“大农业”代表能满足公众对食品更多的知情需求吗？

垂钓者以钓到“鱼王”为乐。养鱼户也一样。因此，今年稍早时，当一条17公斤的硕大三文鱼被拉出鱼塭时，人们不禁欢呼雀跃。繁殖并饲养这条大鱼的渔场靠近挪威一个峡湾口的村庄。“这真是不可思议。”世界最大的食品贸易公司——嘉吉公司的水产部门总裁艾纳·瓦斯纳（Einar Wathne）说。这条大鱼花了15个月养成，比正常时间缩短了五分之一，而且卖相好，味道也好。瓦斯纳在挪威的同事们将它宰杀后，随即做成生鱼片大快朵颐，以示庆祝。

人们常把嘉吉和农民的大靴子而不是和渔民的水衩联想到一起。这家美国最大的私营公司已有152年历史，作为面向世界的中间商享有盛名。它将世界各地的农户与人类食品及动物饲料的采购商对接。通过一个覆盖70个国家，包括大量的港口、集散中心、粮食和肉类加工厂以及货船在内的贸易网络，嘉吉向农户提供信息和资金，根据食品行业客户的需求调控农户的生产品种，并为两者牵线搭桥。

2015年，嘉吉以15亿美元收购了挪威鱼饲料公司EWOS，这是它第一次向水产养殖业大举出击，也是该公司史上第二大收购案。这使得嘉吉首席执行官麦伟德（David MacLennan）相当引人注目。麦伟德于2013年执掌公司，当时正值农业十几年的好光景即将到头。现在他正在为公司未来的增长搜寻“大鱼”。

嘉吉进军三文鱼产业应该会在两方面有所帮助。首先，这是嘉吉尝试进入更高价值市场的举措之一。自2013年前后由中国引领的大宗商品超级周期结束后，作为嘉吉传统支柱产业之一的大宗农产品贸易一直举步维艰。近期，公司还因用于生物燃料的谷物需求下滑而受创。而全球养殖鱼的消费快速增长，一定程度上挤压了对牛肉、猪肉及其他肉类的消费。鱼饲料在渔业养殖成本中占比最大，更高效的养殖方式是三文鱼产业增长的关键。

其次，通过三文鱼养殖业，嘉吉可以学会怎样与愈发挑剔的消费者打交道。瓦斯纳指出，三文鱼是“高端”产品，因此消费者不仅想知道三文鱼的产地，还想知道三文鱼饲料的来历。捕捞野生三文鱼的渔民有强大的社会关系，他们极力想令舆论反对人工养殖的三文鱼。这场较量能让嘉吉在其更为传统的食品业务上改进产品的可追溯性，比如肉类。

消费者对信息日渐渴求，该如何与之建立信任是嘉吉面临的一个尤为困难的任務。在批评者看来，嘉吉是千人一面的“大农业”代表，穿着靴子肆意践踏环境、动物福利以及小农户。“我承认我们是大企业，但因为我们是私营的，而且主要是做企业对企业的业务……所以要做到非常透明就更难一些，”麦伟德表示，“我们想让大家更多地了解我们。”

麦伟德主张增加信息披露，包括更广泛地使用社交媒体、接受更多的采访以及增加与非政府组织的接触等。如果公司的八位前任老板知道他这想法，他们当中一定会有人气急败坏。1865年嘉吉在美国爱荷华州创建，经过嘉吉和麦克米伦家族几代人的努力，公司从一个地区性的粮食贸易商成长为世界级的巨头。那之后，嘉吉就一直保持低调。它更愿意大众关注它的客户，自己则默默为客户的产品提供原料，比如麦当劳的麦乐鸡和达能的婴幼儿配方奶粉。这种隐秘的风格并不总对它有益。1995年出版的《无形的巨人》（Invisible Giant）一书的书名概括了嘉吉在反全球化主义者眼中的恶名。麦伟德表示，“在信息缺失的情况下，人们会自己编造故事。”

在这样一个拥有15万员工和1100亿营业收入的企业，公司的私有性质让嘉吉有空间从长计议，但也曾让管理层免于因业绩不佳而受罚。评级机构惠誉（Fitch）的比尔·丹斯摩（Bill Densmore）表示，假如嘉吉是一家上市公司，那么在2015年麦伟德和他的首席财务官马塞尔·施密茨（Marcel Smits）改组管理层并精简公司架构之前，它疲软的回报会令维权投资者大为光火。

改革削减了成本，加上近期市场对美国肉类的需求回升尤令嘉吉受惠，公司收益率上升，超过了其主要的上市公司竞争对手阿彻丹尼尔斯米德兰公

司（Archer Daniels Midland）以及邦吉公司（Bunge）（见图表）。然而休斯顿大学研究贸易公司的专家克雷格·皮龙（Craig Pirrong）表示，在嘉吉逐步扩张、向高端市场转移的过程中，公司的私有性质限制了它募集资金投资固定资产的能力。麦伟德表示，自2013年起，他一直寻求引入“一点类似上市公司的企业文化”。不过，他强调公司“没有上市的打算”。

在过去十年大宗商品繁荣期里，大型贸易公司在很大程度上坐失良机。尽管谷物、鸡肉和鱼肉等农产品需求空前激增，收益却很疲软。麦伟德表示，在那段时间，农民投资于能提高产量的土壤测绘新技术、更优良的种子以及更多仓储设备。农户已经可以将粮食攥在手里直到市场行情对自己有利，在与贸易商打交道时也硬气起来。中国国有贸易巨头中粮集团以及英瑞合资的嘉能可公司（Glencore）等新进者也让竞争变得更加残酷。与此同时，近年来北美洲和南美洲一连串的大丰收也带来前所未有的粮食库存，进而压低了价格。

为使嘉吉的收入来源多元化，自2015年起，麦伟德已经出售了价值20亿美元的资产，比如美国一家二流猪肉企业，并投入35亿美元在附加值更高的产品上，比如熟肉、品牌鸡肉、动物营养品以及食品配料等。部分嘉吉现有及前员工认为这样的投资可能是在投机，而不是从长远计。如果恶劣天气或中美贸易战等因素导致供应中断，食品价格波动再次增加，他们希望嘉吉将资金注回到大宗商品中。尽管仍然致力于农业，但麦伟德还是拒绝了这一想法。“如果我们那样做，就会失败。”他说。

拉近与消费者的距离会带来新的复杂度，比如要照顾到公众对转基因生物的普遍反对。虽然嘉吉经销大量的转基因玉米和大豆，但它最近也请一家非政府组织认证了部分非转基因原料。这让它所服务的支持转基因的农民很是不满。

嘉吉还把赌注下在尚未成熟的技术上。8月它投资了“人造肉”公司孟菲斯肉类（Memphis Meats），这家公司从动物活体身上提取细胞来制造牛肉和鸡鸭肉，而不用屠宰动物。这对传统肉类产业可能意味着一场颠覆性的革命。嘉吉还与硅谷创业公司Calysta共同投资了一家工厂。该工厂造价近

5亿美元，将生产一种名为FeedKind的鱼饲料。这种饲料由以甲烷为食的细菌制成，预计产量高达20万吨。这种新方法将减少在鱼饲料中使用凤尾鱼之类的现捕海鲜，不过还未经过大规模检验。

和其他行业那些面临剧变的公司一样，嘉吉担心从农场到餐桌的食品供应系统正遭到破坏。正如埃森哲咨询公司的理查德·佩恩（Richard Payne）所说，对贸易商的威胁来自两端：供应链一端的农民利用更多的科技手段来自己掌控定价、融资和物流；而供应链另一端的零售商迫于像亚马逊这类科技公司的压力，会压榨食品生产商及其供应商。尽管如此，经营了一个半世纪的嘉吉已经学会了如何左右逢源。 ■



Growing leather in factories

More skin in the game

Genetic engineering can now be used to grow leather without any need to raise and kill animals

LEATHERMAKING is an ancient craft. The oldest leather artefact found so far is a 5,500-year-old shoe from a cave in Armenia, but paintings in Egyptian tombs show that, 7,000 years ago, leather was being turned into all manner of things, from sandals to buckets to military equipment. It is a fair bet that the use of animal skins for shelter and clothing goes back hundreds of thousands of years at least.

Leathermaking is also, though, a nasty business. In 18th-century London the soaking of putrefying hides in urine and lime, to loosen any remaining flesh and hair, and the subsequent pounding of dog faeces into those skins to soften and preserve them, caused such a stench that the business was outlawed from the City proper and forced downwind and across the river into Bermondsey. In countries such as India and Japan, the trade tainted people as well as places and was (and often still remains) the preserve of social outcasts such as Dalits and Burakumin.

Modern production methods are less stomach-turning than those of the 18th century. Dog turds, lime and urine have been replaced by chromium and other chemicals. But some of those replacements are, themselves, pretty caustic substances. And the whole leather industry, based as it is on animal hides, is vulnerable these days to sensibilities about the relationship between human beings and other animals that would scarcely have crossed peoples' minds in former years. Set against these considerations is a commercial one: leather, prized for its durability and suppleness, is a business worth \$100bn a year.

These contrasting facts make leather manufacturing a tempting target for technological disruption. And tanned animal skins are indeed about to face a rival. The challenge comes not, as might be assumed, from a substitute made of synthetic polymer, but rather from something which is, in most respects, the same as natural leather. The difference is that, instead of coming from an animal's back, this leather is grown, by the metre, in factories.

| *Moo!*

The most advanced practitioner of the still-experimental art of growing leather is Modern Meadow, an American firm. This month it moved from Brooklyn, New York, where its 60 staff have been quietly developing the new material, to a laboratory in Nutley, New Jersey, where they will begin production trials. Modern Meadow, which has raised more than \$50m from investors and is collaborating with a number of as-yet-unnamed other firms in the clothing, shoe, furniture and automotive industries, hopes to bring the new material to market within two years.

Factory-grown leather promises several advantages over skins taken from animals. One is that it can be made in convenient sheets with straight edges, rather than being constrained by the irregular shapes that animals come in. Another is that it is more consistent than the natural stuff. It is devoid of the scars, marks and other defects to which real skin is inevitably prone. Nor does it vary from animal to animal in the way that natural leather does. All these facts reduce waste and improve quality. They will also, presumably, please those who feel that animals should not have to die in order that people can have nice shoes and plush seat covers.

To produce its leather, Modern Meadow begins with a strain of yeast that has been genetically engineered to make a protein identical to bovine collagen. Collagen is the principal structural protein in animal bodies. In particular, it gives strength and elasticity to skin. It consists of long chains

of amino-acids, the building blocks of all proteins, wound together in threesomes to form triple-helices that are then, in turn, wound together to make fibres.

In animal skins both the synthesis of the initial amino-acid chains and their subsequent winding into fibres are done by special cells called fibroblasts. One crucial trick Modern Meadow's bioengineers have mastered, though they are reluctant to talk about the details, is encouraging the chains spat out by the yeast to assemble themselves into fibres without the intervention of fibroblasts. Once the fibres are there, though, it is not too hard to persuade them to organise themselves into layers that are, to all intents and purposes, sheets of raw leather. These can then go for tanning, dyeing and finishing in the usual way.

According to Dave Williamson, the company's chief technology officer, this process has been designed so that it can be scaled up easily and carried out in existing industrial plants. Dr Williamson used to work for DuPont, a big chemicals firm, so he has lots of experience with such equipment. It would also be possible, he observes, to make the collagen in large, central facilities and then transport it to local factories and tanneries for conversion into hide. As to cost, the new material will, he says, be competitive with natural leather.

One other advantage of Modern Meadow's manufacturing process is that it permits different parts of a sheet to be given different properties. That can change both the look and the feel of the product in controlled ways. One area might, for instance, be made stiff while another is made soft. This would allow the newfangled "hides" to be custom-built for particular designs of shoe. The process could also be tweaked, though the company has announced no plans to do so, to expand beyond cow hides, by encoding other types of collagen in the yeast. That would permit analogues of specialist leathers, such as ostrich or alligator, to be grown.

Modern Meadow is not, Dr Williamson says, actually out to ape leather. Rather, the firm's aim is to produce a new material in its own right, complete with brand name. That is designed to take the wind out of the sails of anyone who might seek, paradoxically, to contrast the perfection of a synthetic product with the inherent flaws of a natural one in a way advantageous to the latter, as has happened to synthetic gem-quality diamonds.

The chosen name will be revealed on October 1st at a fashion show in the Museum of Modern Art, in New York—as will a T-shirt, the first garment to be made from the material. Biotechnology will thus strut its stuff on the catwalk, and leather, whatever title it goes by, will take its first, halting steps away from the abattoir. ■



在工厂种皮

真皮无限量

现在可以通过基因改造来种皮，完全不需要饲养和杀死动物

制革是一项古老的工艺。目前发现的最古老的皮制品是在亚美尼亚一个洞穴里找到的一只5500年前的鞋子。但埃及墓穴里的绘画显示，7000年前，皮已经被制成凉鞋、水桶、军事装备等各种各样的东西了。我们可以合理地推测，至少在几十万年前，动物皮就已被用作遮蔽物和衣服了。

不过，制革也是一门讨人厌的生意。在18世纪的伦敦，人们在尿液和石灰中浸泡渐趋腐化的兽皮，让其上残留的肉和毛松脱，然后敲打狗粪使之渗入兽皮中，让其软化并防腐。这个过程中散发出浓烈的恶臭，使得制革在伦敦市被彻底列为非法，被迫迁往隔河相望的下风区域伯蒙德赛区。在印度和日本这类国家，制革污染人也污染环境，直到今天也往往是达利特人和部落民这类被社会排斥的群体才会从事的行业。

现代制革工艺不像18世纪时那么让人反胃。狗粪、石灰和尿液已被铬等化学品替代。但有些替代物本身就是强腐蚀性物质。基于动物皮肤的整个制革业如今也因为人类和其他动物间关系的敏感而易受攻击，而这种敏感早年间几乎无人注意。和这些顾虑相左的是商业利益：皮革耐用又柔软，深受人们喜爱，是一门每年1000亿美元的生意。

这些相互矛盾的事实让制革很容易成为技术颠覆的目标。而鞣制兽皮确实将迎来一位对手。和人们的猜测不同，它不是一种由合成聚合物打造的人皮替代物，而是一种从大多数方面来讲都和天然皮一模一样的东西。区别在于，这种皮不是来自某种动物的背脊，而是在工厂里一米一米地种植出来。

| 嗒！

美国公司“现代草甸”（Modern Meadow）在研发这种仍处于实验阶段的工艺上走在最前列。它的60名员工之前在纽约布鲁克林静悄悄地开发这种新

材料，本月搬到新泽西州纳特利（Nutley）的一个实验室开始试生产。这家公司从投资者那里融资5000多万美元，如今正和成衣、鞋、家具和汽车制造业里一批不知名的公司合作，希望在两年内将这种新材料推向市场。

相比从动物身上剥离的皮，工厂种植的皮有几项优势。其一是它可以制成一张张边缘平直的皮而方便使用，不会像兽皮那样受到形状不规整的限制。另一个是它比天然皮更均匀，不会带有疤痕、胎记等真皮难免而常有的瑕疵。它也不像天然皮那样存在动物之间的个体差异。所有这些特点都减少了浪费，提升了质量。那些认为动物不该为了人们想要好看的鞋和毛绒椅套而死的人想必也该为此感到高兴。

要生产出这种皮，“现代草甸”公司首先使用一株经基因改造的酵母生成一种和牛胶原蛋白一模一样的蛋白质。胶原蛋白是动物体内主要的结构性蛋白质，尤其能给皮肤增加韧性和弹性。它由氨基酸长链组成，这种肽链是所有蛋白质的基本组成。三条肽链缠绕形成胶原三螺旋，后者再交织形成纤维。

在动物皮中，氨基酸链的合成和接下来交织成纤维的过程都是由一种叫做纤维原细胞的特殊细胞完成的。“现代草甸”的生物工程师们已经掌握了一项重要技术：让酵母“吐出”的氨基酸链无需纤维原细胞的干预就自行聚合成纤维（但他们不愿意透露更多细节）。然而一旦形成了纤维，要促使它们自行排列组合成一张张可用于各种用途的原料生皮，就不是太难了。这些生皮而后会被拿来用惯常的方式鞣制和染整。

据该公司首席技术官戴夫·威廉森（Dave Williamson）称，这项工艺的设计令它易于规模化并在现有的工厂里投用。威廉森博士曾为大型化工公司杜邦工作，所以在相关设备方面有丰富的经验。他认为还有一种可能性是在大型中央设施里制造这种胶原蛋白，再将它们转运到地方工厂和皮革厂内制成皮革。他说这种新材料的成本将能和天然皮竞争。

“现代草甸”的制造工艺另有一个优势：可以让一张皮的不同部位带有不同的特征。这能以可控的方式改变成品的外观和手感，比如让一个地方更坚

硬而另一处更为柔软。这就可以为特定的制鞋设计定制新奇的“兽皮”。这个过程还可以被微调，通过在酵母中编码不同类型的胶原蛋白，使之不仅限于种植牛皮——虽然该公司并没有宣布这方面的计划。这就可以种植出类似于鸵鸟皮或鳄鱼皮等特殊皮的材料。

威廉森博士说，公司的目标实际上并不是模仿真皮，而是生产出一种自成一派的新材料，再赋予它一个品牌。这么做是为防范一些人又要荒谬地把人造物品的完美无瑕和天然物品与生俱来的缺陷拿来对比以凸显后者的“天然”优势，就像人造珠宝级钻石受到的待遇那样。

这种新材料的名字将于10月1日在纽约现代艺术博物馆的一场时装秀上宣布。由它制作的第一件衣服——一件T恤——也会在那里亮相。生物技术的成果将在T形台上昂首阔步，而这种皮，无论它会叫什么名字，都将第一次从远离屠宰场的地方蹒跚起步。 ■



Cancer

Pop!

Microscopic lasers may stop tumours spreading around the body

IT IS more than 50 years since “Fantastic Voyage” hit the silver screen. The film’s premise, shrinking a submarine and her crew of doctors to the point where they can travel through a patient’s bloodstream to repair damage *in situ*, though entertaining, remains as absurd as it was in 1966. Not so the idea that therapeutic machines small enough to circulate in this way might be built. Indeed, perhaps inspired by the film, several such efforts have been made. Some are drug-delivery devices. Some are ways of concentrating externally applied energy into tissue that needs to be killed. And they are starting to be approved for clinical use.

The latest attempt, by Vladimir Zharov of the University of Arkansas and Mark Stockman of Georgia State University, in Atlanta, involves injecting cancer patients with hordes of tiny lasers that will seek out and destroy so-called circulating tumour cells (CTCs). These are cells that have broken off a primary tumour and which, if left unchecked, might lodge in various parts of the body and turn into secondary cancers, a process called metastasis.

The minuscule lasers which the pair use, of a type developed a few years ago by Dr Stockman, are called “spasers”. This is short for surface-plasmon amplification by stimulated emission of radiation. Surface plasmons are clouds of electrons that oscillate over a conductive surface. Spasers generate them in response to stimulation by an external light source.

A red blood corpuscle has, for reference, a diameter of about 7,000nm (nanometres, or billionths of a metre). The spasers created by the two researchers, by contrast, are a mere 22nm across. They consist of a gold core with a diameter of 10nm surrounded by a silica shell doped with

fluorescent dyes. The outer surface of this shell is coated with folic acid.

A conventional laser consists of a resonator (usually a chamber with mirrors at either end, between which the light being amplified bounces), and a gain medium, which sits between the mirrors and takes external energy (also often in the form of light) and employs it to amplify the bouncing light. In the spasers Dr Zharov and Dr Stockman are using, the gold acts as the resonator and the doped silica as the gain medium. Instead of amplifying light, the system amplifies plasmons oscillating across the surface of the gold sphere.

The device's other ingredient, the folic acid, is its guidance system. Unlike most healthy cells, cancer cells are usually covered with folate-receptor molecules. If a spaser comes into contact with such a cell, it therefore tends to stick. So, if a horde of spasers is injected into someone with metastasising cancer, those spasers should quickly track down CTCs in the bloodstream or lymphatic system and bond to them. Laboratory studies show that, often, dozens of spasers will attach themselves to a single cell. Once attached, they are quickly absorbed into that cell.

Spasers so absorbed can be employed for two purposes: diagnosis and destruction. Shining low-level laser light into a patient, either through his skin or (to reach deeper inside) through a fibre-optic probe, causes cancerous cells containing spasers to shine brightly. That reveals their locations. Applying more powerful laser pulses (though still at a level harmless to humans) transforms the spasers into killers. The idea behind this was Dr Zharov's. In a piece of past research he turned a laser onto some cells from a melanoma, an aggressive form of skin cancer. One characteristic of melanomas is the presence in them of particles of melanin, a dark pigment. These particles absorbed the laser light, heated up, and, he discovered, thus created bubbles of steam around themselves that could kill the cells they were in.

The researchers' plan was to use their spasers to do something similar to CTCs, with the spasers substituting for melanin particles. And it worked. The external laser pulses stimulated the spasers to produce plasmons that heated the water surrounding them in a cell to well over 100°C. That created steam bubbles, the sudden formation of which generated shock waves which blew the affected cells to bits.

To exploit this effect therapeutically, Dr Zharov and Dr Stockman plan to fit patients with special wrist sensors. Such a sensor will use low-level laser light to detect spaser-carrying CTCs passing through blood vessels beneath. It will then swiftly activate a high-powered laser to destroy those cells. With luck, this arrangement will keep secondary cancers at bay while a patient's primary tumour is dealt with. Spaser treatment would then continue for a while longer, to deal with leftover CTCs.

Animal trials having been promising; the two researchers are now planning to test the system in people. They are also trying to tweak their spasers to respond to infra-red, rather than visible light. Infra-red penetrates tissue more deeply than visible light can manage, so an infra-red-sensitive spaser should be more effective.

Exactly how good an executioner of human CTCs the spaser system will be remains to be seen. But even a partial slaughter would inhibit metastasis. And that would have a potent effect on treatments for all sorts of cancers. ■



癌症 砰！

微型激光器或可阻止肿瘤在体内扩散

《神奇旅程》（Fantastic Voyage）上映至今已经有50多年了。这部电影的基本设定是把一艘潜艇和艇上的医生缩小到能够穿过患者血流的程度，以便“就地”修复损伤。这一点虽然有趣，其荒谬程度在如今看来也和1966年时并无二致。然而，制造出小到可以进入血液循环的治疗机器却不再是异想天开。事实上，也许是受到电影的启发，人们已经做过几次这样的努力了。有的是制造药物输送装置，有的则是将外部施加的能量集中到需要杀死的组织上。这些装置已开始被批准用于临床。

阿肯色大学的弗拉基米尔·扎罗夫（Vladimir Zharov）和亚特兰大佐治亚州立大学的马克·斯托克曼（Mark Stockman）的最新尝试，是为癌症患者注入大量会寻找和摧毁所谓的循环肿瘤细胞（CTC）的微型激光器。这些细胞是从原发性肿瘤上脱落下来的，如果不加以控制，它们可能附着在身体的各个部位，演变成继发性癌症，这一过程称为癌症转移。

两人使用的微型激光器是几年前由斯托克曼开发的，称为“spaser”，是“激发辐射式表面等离子体放大”的缩写。表面等离子体是在导电表面上振荡的电子云。在受到外部光源激发后，spaser会产生这种电子云。

红血球的直径约为7,000纳米。相比之下，这两位研究员发明的spaser直径仅有22纳米。它有一个直径10纳米的金芯，再包裹上掺有荧光染料的二氧化硅壳。壳的外表面上涂有叶酸。

传统的激光器由谐振器（通常是两端装有反射镜，光在其中往复反射并放大的腔室）和位于反射镜之间并且吸收外部能量（通常也以光的形式提供）的增益介质组成。在扎罗夫和斯托克曼使用的spaser中，由金充当谐振器，掺杂的二氧化硅作为增益介质。该系统不是放大光，而是放大在金球表面振荡的等离子体子。

该设备的另一成分叶酸是其引导系统。与大多数健康细胞不同，癌细胞通常被叶酸受体分子覆盖。因此spaser与这样的细胞接触后较易粘附其上。那么如果将一大批spaser注射到发生癌症转移的患者体内，这些spaser应该会迅速跟踪到血液或淋巴系统中的CTC并与之结合。实验室研究显示，一个细胞上通常就能附着数十个spaser。而一旦吸附，这些spaser会被迅速地吸收到细胞内。

以这样的方式被吸收的spaser可以用于两个目的：诊断和破坏。将低剂量的激光照射到患者身上，无论是透过皮肤还是通过光纤探头（以到达体内更深处），都会让含有spaser的癌细胞发出明亮的光。这就暴露了它们的位置。施加更强大的激光脉冲（仍是无害于人体的剂量）可将spaser变为杀手。这背后的想法来自扎罗夫博士。在过去的一项研究中，他对着一些黑色素瘤（一种侵袭性皮肤癌）细胞开动激光器。黑色素瘤的一个特征是其中存在暗色的黑色素颗粒。这些颗粒吸收了激光后温度升高，他发现，颗粒周围会形成蒸汽泡，并可杀死其所在的细胞。

两位研究员的计划是使用他们的spaser对CTC做类似的处理，而这里的spaser代替了黑色素颗粒。它起效了。外部激光脉冲激发这些spaser产生了等离子体，使其周围细胞中的水加热到远高于100℃的温度。由此突然形成的蒸汽泡产生了冲击波，将细胞打成碎片。

为了在治疗上利用这种效应，扎罗夫和斯托克曼计划让患者戴上特殊的腕式传感器。该传感器将使用低剂量激光来检测穿过下方血管并携带spaser的CTC。然后它将迅速激活高功率的激光来摧毁这些细胞。运气好的话，这种疗法可在对付患者的原发性肿瘤时遏制继发性癌症的发生。Spaser治疗将再多持续一段时间来对付残留的CTC。

动物试验的结果令人振奋；两位研究员正在计划在人身上测试该系统。他们也试图调整spaser，使其能够响应红外线而非可见光。相比可见光，红外线可穿透更深层的组织，所以对红外线敏感的spaser应该会更有效。

Spaser系统作为人类CTC的杀手到底有多好还有待观察。但即使是部分杀

灭也可抑制转移。这将对各类癌症的治疗大有助益。 ■



Facial technology (2)

Making faces

Researchers produce images of people's faces from their genomes

CRAIG VENTER, a biologist and boss of Human Longevity, a San Diego-based company that is building the world's largest genomic database, is something of a rebel. In the late 1990s he declared that the international, publicly funded project to sequence the human genome was going about it the wrong way, and he developed a cheaper and quicker method of his own. His latest ruffling of feathers comes from work that predicts what a person will look like from their genetic data.

Human Longevity has assembled 45,000 genomes, mostly from patients who have been in clinical trials, and data on their associated physical attributes. The company uses machine-learning tools to analyse these data and then make predictions about how genetic sequences are tied to physical features. These efforts have improved to the point where the company is able to generate photo-like pictures of people without ever clapping eyes on them.

In a paper early last month in *Proceedings of the National Academy of Sciences*, Dr Venter and his colleagues describe the process, which they call "phenotype-based genomic identification". The group took an ethnically diverse group of 1,061 people of different ages and sequenced their genomes. They also took high-resolution, three-dimensional images of their faces, and measured their eye and skin colour, age, height and weight. This information was used as a "training set" to develop an algorithm capable of working out what people would look like on the basis of their genes.

Applying this algorithm to unknown genomes, the team was able to

generate images that could be matched to real photographs for eight out of ten people. (This fell to a less impressive five out of ten when the test was restricted to those of a single race, which narrows facial differences.) About a year ago, using the same algorithm, the company produced a prediction of what your correspondent looked like at the age of 20 from her genome. The result can be compared below with a photograph of her at that age. Readers can judge for themselves if it is a reasonable likeness.

Critics immediately took to social media to dispute the findings. Jason Piper, a former employee of Human Longevity, argued that “because everyone looks close to the average of their race, everyone looks like their prediction”. One thing in Dr Venter’s favour, however, is that the findings are based on a relatively small group of people. With machine-learning techniques, the larger the set of data the better the results; working with tens of thousands of genomes could well improve the prediction rate.

Creating pictures of people’s faces from their genomes has a number of potential uses, especially in forensic science. It might be possible to reconstruct the face of a perpetrator from any genetic material they have left behind, such as blood or body fluids. That would allow police to “see” the face of suspects in cases of murder, assault and rape. It could also help with identifying unrecognisable victims who have been burned or maimed. Unsolved cases might be reopened if suitable samples were still available.

As Dr Venter is quick to point out, this technology has other implications, among them for privacy. He considers that genomic information must now be treated as personal information, even if it is presented as an anonymised sequence of letters—as is currently the case in some countries. It will, he warns, be possible to construct a face from the limited genetic data that people currently post online, for example, from DNA-testing services such as 23andMe.

This in turn raises the possibility that people may no longer be willing to have their genetic information included in public sequencing efforts, even though such work can help combat diseases. If facial projections can be made from genomes, then someone's appearance could subsequently be matched to real online photographs. This might mean that people's genetic sequences, and all their flaws, could be connected to their identity in public.

The connection between genes and faces can work both ways. Just as genomes can be used to build up a picture of faces, so facial features are able to reveal genetic diseases. It is reckoned that 30-40% of genetic diseases cause changes to the shape of the face or skull, allowing, in some cases, experienced doctors to diagnose a condition simply by looking at a patient's face. So why not train an app to do that?

| *Face healer*

Companies already are. Face2Gene is a smartphone app developed by FDNA, a startup based in Boston co-founded by Moti Shniberg and Lior Wolf. Mr Shniberg's previous venture was bought by Facebook to develop the photo-tagging feature that identifies people in pictures uploaded to the social-media site. The FDNA app allows a doctor to snap a picture of a patient, upload it to the internet (along with the patient's height, weight and clinical data) and let the firm's algorithm produce a list of possible diseases from its online database. The app can access information on 10,000 diseases; facial recognition works for 2,500 of them, so far.

Each diagnosis comes with a probability score that reflects the chances of the app being correct. It also lists any genetic mutations known to cause the disease, which can help with an analysis of a patient's condition. Dekel Gelbman, FDNA's chief executive, estimates that the app is being used by doctors and researchers in 130 countries. The patients' data are stored securely, anonymised and encrypted.

As with Dr Venter's work, the deeper the pool of data available to facial researchers, the more valuable it becomes. Christoffer Nellaker of the University of Oxford has set up a website called "Minerva & Me", where both the healthy and those with diseases can upload pictures of themselves and provide consent for their images to be used for studies. He is also setting up a network, the Minerva Consortium, to encourage artificial-intelligence researchers to share their data.

Maximilian Muenke of the National Human Genome Research Institute in Bethesda, Maryland and Marius Linguraru of the Children's National Health System in Washington, DC, and their colleagues are trying to broaden things out, too. They have published a series of studies using facial-recognition algorithms that were trained with photos of African, Asian and Latin American patients to identify different genetic diseases with accuracies of more than 90%. In many poor countries, expensive antenatal tests to identify genetic diseases are not available. A baby with Down's syndrome, for example, is usually identified before birth in Europe and America, but in poor countries many are not diagnosed before they are a year old. The researchers intend to produce an app that will help doctors to identify dozens of the most common syndromes using a smartphone. ■



人脸识别技术（2）

构造脸谱

研究人员凭借基因组信息生成人脸图像

生物学家克雷格·文特尔（Craig Venter）是“人类长寿”公司（Human Longevity）的总裁，这家位于圣地亚哥的公司正在建造世界最大的基因组数据库。文特尔是个颇具叛逆色彩的人物。上世纪90年代后期，他宣称由公共资金支持的人类基因组测序国际合作项目使用的方法不对，并自行开发了一套更便宜快捷的方法。而他最新的搅局之作是从基因组数据预测一个人的长相。

人类长寿公司已为45,000个基因组测序，大部分来自参与临床试验的患者，同时也取得了相关的体貌特征数据。该公司用机器学习工具分析这些数据，然后预测基因序列与体貌特征的关联。研究工作取得了进展，公司已经能对未曾见过的人生成类似照片的肖像画。

上月初，文特尔及其同事在《美国国家科学院院刊》（Proceedings of the National Academy of Sciences）上发表论文，描述了这个他们称之为“基于表型的基因组鉴别”的过程。研究人员为不同年龄、来自多个族群的1061人做了基因组测序。他们还拍摄了研究对象的脸部高清三维影像，并记录其眼睛和皮肤的颜色、年龄、身高和体重。这些信息被用作“训练集”，来开发一套能根据基因推断外貌的算法。

研究团队将此算法应用于未知基因组，所生成的人脸图像中，十张里有八张能与真人照片匹配。但当测试仅在单一种族中进行时，由于研究对象面部差异减小，准确率就不太出色了，十张图片中仅五张与真人相似。约一年前，该公司使用同一算法，通过基因组测出本文作者在20岁时的样子。所得人像图片与本人当年的照片并排比较，读者可自行判断两者是否足够相似。

批评者迅速在社交媒体上对研究成果提出了异议。人类长寿公司的前雇员

杰森·派珀（Jason Piper）认为，“人们的容貌与所属种族的平均样貌接近，所以每个人都和预测出的样子差不多”。然而，对文特尔有利的一点是，这项成果仅仅是基于较小范围的人群得出的。对机器学习技术而言，数据集越大，结果就越准确，运用数以万计的基因组可以大大提高预测准确率。

根据基因组生成人脸图像有多种可能的用途，尤其是对于法医学。行凶者遗留的任何基因物质，如血液或体液，都可能用于重建其脸部形象。这能让警方“看到”谋杀、攻击及强奸案件中疑犯的面目。该技术也有助于识别因遭焚烧或肢解而无法辨认的受害人的身份。假如仍然可以获得合适的基因样本，悬案也许可以重新开案调查。

正如文特尔随即指出的，这种技术还有其他影响，包括对隐私的冲击。他认为，基因组信息如今必须被视为个人信息，即便它们是以匿名字母串的形式呈现——一些国家目前就采用这种形式。他警告，仅凭目前发布在网上的有限的个人基因信息，例如在DNA测试服务网站23andMe上公布的那些，便可能构建出其面容图像。

这继而又引发了另一种可能性，即人们可能不再愿意为公共基因测序项目提供自己的基因信息，尽管这类研究有助于对抗疾病。假如可以通过基因组推测容貌，那么一个人的外貌随后就可与网上的真人照片匹配。这可能意味着人们的基因序列及所有缺陷都可与其公开身份联系起来。

基因和面容之间的关联是双向的。正如基因组可被用作构建人脸图像，面部特征也能显露遗传疾病。据估计，30%至40%的遗传性疾病会导致脸部或头骨形状发生变化，在某些情况下，经验丰富的医生只需观察病人的面部便可诊断病情。那何不训练应用程序来完成这样的工作呢？

| 面诊师

已经有公司在这么做了。莫蒂·斯尼伯格（Moti Shniberg）和利奥尔·沃尔夫（Lior Wolf）在波士顿创立的创业公司FDNA开发了一款智能手机应用Face2Gene。斯尼伯格之前创建的公司被Facebook收购，专门开发照片

标记功能，从上传到该社交网站的照片中识别出用户。FDNA的这款应用让医生拍下一张病人的照片，将照片连同病人的身高体重及临床数据传到网上，然后由该公司的算法根据在线数据库生成一份清单，列出病人可能患有的疾病。该应用可以访问一万种疾病的信息，其中能用人脸识别做出诊断的目前有2500种。

每个诊断都附有一个概率数字，表示该应用的预测正确率。程序还会列出已知可能导致该疾病的基因突变，帮助分析患者的病情。FDNA的首席执行官德克尔·季博曼（Dekel Gelbman）估计，130个国家的医生和研究人员正在使用该应用。患者的数据经匿名和加密处理，被安全地存储起来。

跟文特尔的研究一样，面部研究人员可用的数据量越大，其研究的价值就越大。牛津大学的克里斯托弗·奈拉科尔（Christoffer Nellaker）设立了名为“智慧女神与我”（Minerva & Me）的网站，健康人士或患者都可以上传自己的照片到该网站，并授权各项研究使用这些照片。他还设立了名为“智慧女神联盟”（Minerva Consortium）的社团网络，鼓励人工智能研究人员分享数据。

马里兰州贝塞斯达市（Bethesda）的美国国家人类基因组研究所（National Human Genome Research Institute）的马克西米兰·穆恩克（Maximilian Muenke）和华盛顿特区美国国家儿童健康系统（Children's National Health System）的马吕斯·林古拉鲁（Marius Lingurararu）及其同事们也在努力扩展这方面的研究。他们已发表一系列研究成果，运用以非洲、亚洲及拉美患者的照片训练出的人脸识别算法来辨别不同的遗传疾病，准确率超过90%。许多贫困国家没有昂贵的产前检查来筛查遗传疾病。比如，在欧洲和美国，患唐氏综合症的婴儿通常在产前就能筛查出来，但在贫困国家，许多唐氏婴儿在一岁前是无法诊断的。研究人员打算研发一款应用，帮助医生使用智能手机来识别数十种最常见的综合症。■



Facial technology (1)

Keeping a straight face

In the first of two stories about faces and technology, artificial intelligence is used to spot signs of sexuality

MODERN artificial intelligence is much feted. But its talents boil down to a superhuman ability to spot patterns in large volumes of data. Facebook has used this ability to produce maps of poor regions in unprecedented detail, with an AI system that has learned what human settlements look like from satellite pictures. Medical researchers have trained AI in smartphones to detect cancerous lesions; a Google system can make precise guesses about the year a photograph was taken, simply because it has seen more photos than a human could ever inspect, and has spotted patterns that no human could.

AI's power to pick out patterns is now turning to more intimate matters. Research at Stanford University by Michal Kosinski and Yilun Wang has shown that machine vision can infer sexual orientation by analysing people's faces. The researchers suggest the software does this by picking up on subtle differences in facial structure. With the right data sets, Dr Kosinski says, similar AI systems might be trained to spot other intimate traits, such as IQ or political views. Just because humans are unable to see the signs in faces does not mean that machines cannot do so.

The researchers' program, details of which are soon to be published in the *Journal of Personality and Social Psychology*, relied on 130,741 images of 36,630 men and 170,360 images of 38,593 women downloaded from a popular American dating website, which makes its profiles public. Basic facial-detection technology was used to select all images which showed a single face of sufficient size and clarity to subject to analysis. This left 35,326 pictures of 14,776 people, with gay and straight, male and female, all

represented evenly.

| *Out of the numbers*

The images were then fed into a different piece of software called VGG-Face, which spits out a long string of numbers to represent each person; their “faceprint”. The next step was to use a simple predictive model, known as logistic regression, to find correlations between the features of those faceprints and their owners’ sexuality (as declared on the dating website). When the resulting model was run on data which it had not seen before, it far outperformed humans at distinguishing between gay and straight faces.

When shown one photo each of a gay and straight man, both chosen at random, the model distinguished between them correctly 81% of the time. When shown five photos of each man, it attributed sexuality correctly 91% of the time. The model performed worse with women, telling gay and straight apart with 71% accuracy after looking at one photo, and 83% accuracy after five. In both cases the level of performance far outstrips human ability to make this distinction. Using the same images, people could tell gay from straight 61% of the time for men, and 54% of the time for women. This aligns with research which suggests humans can determine sexuality from faces at only just better than chance.

Dr Kosinski and Mr Wang offer a possible explanation for their model’s performance. As fetuses develop in the womb, they are exposed to various levels of hormones, in particular testosterone. These are known to play a role in developing facial structures, and may similarly be involved in determining sexuality. The researchers suggest their system can pick up subtle signals of the latter from the former. Using other techniques, the program was found to pay most attention to the nose, eyes, eyebrows, cheeks, hairline and chin for determining male sexuality; the nose, mouth corners, hair and neckline were more important for women.

The study has limitations. Firstly, images from a dating site are likely to be particularly revealing of sexual orientation. The 91% accuracy rate only applies when one of the two men whose images are shown is known to be gay. Outside the lab the accuracy rate would be much lower. To demonstrate this weakness, the researchers selected 1,000 men at random with at least five photographs, but in a ratio of gay to straight that more accurately reflects the real world; approximately seven in every 100. When asked to select the 100 males most likely to be gay, only 47 of those chosen by the system actually were, meaning that the system ranked some straight men as more likely to be gay than men who actually are.

However, when asked to pick out the ten faces it was most confident about, nine of the chosen were in fact gay. If the goal is to pick a small number of people who are very likely to be gay out of a large group, the system appears able to do so. The point is not that Dr Kosinski and Mr Wang have created software which can reliably determine gay from straight. That was not their goal. Rather, they have demonstrated that such software is possible.

| *To calculate the selves of others*

Dr Kosinski is no stranger to controversial research. He invented psychometric profiling using Facebook data, which relies upon information in a person's profile to model their personality. The Trump campaign used similar models during last year's presidential campaign to target voters, an approach which has generated criticism.

Dr Kosinski says he conducted the research as a demonstration, and to warn policymakers of the power of machine vision. It makes further erosion of privacy "inevitable"; the dangers must be understood, he adds. Spouses might seek to know what sexuality-inferring software says about their partner (the word "gay" is 10% more likely to complete searches that begin "Is my husband..." than the word "cheating"). In parts of the world where being gay is socially unacceptable, or illegal, such software could

pose a serious threat to safety. Dr Kosinski is at pains to make clear that he has invented no new technology, merely bolted together software and data that are readily available to anyone with an internet connection. He has asked *The Economist* not to reveal the identity of the dating website he used, in order to discourage copycats.

It is true that anyone wishing to replicate Dr Kosinski's work to determine intimate traits from faces will face significant challenges in applying laboratory science to the outside world. But they will be helped by ever-growing volumes of data and improving algorithms. "The latter, over time, inevitably win," says Alessandro Acquisti of Carnegie Mellon University, who has shown that an individual's social security number can be discovered using face recognition and online information. For those with secrets to keep, all this is bad news. ■



人脸识别技术 (1)

不露声色

人脸与科技专题之一——用人工智能识别性取向

现代人工智能（以下简称AI）深受推崇。归根到底，就是因为它那从大量数据中发掘模式的超人能力。Facebook已利用这种能力绘制出空前详尽的贫困地区地图，它使用的AI系统学会了如何在卫星图片中辨认人类居住区域；医疗研究人员训练智能手机中的AI程序来检测癌症病变；谷歌的一套系统可以准确猜出照片拍摄的年份，只因为该系统看过的照片数量之多非人力所能及，因而能发现人类无法察觉的模式。

AI发掘模式的能力正被用于更为私密的事情。斯坦福大学的米哈尔·科辛斯基（Michal Kosinski）和王轶伦的研究显示，机器视觉可通过分析人脸来推断性取向。他们认为，软件是通过检测面部结构上的细微差异而做出推断的。科辛斯基表示，只要使用恰当的数据集，也许还可以训练类似的AI系统来识别其他私密特征，如智商或政见。人类无法发现人脸发出的这些信号，并不意味着机器也识别不了。

这项研究的详情即将发表于《个性与社会心理学期刊》（Journal of Personality and Social Psychology）。研究使用的数据下载自美国一家公开会员资料的热门约会网站，包含36,630名男性的13,0741张照片，以及38,593名女性的170,360张照片。研究人员首先利用基本的人脸检测技术，在所有照片中挑选出单张人脸的大小和清晰度可满足分析需要的照片，最终选出14,776人的35,326张照片，其中包括同性恋和异性恋、男性和女性，比例均等。

| 数字乾坤

接着，这些图片被输入到另一个名为VGG-Face的软件中，它给每个人都分配了一长串数字，作为其“脸纹”。下一步是采用名为“逻辑回归”的简单预测模型，探寻“脸纹”特征与其主人性取向（按约会网站上公布的情况）之间的关联。当所得出的模型分析它之前没见过的人脸数据时，区分同性恋

和异性恋的能力远高于人类。

面对随机显示的一张男同照片和一张直男照片，该模型的辨别准确率为81%。当显示同一人的五张照片时，模型的准确率达91%。在女性数据上，模型的表现较为逊色，凭一张照片辨别性取向的准确率为71%，五张照片时的准确率为83%。两种情况下，其表现均远超人类的区分能力。面对同样的照片，人们对男性性取向的识别率为61%，对女性性取向的识别率为54%。有研究显示人类从他人面部特征辨别性取向的能力仅略胜于瞎猜，上述数字印证了这一点。

科辛斯基和王轶伦为该模型的表现提供了一种可能的解释。胎儿在子宫中发育时，会暴露于各种不同水平的激素（尤其是睾丸酮）环境中。目前已知激素水平会影响到面部结构的发育，而它们对性取向可能也有类似的作用。研究人员表示，系统可以从面部结构获取有关性取向的细微信号。通过使用其他技术，研究人员发现该程序在识别男子性取向时最留意观察鼻子、眼睛、眉毛、面颊、发际线和下巴；对于女性，程序则更关注鼻子、嘴角、头发和领口。

这项研究有其局限性。首先，约会网站上的照片很可能会特别彰显个人的性取向。91%的准确率是有前提的——已知显示照片的两名男子中有一人是同性恋。在实验室之外，准确率会低得多。为展示这一弱点，研究人员随机选取1000名男子，每人至少有五张照片，但其中男同和直男的比例更接近于现实世界的情况——每100人中约有7人为同性恋。在被要求挑出100名最有可能是同性恋的男子时，系统选择的人中只有47人是男同。这表明，在系统看来，某些直男比真正的男同更像同性恋。

然而，当要求系统挑选出它最有把握是同性恋的十张脸时，它选出的十人中有九人的确是同性恋。假如目标是从一大群人中挑出少数很可能是同性恋的人，系统似乎是可以胜任的。重点并不是科辛斯基和王轶伦创造出了能可靠识别性取向的软件——这不是他们的目标，而是他们证明了这样的软件已能够实现。

| 计算他人隐私

科辛斯基并非第一次涉足争议性研究。他之前发明过基于Facebook数据的心理测量分析方法，利用人们个人资料中的信息估测其个性。去年美国总统大选时，特朗普的竞选团队就采用过类似的模型来定位目标选民，这种方法引来了批评。

科辛斯基表示，他做这项研究是要演示机器视觉的威力，并使政策制定者对此有所警惕。这种威力会令个人隐私“不可避免地”被进一步侵蚀，而人们必须要了解这种危险。配偶也许会想知道性取向识别软件会如何判断自己的伴侣（搜索关键词“我丈夫是不是……”时以“同性恋”结尾的几率比“出轨了”高10%）。在同性恋不为社会接受或被视为非法的地区，这样的软件可能会造成严重的安全威胁。科辛斯基竭力强调自己并没有发明什么新技术，只是把互联网上任何人都可以取得的软件和数据结合起来而已。他请《经济学人》对其使用的约会网站保密，以阻止他人效仿。

诚然，任何人若想复制科辛斯基的研究、通过人脸特征推断私密特质，都会在把实验室技术应用于外部世界时面临重大挑战。但不断增加的数据量和不断改进的算法会帮助他们。“假以时日，他们定会胜出。”卡内基梅隆大学的亚历山德罗·阿奎斯蒂（Alessandro Acquisti）说道。他已证明，运用人脸识别技术和网上信息就能查出一个人的社保号。对那些有秘密要隐藏的人来说，这一切都是坏消息。■



Visual computing

The facial-industrial complex

Ever better and cheaper, face-recognition technology is spreading

TOURING the headquarters of Megvii in Beijing is like visiting Big Brother's engine room. A video camera in the firm's lobby recognises visitors in the blink of an eye. Other such devices are deployed around the office. Some of the images they capture are shown on a wall of video called "Skynet", after the artificial-intelligence (AI) system in the "Terminator" films. One feed shows a group of employees waiting in front of an elevator with a white frame around every face and the name of each person next to it. Quizzed on the Orwellian overtones of the set-up, Yin Qi, the startup's chief executive, simply remarks that "this helps catch bad guys."

Even if Mr Yin wanted to ponder the implications of the technology, he would not have the time. Megvii is busy building what he describes as a "brain" for visual computing. The firm has come a long way since its founding in 2011 (its name stands for "mega vision"). More than 300,000 companies and individuals around the world use its face-recognition technology, which is called Face++, making it one of the biggest such services. In December Megvii raised \$100m, giving it a valuation of nearly \$2bn and turning it into the world's first billion-dollar startup from might be called the "facial-industrial complex".

Providers in this field sell hardware and software tools to recognise faces and then connect those faces to other useful data. Although the market is fairly small—the most optimistic estimates put it at a few billion dollars—the technology has started to permeate the wider business landscape. The main reason is that the accuracy of facial recognition is rapidly improving, putting it on the same trajectory as speech recognition, which really took off when accuracy improved by a final few percentage

points, to almost 100%. “Most people underestimate the difference between 95% and 99% accuracy—99% is a game-changer,” Andrew Ng, a noted AI researcher, has said about speech recognition.

What’s more, the smartphone will do for face recognition what smart speakers, such as the Amazon Echo, have done for speech recognition: make it acceptable to consumers. Millions of Chinese already “swipe” their faces on smartphones to authorise payments. On September 12th Apple unveiled a new version of its iPhone, with technology that can reliably identify the owner’s face and then unlock the device, even in the dark. That will come only a few weeks after Samsung presented a new Galaxy Note with a similar but less sophisticated feature.

It makes sense to separate facial-recognition technology into two categories: the underlying capability and the applications that make use of it. Megvii’s Face++ belongs in the first category, as do similar offerings from SenseTime, another Chinese startup, NTechLab, a Russian firm, as well as Amazon, IBM and Microsoft. All provide face recognition as a cloud-computing service. Megvii’s customers can upload a batch of photos and names, and use them to train algorithms, which then can recognise those particular people. Firms can also integrate the recognition service into their own offerings, for instance to control access to online accounts.

Megvii’s and SenseTime’s services are largely founded on good data. They have access to the Chinese government’s image database of 700m citizens, who are each given a photo ID by the age of 16. Chinese government agencies are also valuable customers—more and more of the country’s hundreds of millions of surveillance cameras will soon recognise faces. In Shenzhen facial recognition is used to identify jaywalkers; names and pictures go up on a screen. In Beijing the municipality has started using the technology to catch thieves of toilet paper in public restrooms (its system also prevents people from taking more than 60 centimetres of paper within

a nine-minute period).

Commercial applications, often powered by one of the cloud-computing services, are spreading even faster. On September 1st Ant Financial, a subsidiary of Alibaba, deployed its “Smile to Pay” system for the first time in a physical store: customers at a healthier version of a KFC restaurant, called KPRO, in Hangzhou, can settle their bill by looking at a screen (see picture). Xiaomai, a chain of convenience stores, has said it will use facial scans when people enter its stores in order to study their behaviour. Several Chinese banks now let users identify themselves at ATMs with their faces.

The West is further behind. Some industries have long used a basic kind of face recognition, including casinos wishing to turn away notorious gamblers. But it is mainly big online companies that make (cautious) use of the technology. Facebook has gone furthest by having its members tag friends on photos so the firm’s algorithms can recognise them on other pictures. Google employs the technology in order to group pictures that users have uploaded to its photo service. Amazon’s new home speaker, Echo Look, also has a camera, which could presumably be made to recognise faces.

Other firms are testing the waters. JetBlue and other American airlines have taken initial steps to match passengers’ faces to passport photos, aiming to eliminate boarding passes. Lloyds Bank is not the only Western bank planning to copy Chinese ones and allow customers to use their faces to log into accounts. Uber, a ride-hailing firm, has a system requiring drivers in India to take a selfie before starting a shift. This should cut down on unregistered drivers impersonating registered ones. Nvidia, a chipmaker, has plans for facial recognition in its new Californian headquarters.

There is potential for products that lift sales, too. Video cameras could, for instance, recognise loyal customers and VIPs who deserve special

treatment. They could detect dissatisfaction on shoppers' faces and dispatch staff to intervene. Walmart, the world's largest retailer, is said to be working on a facial-recognition system to improve customer service.

Unsurprisingly, perhaps, the spread of these services has already prompted efforts to thwart them. An Israeli startup, D-ID, which stands for "de-identification", has developed software that slightly alters photos so that algorithms cannot recognise them. This allows people to share pictures of their faces without having to worry that they will be used to identify them. Others have suggest low-tech defences against sophisticated surveillance systems, such as glasses with hallucinogenic patterns on the frame of the specs, or simply wearing masks or make-up.

Yet it is unlikely that such "adversarial attacks", in the lingo, will keep face recognition from being widely used. Mr Yin of Megvii expects the technology to become a commodity. This is why he has already set his sights higher. He is directing the firm's computer-vision brain towards even more complex tasks, such as interpreting human behaviour and recognising objects.

In the long run Mr Yin wants his firm to develop into an "algorithm factory" that offers all sorts of building blocks for computer-vision services, which other firms will be able to combine and recombine in order to come up with ever more sophisticated offerings. Whether Megvii lives up to this ambition or not, the technologies it peddles will only spread. ■



视觉计算

人脸识别-产业复合体

人脸识别技术性能不断提高，价格持续降低，应用范围渐广

在旷视科技的北京总部里参观，仿佛身处“老大哥”的中央控制室。公司大堂中的摄像头瞬间就能辨认出访客，办公楼里其他各处也安装了类似的设备。这些摄像头捕获的一些图像显示在一面叫“天网”的视频墙上（得名于电影《终结者》中的人工智能系统）。在其中一幅图像上，一群员工在电梯门外等候，每个人的面孔都由一个白色方框围住，旁边打出这个人的名字。当被问道这样的设置会不会有些奥威尔小说的意味时，这家创业公司的CEO印奇只回了一句，“这能帮着抓坏人。”

就算印奇会想要仔细思索这一技术有何意味，恐怕也没那个时间。用他的话来说，旷视如今正忙于打造一个视觉计算的“大脑”。该公司于2011年创立（其名字“Megvii”是“mega vision”即“巨大的视野”的缩写），至今已取得长足的发展。全球超过30万家公司和个人使用该公司研发的名为“Face++”的人脸识别技术，Face++因而成为这类服务中的领头羊之一。去年12月，旷视科技融资一亿美元，估值达到近20亿美元，在或可称之为“人脸识别-产业复合体”的队伍中成为全球第一家“独角兽”公司。

这一领域的供应商出售用来识别人脸的硬件及软件工具，再将识别出的人脸与其他有用的数据关联起来。这个市场相当小，最乐观的估计也只不过几十亿美元，不过该技术已开始向更广泛的商业领域渗透。这背后的主要原因是人脸识别的精确度正在快速提升，因而走上了和语音识别相同的发展轨迹——后者正是在精确度突破了最后几个百分点、几乎达到100%之时，真正实现了腾飞。知名人工智能研究者吴恩达针对语音识别这样说过：“大多数人都低估了精确度达到95%和达到99%之间的差别。达到99%，游戏规则就变了。”

再者，智能手机也会为人脸识别的发展发挥作用，就如同亚马逊的智能音箱Echo为语音识别所起的作用——让这项技术为消费者所接受。在中国，

已有数百万人在智能手机上“刷脸”来授权支付。苹果于9月12日发布的新款iPhone附带能够准确识别机主面孔来解锁手机的功能，即使在黑暗中也能操作。仅几周前三星推出的新款盖乐世Note也有类似的功能，但没有苹果的那么复杂。

将人脸识别技术分为两类是说得通的：一类是底层功能，另一类是利用此功能的各种应用。旷视科技的Face++属于第一类，同属这一类的还有另一家中国创业公司商汤科技、俄罗斯公司NTechLab、亚马逊、IBM和微软提供的类似服务。这些公司提供的人脸识别功能都属于云计算服务。旷视的客户可以上传一批照片和人名来训练算法，之后算法就可以识别出这一批人。企业也可以将人脸识别功能与自己提供的服务结合起来，例如管控对网上账户的访问。

旷视和商汤的服务大体上是建立在良好的数据之上。在中国，居民到16岁会办理一张带照片的身份证件，旷视和商汤能够访问包含七亿人身份照片的政府数据库。各个政府部门也是有价值的客户——全国有数亿个监控摄像头，其中能识别人脸的摄像头将会越来越多。在深圳，这一技术被用于识别乱穿马路的行人，这些人的名字和照片会显示在一个屏幕上。在北京，市政部门已开始采用该技术来识别在公共卫生间偷拿厕纸的人（该系统还会防止人们在九分钟之内拿取的卫生纸超过60厘米）。

商业应用（通常是在其中一家云计算服务的推动下）普及的脚步还要更快。9月1日，与阿里巴巴有关联的蚂蚁金服首次在杭州一家实体店中安装了“微笑支付”系统：在肯德基的绿色健康餐厅KPRO，消费者只需注视一个屏幕就能付账（见图）。连锁便利店小麦也表示将会在顾客进店时扫描他们的脸，为的是研究他们的行为。几家中国的银行如今让用户能在使用ATM机时刷脸证明身份。

西方国家远远落在了后面。一些行业早就采用了一种比较基础的人脸识别技术，比如赌场希望以此将声名不佳的赌客拒之门外。不过使用这项技术的主要是大型互联网公司——虽然不无谨慎。Facebook在这方面走得最远，它让用户在照片上标识出朋友，这样公司的算法就可以在其他照片上

将这些人识别出来。谷歌运用这项技术，将用户上传至其图片服务器上的照片分组。亚马逊的新款家用音箱Echo Look还有一个摄像头，很可能会用来做人脸识别。

其他的公司正在试水。捷蓝航空（JetBlue）和其他一些美国航空公司已采取初步行动，将旅客的脸和护照照片作比对，目标是取消登机牌。除劳埃德银行（Lloyds Bank）之外，其他西方银行也计划效仿中国的银行，让客户能够刷脸登录账户。在印度，网约车公司优步的一个系统要求司机在倒班上岗之前先自拍一张照片，此举应该可以减少未注册司机冒充注册司机的情况。芯片制造商英伟达计划在位于加州的新总部引入人脸识别系统。

能够帮助提高销售额的产品也很有前景。例如，摄像头可能会识别出值得给予特殊待遇的忠实顾客和VIP会员，也许还会探测到购物者不满的神色，然后派员工上前服务。世界最大的零售商沃尔玛据说正在开发一个人脸识别系统以改善客户服务。

随着这些服务日渐推广，人们已开始想方设法对抗它们，这或许也是意料之中的事。以色列创业公司D-ID（公司名意为“de-identification”，即“去身份识别”）开发了一种软件，可轻微修改照片，使之无法被算法识别。如此一来，人们在分享带有自己脸部的照片时就不用担心照片会被用于识别自己的身份。其他人想出了一些技术含量较低的办法来防御高明的监控系统，例如戴上那种镜框上有令人眩晕的图案的眼镜，或者干脆戴面具或化妆。

然而，这类行话称之为“敌手攻击”的举动不大可能会阻止人脸识别技术被广泛应用。旷视的印奇预计这项技术将会成为一种日常商品，因此他已定下了更高的目标。眼下他正引领公司的计算机视觉“大脑”去攻克更加复杂的任务，例如解读人类的行为和辨认物品。

印奇的长远规划是让公司成为一家“算法工厂”，为计算机视觉服务提供各种模块化产品，其他公司可对这些产品加以组合再组合，以开发出越来越高级的服务。不管旷视科技的这个宏图大志能否实现，它出售的那些技术

都将广泛传播。■



Building on success

The future, and how to get there

There is a lot more for immunotherapy to do

IMMUNOTHERAPY offers huge promise, both as an addition to established therapies and as a foundation for future ones. Hundreds of trials are pairing CTLA-4, PD-1 or PD-L1 inhibitors with chemotherapy, radiation and targeted therapies. One hope is that the older treatments will increase the range of antigens that the cancer offers for the immune system to latch on to, both by driving further mutations and by killing cancer cells. Dead cells release more antigens.

Then there is the development of further immunotherapies, which is being pursued both by building on the successes of the first checkpoint inhibitors and by using entirely new technologies, such as genome editing. Dr Wolchok at Memorial Sloan Kettering is working on the next generation of immune-modulators. These include new inhibitory compounds for IDO and TIM-3, another checkpoint. Some researchers are trying to remove further brakes on the system by killing or silencing some of its regulatory cells. Others are looking at molecules which activate the immune system in a similar way to IL-2. Nektar Therapeutics, a biotech firm based in San Francisco, is developing an engineered therapy which does this in a way that should, in principle, encourage tumour-killing T-cells. It is being tested as a combination treatment with an anti-PD-1 drug in five tumour types, including bladder cancer and a hard-to-treat form of breast cancer.

Other approaches seek to make sure that the immune system responds to as many cancer antigens as possible. Viruses genetically engineered to attack cancer cells might be used to this end. Even if such viruses did not kill enough cells to do the cancer much damage, the way in which they kill the cells would release otherwise hard-to-detect antigens that might help

the immune system target the tumour better.

Alternatively, the antigens could be provided from outside. Now that immunotherapies have wind in their sails, various old ideas are coming back into vogue. One of them is vaccination. The vaccines with which people are familiar are those against infectious disease. They work by priming the immune system to respond to an antigen associated with a specific pathogen, so that when the system encounters the infection for real it already knows how to fight it. Because some infections can lead to cancer, some of these vaccinations can prevent it. Sometimes, as in vaccination against hepatitis B, which can cause liver cancer, this is an added bonus. Sometimes, as in vaccination against human papilloma virus, which can cause cervical cancer, it is the main point.

But there may be another way to use vaccines against cancer. Equipped with the right antigen, a vaccine might encourage an immune response to a tumour which is already present, but which the immune system has failed to get to grips with. It is an approach that has been frequently tried in the past, and has repeatedly failed. But the availability of checkpoint inhibitors and the ability to pick out the most promising antigens may allow this form of targeting to come into its own.

Neon Therapeutics, Gritstone Oncology, Genocea Biosciences and other biotech firms are all pursuing the creation of personalised vaccines based on the mutations in an individual tumour. The trick is to find which of the novel antigens its genome says the tumour might be churning out are the most likely to provoke a strong response when served up to the immune system in the form of a vaccine. Jill O'Donnell-Tormey at the Cancer Research Institute (CRI), a non-profit in New York that concentrates on immunotherapies, says that everyone has their favourite algorithm to predict which antigens will get the best response. Together with the Parker Institute in San Francisco, CRI is creating a "bake off" where these

algorithms will be tested against each other.

If vaccines work in late-stage cancer—which is where most therapies are tried first—there might be scope for bringing them in sooner, at least in some cancers. In decades to come it is possible to imagine an approach where a tailored vaccine might be the first—and, ideally, the only—response to a blood test showing the presence of a cancer.

| *Reprogramming the genome*

Like immunotherapies, vaccines offer a way to hack the immune system by changing the way that its cells fight the cancer and increasing the number of them doing so. A less circuitous way of doing this is now on offer: reprogram the immune system directly. Take some of its cells out of the body, manipulate them so that they do what you want, encourage them to divide and multiply, then put them back and let them get on with the job.

The technology along these lines that has got furthest is called CAR-T, where CAR stands for “Chimeric antigen receptor”. These CARs are produced by splicing together the gene for an antibody that recognises a tumour antigen and the gene for a receptor that sits on the surface of the T-cells; put this new gene into a T-cell and it will be precisely targeted at the tumour. The small clinical trials undertaken to date suggest that this could be extremely effective. A trial of 31 patients with acute lymphoblastic leukaemia brought a complete, and unprecedented, remission in 93% of cases. A CAR-T therapy called Kymriah (tisagenlecleucel), made by the Swiss firm Novartis to treat B-cell acute lymphoblastic leukaemia, was approved for use in America on August 30th.

There are two main limitations to CAR-T. One is that so far the T-cells have been programmed to target a molecule, CD19, which is only common to the surface of a few blood cancers. The other is that CAR-T has been known to trigger immune reactions which can prove fatal. Neither problem is

obviously insoluble. Editing genes has been made much easier by a new technology known as CRISPR-Cas9, which has already been used to improve the way that CAR-T cells are engineered in mice. It may well eventually allow the receptors used in such therapies to be personalised to the specifics of the patient's cancer. And more precision, as well as experience, should lead to immune responses less likely to run away with themselves.

What such advances will not do, though, is make such treatments cheaper. Novartis's new therapy costs \$475,000. Genome-editing treatments seem likely to be the most expensive cancer treatments the world has yet seen. And that is saying quite a lot, since many of the newer cancer treatments are eye-wateringly pricey (see chart).

There are various reasons for this. More sophisticated R&D costs a lot. And antibodies are much more expensive to make than the smaller molecules used in older therapies. Generic versions of them are still few and far between. A company that can make antibodies which pass regulatory muster is much better advised to make ones it can sell for a premium.

But the overwhelming factor is that in America, the world's largest market for drugs, prices are set by what the market will bear. When life-saving drugs are available from only one or two providers high prices are a given. This is why pharma companies have piled into oncology over the past decade. They see a market which, by 2025, is forecast to be worth \$45bn-100bn a year.

Not all progress is expensive. Effective early diagnostics could save both money and suffering. The knowledge gained from blood biopsies should allow doctors to tailor treatments better, and avoid drugs that will not work on a given patient. And in a different economic setting bespoke vaccines, gene-editing treatments and the like could in times to come short-circuit

rising prices. Molecules made inside the body by reprogrammed cells should be cheaper than those made in expensive cultures. Cutting and splicing the genome could be a great deal cheaper than using scalpels and lasers on the body.

But in the world as it is new cancer therapies will continue to be among the most expensive interventions medicine has to offer, creating a challenge for health systems around the world. And some will disappoint. The immune system's complexity means that it will not always react as doctors hope. Some treatments will prove less effective than at first they seemed. This is a particular problem for cancer drugs, which tend to be approved after comparatively small trials. A recent study of 36 drugs approved between 2008 and 2012 found that 18 did not help patients to live longer. The price of these drugs ranged from \$20,000 to almost \$170,000 per patient.

The incidence of cancer will continue to be dominated by demographics. In developed countries, new therapies may not reduce the chances of getting cancer for some time, simply because older people get more cancers. But the chances of surviving your first cancer, or your next cancer, will improve—and for those with more amenable cancers, and access to the best treatment, they may do so quite quickly. Ever more people will still be told, “I’m afraid you have cancer.” But the words will become less fateful, the diagnosis ever less feared.

| *The cost of progress*

When Ms Milley was diagnosed with advanced lung cancer, she went on to Google and read the words “death sentence”. It is, alas, fairly typical for patients with terminal cancer to have little idea about their prognosis unless they seek it out. Many might be better served by more openness.

But prognosis is not destiny. Ms Milley started taking Keytruda in

December 2015. After two months of treatment her lesions had almost entirely vanished. So far, they have mounted no comeback, and she continues to feel well. She finds the response “amazing”.

On any given drug, in any given trial, most people will not be as fortunate. But one of the strange consolations of the current progress being made against cancer is that modern biomedicine makes it possible to learn more from failure than ever before. Huge amounts of the knowledge now saving lives was gained from dead and dying patients, loved ones and friends who lost their fight for life but left a legacy of data. In any given case, that is scant recompense. Put those contributions together, though, and they make a remarkable memorial. ■



乘胜追击

未来，以及如何抵达

免疫疗法能做的还有很多

无论是作为传统疗法的补充，还是作为未来治疗的基础，免疫疗法都带来了巨大的希望。目前有数百个试验正在将CTLA-4、PD-1或PD-L1抑制剂与化疗、放疗及靶向治疗配对。一个希望是，传统方法将通过驱动更多突变和杀死癌细胞来增加免疫系统可攻击的癌抗原的范围。被杀死的癌细胞会释放更多抗原。

然后是开发更多的免疫疗法，目前有两种途径：一是以第一批检查点抑制剂取得的成功为基础，开发新药物；二是使用全新的技术，比如基因编辑。纪念斯隆-凯特琳癌症中心的沃尔乔克医生正在研制下一代免疫调节剂，其中包括针对IDO和另一个检查点TIM-3的新抑制剂。一些研究人员正在尝试杀死或关闭免疫系统中的一些调节细胞来进一步移除对免疫系统的制动。其他人正在研究能像IL-2那样激活免疫系统的分子。总部位于旧金山的生物技术公司Nektar Therapeutics正在开发一种基因改造疗法来激发免疫反应，原则上会促生出能够击杀肿瘤的T细胞。目前这种疗法正和抗PD-1药物联合用于治疗五类肿瘤，包括膀胱癌和一种难以医治的乳腺癌。

其他方法则要确保免疫系统对尽可能多的癌抗原做出响应。经基因改造以攻击癌细胞的病毒可用于此目的。即使这样的病毒不能杀死足够多的癌细胞来严重破坏肿瘤，它们杀死癌细胞的过程会释放出原本难以被探测到的抗原，从而可能帮助免疫系统更好地瞄准肿瘤。

这种抗原也可以从外部提供。既然如今免疫疗法风头正劲，各种老点子又开始焕发青春。其一是接种疫苗。人们熟悉的疫苗都是针对传染病的，其作用机制是让免疫系统提前做好对与特定病原体相关的抗原做出反应，这样，当免疫系统真正遭遇感染时，就已经知道如何对付它了。一些感染可能导致癌症，所以一些疫苗就可以防癌。有时打疫苗是一个额外措施，比如接种乙肝疫苗——乙肝可能导致肝癌。有时打疫苗是抗癌的关键措

施，比如接种人乳头状瘤病毒疫苗（HPV），这种病毒可能导致宫颈癌。

但可能还有另一种方式来利用疫苗抗癌。带有正确抗原的疫苗可能会促使免疫系统对已经存在却未能被识别的肿瘤做出反应。这种方法在过去屡战屡败，但如今有了检查点抑制剂，再加上已有能力筛选出最有用的抗原，这种定向疗法可能会功德圆满。

Neon Therapeutics、Gritstone Oncology、Genocea Biosciences等生物技术公司都在研制基于个体肿瘤突变的个性化疫苗。从患者的基因组可以了解到其肿瘤可能会释出哪些新型抗原，而个性化疫苗的关键就在于从中找出那个最可能激发免疫系统做出强烈反应的抗原，然后把这种抗原提呈给免疫系统。专攻免疫疗法的纽约非营利组织癌症研究所（CRI）的吉尔·奥唐奈-托米（Jill O'Donnell-Tormey）表示，在预测哪种抗原将激发最佳反应时，每个人都有自己喜欢的算法。该组织正与旧金山的帕克癌症免疫疗法研究所合作，设计一个比赛来比试不同的算法。

假如疫苗能在晚期癌症中发挥作用（大部分疗法会首先在晚期癌症中尝试），那么或许可以让它们更早地参与到治疗中——至少在某些癌症中可以这样尝试。在未来几十年里，或许可以想象，当血液检测发现癌症时，定制疫苗可能是首先采用的方法，在理想情境下还可能是唯一需要采用的方法。

| 改编基因组

和免疫疗法一样，疫苗是一种干预免疫系统的手段：改变免疫细胞对抗癌症的方式，并增加参与斗争的细胞数量。现在还有一种不那么迂回的方法：直接改编免疫系统。把一些免疫细胞从体内取出，操纵它们使其能做你想让它们做的事，促进其分裂和繁殖，再把它们放回体内，让它们去做这件事。

在这类技术中走在最前沿的一种叫CAR-T，其中CAR代表“嵌合抗原受体”。这些CAR是这样产生的：将能够识别肿瘤抗原的抗体的基因和位于T

细胞表面的受体的基因拼接在一起。将这种新型基因置入T细胞中，它就能精确追击肿瘤。迄今为止开展的小型临床试验表明这可能非常有效。在对31例急性淋巴细胞白血病患者试验中，93%的患者出现了完全缓解，这是史无前例的。瑞士诺华公司（Novartis）制造的治疗B细胞急性淋巴细胞白血病的CAR-T疗法Kymriah（tisagenlecleucel）于8月30日获准在美国使用。

CAR-T有两个主要的限制。一是到目前为止，T细胞被编程用于狙击CD19分子，而这种分子仅常见于少数几种血癌的表面。二是CAR-T已知会引发可能致命的免疫反应。但这两个问题都并非明确无解。一种名为CRISPR-Cas9的新技术已经让基因编辑变得容易了许多，该技术已被用于改善在小鼠身上改造CAR-T细胞的过程。最终它可能会使这类治疗中使用的受体能够依据患者的具体情况来定制。而精准度的提高和经验的积累应该会减少免疫反应失控的情况。

不过，这些进展并不会让这类治疗变得更便宜。诺华的新疗法费用为47.5万美元。基因组编辑看来是世上最昂贵的癌症治疗方法。这个“最”非同小可，因为许多新疗法都已经贵得叫人瞠目结舌（见图表）。

这其中有很多原因。更复杂的研发过程成本很高。而相比在许多传统疗法中使用的较小的分子，研制抗体要贵得多。这些抗体的通用版本仍然少之又少。假如一家公司能够研制出达到监管标准的抗体，那么它当然是要制造那些能卖出高价品种才更符合自身利益。

但有一个压倒一切的因素。在美国这个全球最大的药品市场，价格是由市场可以承受的水平决定的。如果只有一两家供应商能提供拯救生命的药物，高价是必然的。这就是为什么过去几十年里制药公司蜂拥而入抗癌领域的原因。他们看到了这样一个市场：到2025年，其年价值预计将达到450亿至1000亿美元。

并非所有的进展都是昂贵的。有效的早期诊断既可以省钱又能减少痛苦。从血液活检中获得的信息应该会让医生更好地定制治疗，避免对个体病患

使用不起效的药物。而在不同的经济环境中，定制疫苗、基因编辑等治疗手段在未来不一定会更加昂贵。被改编的细胞在体内产生的分子应该会比在昂贵的培养液中制成的分子更便宜。切割和拼接基因组可能会比在病人身上使用解剖刀和激光便宜得多。

但在当前这个世界，新的癌症疗法仍将会是医学所能提供的最昂贵的干预措施之一，这为全球的医疗系统都带来了挑战。而一些方法会令人失望。免疫系统的复杂性意味着它的反应未必符合医生的预期。一些方法的实际效果会比一开始表现出来的差。这是抗癌类药物特有的问题，因为这些药物往往都是在相对小规模试验后被批准的。近期对2008年至2012年间获批的36种药物的研究发现，其中18种并没能帮助延长患者的生命。这些药物的价格从每位病人2万美元到近17万美元不等。

癌症的发病率将继续由人口构成所主导。在发达国家，新疗法在一段时间内可能并不会减小患癌的几率，这是因为老龄化会让更多人患癌。但是，人们从第一次癌症或下一次癌症中幸存下来的可能性将提高，尤其是对于那些罹患较易治疗的癌症并可获得最佳治疗的患者，存活几率可能会迅速提升。未来还是会有越来越多的人被告知：“你恐怕患上了癌症。”但这句话不再会有那么致命的意义，而人们也会越来越不害怕听到它。

| 进步的成本

当米莉被诊断患有晚期肺癌时，她上谷歌搜了搜，看到了“死刑”二字。可惜，在晚期癌症患者中，这种情况很典型：他们对自己病情的预后知之甚少，除非自己回家做点功课。假如医生能更开诚布公，可能对他们更好。

但预后并非宿命。米莉从2015年12月开始服用齐求达。经过两个月的治疗，她的病灶几乎完全消失，而且到目前为止都没有复发，她持续感觉良好。她发现药效好得“惊人”。

在使用任何一种药物、参加任何一个试验时，大多数人都不会像米莉那样幸运。但是，目前在抗癌领域取得的进展带有一个奇怪的慰藉：现代生物医学让我们可以前所未有地从失败中学习。如今正在拯救生命的大量知识

是从已经离世和濒临死亡的病人身上得来的。我们的爱人和亲友未能打赢抗癌这一仗，但留下了宝贵的数据。在任何一个个体身上，这几乎算不上是什么回报。但这些贡献累积起来，它们筑成了一个非凡的纪念碑。■



Free exchange

An offer we can't refuse

Powerful companies can be a boon to customers, but they still deserve scrutiny

WHEN Amazon announced in June that it would buy Whole Foods, an upmarket grocer, for \$13.7bn, other firms shuddered. The spread of Amazonian tentacles is worrying to those wary of concentrated corporate power. But shoppers entering their local Whole Foods these days find oddly low prices alongside the new stacks of Echoes, Amazon's voice-activated digital helpmate. This raises a question. Is Amazon hellbent on building a world-straddling monopoly, or merely injecting innovation and competition into yet another new market? For antitrust regulators, the welfare of the consumer is the priority. Yet working out how to protect it is harder than ever.

Competitiveness in most industries is a matter of degree. In the idealised marketplace of economics textbooks, the price people pay for goods equals the cost of producing an additional unit. Any higher, the theory goes, a competitor could cut the price a smidgen, sell another unit and profit. Yet outside commodity markets, most firms can charge more than marginal cost. Competing products are not perfect substitutes (no two brands of pasta sauce are exactly the same) and rivals cannot swoop in at once. The more distinctive a product, and the higher the barriers to entry, the more its seller resembles the nasty monopolies of the textbooks: raising prices and gouging profits. Breaking up such monopolies—as America's regulators once carved up Standard Oil and AT&T—is good for consumers and the economy as a whole.

If the competitiveness of markets is a spectrum, research suggests that American business has been moving along it, and not in the right direction. A new working paper from the National Bureau of Economic Research, by

Jan De Loecker of Princeton University and Jan Eeckhout of University College, London, provides some stark evidence. The authors analyse data on publicly traded American firms from 1950 to 2014. From 1950 to 1980, average mark-ups—that is, what firms charge customers above their cost of production—were relatively low (and flat), at about 18% over cost. Since 1980, however, mark-ups have risen steadily, to 67% on average. That translates into growth in the consumer-price level, relative to firms' costs, of about 1% per year.

But this rise in market power comes in several guises, with varying implications for consumers. In some industries—such as airlines, telecoms and retail banking—the public seems to be getting a raw deal.

Consolidation has been accompanied by high profits and shoddy service. Elsewhere, however, margins are probably rising as a result of product differentiation and personalisation. A name-brand designer, for instance, can charge a premium because the fashions sold by competitors, whatever their beauty, cannot (legally) carry that name. A firm selling bespoke IT services is in an analogous position. In tailoring its services to a customer's unique circumstances, it provides something of value and raises the cost of switching, earning itself room to charge a premium. Niche products seem to be on the rise in some professional services, in corners of the retail industry and on the high street—where quirky cocktail bars can charge far more than less funky mass-market watering holes. Such markets fall short of the ideal of perfect competition, but nor are they examples of lazy monopolies ripping off hapless consumers.

Amazon and other big internet firms belong to a different category from both the lumbering bullies of the airline industry and wallet-draining boutiques. High rates of profit combined with industry consolidation suggest there is no shortage of market power in the tech world. But it is tricky to work out what that means for consumers. In some cases, market power (and associated profits) can be seen as the prize for costly

innovation. That, after all, is the logic behind patents, which reward inventors for making knowledge public by granting them a temporary monopoly. Indeed, market power can be a lure to innovation. Constructing a new telecoms network is good for consumers but expensive; the reason to do it is the knowledge that it will not be viable for latecomers to compete away the first mover's profits.

When there are benefits to scale, dominant firms can cut costs and fatten margins without raising prices. The pile of data amassed by Google, for example, gives it an extraordinary edge in selling personalised advertisements, but also allows it to serve all its customers more effectively. And in the tech world, market power can be tenuous. New platforms displace old ones, and fresh technologies can undercut the value even of sprawling physical networks. Yet innovation-derived market power should not give firms a free pass—even if prices fall as a result.

| *Kale joys*

Tech giants like Apple and Facebook work to enmesh their customers in ecosystems that are difficult to escape from. Big firms can use the hordes of customers acquired in one business to put pressure on suppliers or squeeze customers in another. Microsoft once argued that bundling its browser with its Windows operating system gave consumers an extra boon at no cost; rivals thought consumers would lose out by becoming more captive to Microsoft's systems. The question hanging over today's antitrust debates is whether startling deals for consumers—from Gmail to cut-price organic almond butter—are the happy by-products of innovation or the foundations of formidable barriers to competition, which will ultimately harm consumers.

For now, the grocery market seems healthy enough. Amazon's annual sales are less than a third those of Walmart and its share of the grocery market is an unimpressive 2%, even after its recent acquisition. Both Amazon

loyalists and Whole Foods shoppers are likely to enjoy the perks of the combination, and cheaper avocados will come as a relief to hungry hipsters. But regulators must be vigilant, lest the time come to say: Stop! Good buy to all that. ■



自由交流

难以拒绝的优惠

实力强大的公司可以成为消费者的福音，但仍需对它们密切留意

亚马逊6月宣布将斥资137亿美元收购高端食品商全食超市（Whole Foods），令其他公司不寒而栗。在那些警惕企业权力集中的人看来，亚马逊的触手伸得越来越远，令人担忧。不过，这些日子走进本地全食超市的购物者发现，除了货架上多了几排Echo——亚马逊的声控数字助手，商品价格低得出奇。由此产生了一个问题：亚马逊是在不顾一切地打造一个横跨全球的垄断企业，还是只是在向又一个新市场注入创新和竞争？对反垄断监管者来说，消费者的福祉是头等大事，但要弄明白如何保护这种利益却比以往任何时候都更难了。

在大多数行业里，竞争是个程度问题。在经济学教课书描绘的理想化市场中，人们向商品支付的价格等于额外生产一件产品所需的成本。按此理论，如果价格比这更高，竞争对手就可以略微削价，卖出另一件产品并获利。但在大宗商品市场之外，多数企业都能够定出高于边际成本的价格。竞争性产品并不是完美的替代品（没有哪两个品牌的意面酱是完全一样的），竞争者也不会迅速挤入市场。一件产品越是独特，市场的准入门槛越高，其销售者的做派就越像教科书中可恶的垄断企业：抬高价格并攫取大把利润。打破这种企业的垄断地位——就像美国监管机构当年分拆标准石油和AT&T那样——对消费者和整个经济都有好处。

如果说市场的竞争程度是一个“光谱”，研究显示美国的商业一直在这个区间移动，但不是朝着正确的方向。美国国家经济研究所最近发布了一篇工作论文，从中可看出一些赤裸裸的证据。论文的两位作者——普林斯顿大学的扬·德·洛克（Jan De Loecker）和伦敦大学学院的扬·埃克豪特（Jan Eeckhout）分析了美国上市公司在1950年至2014年间的数据库。从1950年到1980年，平均的标高金额（即商品定价高出生产成本的部分）相对较低（且持平），大约相当于成本的18%。然而自1980年起，标高金额一直在稳步上升，到2014年平均占到生产成本的67%。也就是说，相对于

企业的成本，消费价格水平每年大约上升1%。

不过这种市场支配力的提升有几种不同表现，对消费者的影响也有所不同。在某些行业，例如航空、电信、以及零售银行，公众似乎正在遭受不公平的对待。伴随企业整合而来的是高额利润和劣质的服务。然而在其他行业，利润率提升也许是产品差异化和个性化行销的结果。比如，一位知名品牌设计师可以把价格定得很高，因为竞争对手出售的时装不管有多好，也不能（合法地）使用其品牌的名字。售卖定制信息技术服务的公司情况与此类似。公司依据客户的独特情况为其量身定制服务，过程中提供了有价值的东西，增加了对方更换服务商的成本，从而获得了抬高价格的资本。在零售行业的角落及大众市场，某些专业服务领域里的利基产品似乎在增加，比如，那些稀奇古怪的鸡尾酒吧和面向大众市场的、没那么时髦的酒吧相比，酒水的价钱会高出许多。这样的市场未达到充分竞争的理想状态，但它们也不同于那种狠宰倒霉的消费者、日子舒坦的垄断企业。

亚马逊和其他大型互联网公司属于另外一个类别，它们既不同于那些仗势欺人、行动迟缓的航空公司，也不像那些会榨干人们钱包的精品店。从科技业界的高利润率和行业整合可以推测，该行业不乏市场支配力，但要弄清楚这对消费者来说意味着什么并不容易。在某些情况下，市场支配力

（以及由此而来的利润）可以被视作对昂贵创新的奖赏，毕竟专利背后的逻辑就是如此——发明者将自己的新发现公开，作为回报，他们将获得暂时的垄断地位。市场支配力确实可以成为创新的诱因。搭建一个新的通讯网络对消费者有益，但却造价高昂，之所以有人会去做这件事，是因为他知道自己作为先行者获得的利润不会被后来者抢夺。

当取得了规模效益，占据霸主地位的企业不用提价就能降低成本、增加利润。以谷歌为例，该公司因积聚了大量数据而在出售精准广告方面占据非同寻常的优势，不过这些数据也让它得以更有效地为所有用户服务。而且，在科技行业里，市场支配力也可能很脆弱。新平台取代旧平台，即使是覆盖范围广阔的有形网络，其价值也可能被创新科技削弱。但是，就算公司的市场支配力是因创新而获得，也不应让它们随心所欲——就算价格因此下降也不行。

| 煞风景

苹果和Facebook这样的科技巨头努力将用户锁在自己的生态系统中，让他们难以脱身。大公司可利用自己在一项业务中获得的大批用户，在另一项业务中向供应商施压或压榨用户。微软曾经声称，自己将浏览器与Windows操作系统捆绑销售的做法让用户不用多花钱就得到了一项额外福利。竞争对手却认为，这让用户越发受制于微软的系统，而丧失获取其他好东西的机会。如今关于反垄断的讨论中，一个仍有待厘清的问题是，消费者获得的那些惊人的礼遇——从Gmail到降价的有机杏仁酱——是令人愉悦的创新副产品，还是构成了巨大竞争壁垒的基础。若是后者，消费者最终将会受损。

目前来看，食品杂货市场还非常健康。亚马逊的年销售额不到沃尔玛的三分之一，即便在近期的并购之后，它在食品杂货市场中的份额也只有区区2%。亚马逊的忠诚支持者和全食超市的顾客很可能都会从两者的结合中享受到好处，饥肠辘辘的潮人们也会因牛油果降价而感到宽慰。但监管者一定要保持警惕，以免到了哪天，什么划算的买卖都没了。■



Free exchange

Priceless

Free stuff on the internet comes at a cost

FACEBOOK, whose users visit for an average of 50 minutes a day, promises members: “It’s free and always will be.” It certainly sounds like a steal. But it is only one of the bargains that apparently litter the internet: YouTube watchers devour 1bn hours of videos every day, for instance. These free lunches do come at a cost; the problem is calculating how much it is. Because consumers do not pay for many digital services in cash, beyond the cost of an internet connection, economists cannot treat these exchanges like normal transactions. The economics of free are different.

Unlike conventional merchants, companies like Facebook and Google have their users themselves produce value. Information and pictures uploaded to social networks draw others to the site. Online searches, selections and “likes” teach algorithms what people want. (Now you’ve bought “The Communist Manifesto”, how about a copy of “Das Kapital”?)

The prevalence of free services is partly a result of history. In the early years of the internet, consumers became used to getting stuff for nothing. They have little idea of how much their data are worth; since digital companies have access to billions of people, the value of one person’s data is tiny anyway. More fundamentally, scarcity is not a constraint in the digital world as it is in the physical one. Data are both inexhaustible and super-cheap to transport. In 1993 MCI Mail was charging people 50 cents for the first 500 characters of a digital message, increasing by ten cents for each extra 500. The internet slashed that price to zero. Charging would have been impractical, so small is the marginal cost.

Users may pay nothing, but companies like Google and Facebook have fixed

costs to cover: engineers, data centres, etc. To make money, they squeeze their users indirectly, by charging companies to put appropriate advertisements in front of captive eyeballs. In the second quarter of 2017, Facebook eked an average of \$4.65 out of each of its users by peppering screens with ads and promoted posts. (By comparison, just eight cents came from payments and other fees, mainly from people paying for stuff within virtual games.)

In the absence of prices, economists struggle to work out what people are getting back when they barter their data and attention for digital services. Some evidence suggests that they are doing rather well. A recent study by Erik Brynjolfsson, Felix Eggers and Avinash Gannameneni of the Massachusetts Institute of Technology offered people different cash amounts in exchange for giving up Facebook for a month. Based on the responses, they then estimated its average annual value to the consumer at around \$750. A simpler survey in the same study (without real cash offers) suggested that on average people value free search engines at \$16,600 per year, maps at \$2,800 and video at \$900.

This sounds like a wonderful deal for the consumer, but it generates problems elsewhere. Take taxes. Professionals are not allowed to evade tax by selling their services for benefits in kind, so why should consumers not be taxed if they are paid for their data in the form of services? Statisticians also struggle in a post-price world. GDP is mostly measured by transactions at market prices. A recent study by Leonard Nakamura of the Federal Reserve Bank of Philadelphia and Jon Samuels and Rachel Soloveichik of the Bureau of Economic Analysis used the amount spent on advertising to estimate uncounted output, and calculated that in 2013 American GDP should have been \$19bn higher than reported.

Privacy activists also worry. Consumers tend to respond much more strongly to “free” offers than to prices that are only fractionally higher than

zero. When Amazon first offered free shipping in European countries, orders surged—but not in France, where by mistake it charged around ten cents. The activists’ concern is that the “free” label fosters poor decisions, making people, for example, reveal more about themselves than they would in a more formal exchange. Researchers talk of the “privacy paradox”: when asked, people say that they care much more about their privacy than their actions would suggest.

The free economy also troubles competition authorities. Excessive market power can be defined as the ability to raise prices above what would be charged in a competitive market. With no prices to compare, and other options only a click away, companies such as Google seem to operate in an environment of cut-throat competition. It is naive to think so. Consumers are more captive than the low cost of switching might imply. Google, for example, commands a market share for internet search of over 90% in most countries in the European Union, where antitrust authorities in June fined it €2.4bn (\$2.7bn) for promoting its own comparison shopping services above its competitors’. Its services may have been free, but the trustbusters judged that its market power was curbing consumers’ choices. In the absence of prices, lack of competition will show up in other ways: demanding more information from users than they want to give, for example; or irritating them by stuffing their service chock-full of adverts.

| *No such thing as a free exchange*

Opinion is divided on whether the free economy needs fixing, and if so, how. In his book “Who Owns the Future?”, Jaron Lanier suggests that tiny payments for digital contributions might correct yet another problem, a misallocation of labour. If companies paid people for useful data, rather than mopping up what they leave behind as they use online services, then prices could nudge people towards more productive online activity. Others advocate tougher regulation, mandating that consumers have the option of

paying for a version of their social-media platforms free of advertisements and digital profiles. Neither seems imminent, and each comes with its own problems. But both would at least force people to start counting the cost of that priceless lunch. ■



自由交流

道是无价却有价

互联网免费午餐有代价

Facebook的用户平均每天花50分钟使用该网站。它“免费，且永远免费”的承诺对用户来说无疑像捡了个大便宜。表面上看，互联网上净是这种“大便宜”，Facebook只是其中之一——YouTube的观众每天观看视频的时间总计多达10亿小时。这些免费午餐确实是有代价的，问题在于如何计算这些代价。除了连接互联网的费用，消费者没有为很多数字服务付费，经济学家因而不能将这类交换视为常规交易。免费服务的经营模式有所不同。

有别于传统商家，Facebook和谷歌这样的公司让用户自己来为它们创造价值。上传到社交网络的信息和图片会将其他人吸引过来。在线搜索、选择和“点赞”让算法了解人们的需求。比如，既然你买了本《共产党宣言》，那是否考虑再买一本《资本论》呢？

免费服务盛行在一定程度上是历史的产物。在互联网时代早期，消费者就已习惯了免费午餐。他们不清楚自己的数据值多少钱。而数字公司接触到的人数以亿计，因此单个人的数据不管怎么说价值都很小。更重要的是，不同于实体世界，数字世界里没有“稀缺”一说。数据取之不竭，传输又超级便宜。1993年，美国通讯公司MCI的电邮服务对前500个字符收费50美分，之后每增加500个字符续收10美分。而互联网则将这笔费用削减至零。边际成本微乎其微，还收费的话就不切实际了。

用户也许是不用支付任何费用，但谷歌和Facebook这样的公司需要承担花在工程师、数据中心等上面的固定成本。为了赢利，它们间接榨取用户，将精准定位的广告推送到用户眼前，让他们不由自主地浏览，为此向公司收取广告费。通过充斥屏幕的广告和推广帖，2017年第二季度Facebook平均从每个用户那里赚取了4.65美元。相比而言，只有8美分来自用户付费和其他费用，主要是购买虚拟游戏中的装备。

由于不存在价格，经济学家很难计算出人们在用数据和注意力换取数字服务时实际得到了多少。一些证据显示人们得到免费服务挺值的。在最近的一项研究中，麻省理工学院的埃里克·布莱恩约弗森（Erik Brynjolfsson）、菲利克斯·艾格斯（Felix Eggers）以及阿维纳什·甘纳门耐尼（Avinash Gannameneni）向受试者提供数目不等的现金，作为交换，受试者放弃使用Facebook一个月。他们根据受试者的反应估算出，对消费者来说Facebook的平均年价值在750美元左右。同一项研究中一个更简单的调查（没有真正提供现金）显示，平均下来，人们对免费搜索引擎的估价为每年16,600美元，免费地图2800美元，免费视频900美元。

听起来，这对于消费者是个很不错的交易，但它却在其他方面引发了问题，比如税收。既然不允许专业人士以出售服务换取实物福利的方式逃税，那如果消费者提供了数据而以服务的形式获得报酬，他们怎么就可以不交税？统计人员同样因为无价格领域而为难。GDP大多由以市场价成交的交易来衡量。在最近一项研究中，费城联邦储备银行的莱纳德·纳卡穆拉（Leonard Nakamura）以及美国商务部经济分析局（BEA）的乔恩·塞缪尔斯（Jon Samuels）、雷切尔·索洛维切克（Rachel Soloveichik）通过广告费来估算未计入的产值，估测出2013年美国GDP应该比实际报告的多190亿美元。

隐私权倡议人士也感到担忧。比起那些几近为零的价格，消费者对免费品还是情有独钟得多。亚马逊在欧洲首次推出免运费服务时，订单激增，但法国除外——由于操作失误，亚马逊在法国收取大约10美分的运费。隐私权倡议人士担心，“免费”的旗号会助长轻率的决定，例如，比起较为正规的交易，人们在获取免费服务时会泄露更多的隐私。研究人员谈到了“隐私悖论”的现象：当被问及隐私权时，人们表示他们很关心自己的隐私，而他们的行为却远非如此。

免费经济同样困扰着竞争监管机构。过高的市场支配力可以定义为，企业能够将价格提升到高于竞争性市场中要价的水平。没有明码标价可以比较，且用户只需点一下鼠标就可轻易转向其他选择——这样看来，谷歌这样的公司好像是在一个竞争惨烈的环境中运营。如果这样想就未免天真

了。虽然转换服务商的成本极低，消费者并没有看上去那么自由。例如，谷歌在欧盟大多数国家控制着超过90%的互联网搜索的市场份额，今年6月，因为在搜索结果中将自己的比价购物服务置于其他竞争对手之上，欧盟反垄断机构向其罚款24亿欧元（27亿美元）。它的服务或许是免费的，但是反垄断人士判定，它的市场支配力限制了消费者的选择。在没有标价的情况下，竞争不足会以其他方式呈现，比如要求消费者提供超出其意愿的信息，或者在服务中填满广告而让消费者不堪其扰。

| 天下没有免费的交易

免费经济是否需要修正？如果需要，该怎么修正？对此人们意见不一。杰伦·拉尼尔（Jaron Lanier）在《谁拥有未来》（Who Owns the Future?）一书中表示，如果用户在网络上的贡献能得到哪怕很少的报酬，可能还会纠正另一个问题——劳动力分配不当。假设公司为有用的数据向人们付费，而不是将他们使用网络服务时留下的信息“一网打尽”，那么价格可能会将人们推向更富效益的网络活动。另一些人倡导更严厉的监管——规定消费者可以付费来选用一个没有广告也无需提供个人资料的社交媒体平台。以上两种措施似乎都不会很快到来，而且也都有各自的问题。但是至少两者都会迫使人们开始计算——这种免费午餐究竟代价几何？ ■



Loosening inhibitions

Immunity, and how to encourage it

Medicine has finally figured out how to get the immune system to fight cancer

THAT infections could sometimes cause a cancer to retreat, or even vanish, was known well before the advent of modern medicine. Imhotep, a pharaoh, recommended treating a tumour with a poultice followed by an incision—something that would help an infection develop. In early modern Europe doctors used septic dressings on tumours with ulcers and deliberately created purulent sores. By the end of the 19th century, William Coley, a bone surgeon in New York, was methodically infecting patients with *Streptococcus* bacteria.

Coley's work fell out of favour, partly thanks to the rise of radiation therapy. Many continued to cling to the idea that the immune system might in some circumstances be provoked into recognising, attacking and subduing a cancer; they just didn't know how to provide the provocation. In 1976 this latent belief in the potential of "immunotherapy" blossomed into hope with the discovery of interleukin 2 (IL-2). IL-2 is a growth factor that encourages the production of T-cells, white blood cells that scan the body for unwanted invaders and, on finding them, activate other parts of the immune system, including the B-cells which produce antibodies.

But IL-2 was a false dawn. On its own, it activated the immune system indiscriminately, and the immune system is a powerful beast; Elad Sharon, at the National Cancer Institute's division of treatment and diagnosis, says the effects were "toxic and messy, and frequently sent patients to the ICU." That might have been more tolerable in a drug that delivered. But to general surprise and discouragement IL-2 cured only a few patients of metastatic cancers. It was not clear why the treatment was not more effective.

Answers started to arrive in the 1990s. James Allison, at the Cancer Research Laboratory at the University of California, Berkeley, began work on a protein called CTLA-4 on the surface of some T-cells. By 1996 he had shown that this protein put a brake on the immune response to cancer. Blocking CTLA-4 with an antibody removed the brake; the immune system activated itself and got to work. Tumours in mice vanished when the animals were given CTLA-4-blocking antibodies. Though it was not immediately obvious, in retrospect this came to be seen as one of the reasons IL-2 never really worked: it is not possible to make a car run faster if its brakes are jammed on.

At the time oncologists were unimpressed by Dr Allison's results. Cancer had been cured in mice many times over. And after many failed trials, immunotherapy was in exile—banished to the small corners of the big oncology meetings. But in 1999 Tasuku Honjo of the University of Kyoto, in Japan, showed that the gene for a protein called PD-1 also seemed to tamp down the immune system. When this gene was switched off in mice, some developed autoimmune diseases—a sign of an immune system in overdrive. In collaboration with Arlene Sharpe and Gordon Freeman at Harvard, Dr Honjo showed that some cancer cells had a second protein called PD-L1 on their surfaces which, by interacting with the PD-1 on T-cells, protected the cancer from them. Dr Honjo remembers approaching many companies with the finding, but “none wanted to invest.”

Despite a general wariness on the part of pharma companies, though, a trickle of development on therapies aimed at CTLA-4 and PD-1 did begin. Then, in 2010, Bristol-Myers Squibb released results from a trial of an anti-CTLA-4 antibody, Yervoy (ipilimumab), in malignant melanoma. Compared with the state of the art, they were fantastic. It was the first drug shown to change survival in this devastating disease, raising the median to ten months. Some survived much longer.

What was going on? Because the immune system is such a powerful beast, evolution has equipped it with a system of checks and balances lest it get out of hand. Both CTLA-4 and PD-1 are parts of that system. When one sort of immune cell presents an antigen which it has picked up to another, the second cell will ignore it if, at the same time, the first cell stimulates the CTLA-4 receptor. If the CTLA-4 receptor is blocked with an antibody like Yervoy, though, this “checkpoint” system does not work. Unchecked, the immune system is able to react to a wider range of antigens—including tumour antigens. Freed up by Yervoy the body’s T-cells started attacking the melanomas. And, it turned out, kept on attacking them. Perhaps the most remarkable feature of the new “checkpoint inhibitor” was that a small subset of patients survived for year after year.

Despite indications of success with melanomas, many scientists thought the checkpoint-inhibitor mechanism would not be broadly effective. Melanomas accumulate a very large array of mutations, and are thus more likely than most cancers to display antigens which trigger an immune response. This argument was bolstered by the observation that melanomas are more likely than other cancers to be subject to spontaneous remissions—presumably because something else kicks the immune system into gear. What was more, Yervoy had serious, sometimes life-threatening side-effects.

Pessimists have a pretty good record when it comes to cancer prognostication. But this time they were wrong. At Merck Roger Perlmutter, an immunologist who had previously left the company, was brought back to run the research labs. He became very interested in a PD-1-blocker then known only as MK-3475. Unlike CTLA-4, which works higher up the immune system’s chain of command, PD-1 has a front-line role; if a cancer cell carries PD-1’s counterpart, PD-L1, on its surface, T-cells will ignore the cell despite any suspicious antigens it may be carrying (see diagram). MK-3475 seemed to block the interaction nicely. It might thus render the

immune system blind to the cancer's subterfuge. "Whatever [else] you are doing, stop," Perlmutter told his clinical-development group. Merck expanded a phase 1 trial programme looking at the drug's effect on advanced melanoma to more than 1,200 patients, making it the largest phase 1 trial in the history of oncology.

The expansion was in part a response to a new discovery: early evidence suggested that checkpoint inhibitors could also get results with lung cancers, which are a much bigger killer than, and thus represent a much larger market than, malignant melanomas. Luis Diaz, head of solid-tumour oncology at the Memorial Sloan Kettering Cancer Centre in New York, recalls: "It was completely unexpected. Prior to that I was not a believer in immunotherapy."

| *Whispers of a cure*

Merck's PD-1 drug would eventually be given the commercial name Keytruda (pembrolizumab). In 2014 it became the second checkpoint inhibitor to be approved in America—the world's largest and most lucrative pharmaceutical market. Opdivo (nivolumab), a PD-1 drug which Ono Pharmaceuticals had developed on the basis of Dr Honjo's work, soon joined it, having been licensed in Japan a little earlier. In some cases the drug produced effects little short of miraculous. In 2016 it was announced that it had cleared former president Jimmy Carter of metastatic melanoma that had spread to his liver and brain.

In lung cancer, and in many other cancers, the patients who responded tended to have a higher mutational burden, like that seen in melanoma. More antigens means more targets for the immune system to tackle when the drug lets it off the leash. This observation provided a way to spot some of the patients most likely to benefit. In 2017 Keytruda was approved for use in any cancer that has mismatch-repair-gene defects, a flaw which means that a cancer accumulates even more mutations—and thus more possible

antigens—than most.

Another indicator that the drug may have something to offer is the tumours' expression of PD-L1. Tumours expressing a lot of PD-L1 are investing in keeping the immune system duped; when the PD-1 system is interrupted they should prove particularly vulnerable. At the start of October 2015, Keytruda was approved for use in advanced non-small-cell lung cancer in cases where other treatments had failed and when there was PD-L1 on more than 50% of the tumour cells. Ms Milley's score was 80%, and she started treatment almost immediately.

Jedd Wolchok, a medical oncologist at Memorial Sloan Kettering, says immunotherapies do not have the same kinds of impact as other types of cancer therapy. In some cases they do not work at all. In other cases they can either eliminate the cancer entirely, or cause it to stabilise, or regress. Responses to therapy are often longer lasting than those seen in targeted drugs. And they tend to persist after patients stop taking the drug (at present CTLA-4 drugs are usually administered for only a matter of months).

The nature of the long-lasting responses is intriguing. Dr Wolchok has patients who started treatment for malignant melanoma eight years ago. He finds it particularly interesting that in some cases scans of the cancers taken before treatment (when the prognosis for the patients would have been six or seven months) and scans taken today look more or less equally dreadful. Biopsies of the tumours reveal a lot of immune cells and a lot of dead tumour cells. Dr Wolchok says it looks like a "chronic struggle between a patient's immune system and cancer". This apparent equilibrium is quite different from what is seen in chemotherapy, where the cancer will be either susceptible or resistant. The difference seems to be due at least in part to the fact that the immune response, like the cancer, can evolve.

Though immunotherapy is still new, it has already radically shifted the treatment and research landscape. A wide range of combinations is being tested in the hope of improving patients' responses. A trial combining Opdivo and Yervoy in malignant melanoma has shown tumours to shrink in 60% to 70% of patients (although it causes serious side-effects). Dr Wolchok says it is not yet possible to calculate the median survival time in the trial population—because more than half of the patients are still alive.

Compared with the more limited range of patients that can be treated with most targeted therapies, immunotherapies seem to work in many cancers. And as Dr Sharon at the NCI points out, it also produces cures. But this excitement needs to be tempered with the grittier reality that, across all cancers tried so far, only about 20% respond to the new approach. The response varies greatly between types of cancer. In patients who have failed the usual treatments for Hodgkin's lymphoma it is 90%. In pancreatic and most colorectal cancers it is basically zero.

Improving this response is perhaps today's biggest oncological challenge—the source of more excitement, and investment, than any other recent development in the field. Part of the answer will come from a better understanding of the steps needed to generate an anti-tumour response from the immune system, and of the therapeutic targets available. For example, Hervé Hoppenot, the boss of biotech firm Incyte, a biotech firm based in Wilmington, Delaware, says that some tumours protect themselves from the immune system using another checkpoint, IDO1 (an enzyme that was first discovered in a search for ways to protect a fetus from immune rejection). Incyte is testing epacadostat, an existing drug known to inhibit IDO1, as a cancer treatment both alone and in combination with PD-1 blockers.

There are well over 1,000 clinical trials of checkpoint inhibitors going on; what was at first a trickle, then a current, is now a torrent. Some worry that

things have gone too far too fast. Jeff Bluestone, who runs the new Parker Institute for Cancer Immunotherapy in San Francisco, says “many of [these trials] are based on minimal data and very limited clinical evidence about what combination will work”. Some fear there are too few patients to allow these trials to be run, others that there is too little thought and planning and a lot of duplication of effort. Dr Freeman at Harvard says he has been told there are over 80 Chinese groups developing different PD-1 antibodies.

This enthusiasm may lead to wasted efforts, and even delay progress. But there is no doubt that immunotherapy will from here on be a key part of treatment for a growing number of cancers. Perhaps the most telling measure of its success is that some oncologists have started to complain, quietly, of a shortage of specialist doctors. Patients keep coming back instead of dying. ■



松动的抑制

免疫力，以及如何激发它

医学界终于弄明白如何让免疫系统对抗癌症

感染有时会导致肿瘤缩小甚至消失，这一点人们在现代医学出现前很久就已知道。古埃及法老伊姆霍特普（Imhotep）建议通过药膏和切口治疗肿瘤——这有助于发展出某种感染。在现代欧洲早期，医生们在破溃的肿瘤上包裹一层脓毒性物质，故意造成脓疮。到19世纪末，纽约骨科医生威廉·科利（William Coley）系统性地用链球菌来感染病患。

一定程度上由于放射治疗的兴起，科利的方法渐被冷落。许多人仍然坚持认为，免疫系统在某些情况下可能会被激发而识别、攻击和攻克癌症，他们只是不知道如何制造这种激发。1976年，介白素-2（IL-2）的发现让人们们对“免疫疗法”潜力的这种隐伏信念萌生出希望。IL-2是促进T细胞生成的生长因子，而T细胞这种白细胞会扫描搜索人体不想要的入侵者，并在发现它们后激活免疫系统的其他部分，包括产生抗体的B细胞。

但IL-2是一道虚幻的曙光。仅凭IL-2，它会不加区别地激活免疫系统，而免疫系统是一头猛兽。美国国家癌症研究所（NCI）治疗和诊断部门的埃拉德·沙伦（Elad Sharon）表示，它的效果是“有害而混乱的，常使得病人被送进重症监护室”。假如一种药物切实有效，那么人们或许更能容忍这一点。但是，让众人吃惊又沮丧的是，IL-2仅仅治愈了少数几个转移性癌症患者。这种治疗为什么没有起到更好的效果，在当时不得而知。

答案在20世纪90年代开始浮现。加州大学伯克利分校癌症研究实验室的詹姆斯·艾利森（James Allison）开始研究某些T细胞表面带有的一种叫做CTLA-4的蛋白质。到1996年，他已经证明这种蛋白质抑制了对癌症的免疫反应。用抗体阻断CTLA-4会解除这种抑制，从而使得免疫系统自行激活并开始工作。当给予小鼠这种CTLA-4阻断抗体时，小鼠身上的肿瘤消失了。虽然有一点在当时并非显而易见，但后来人们回想起来时，意识到它是IL-2从未真正发挥作用的原因之一：如果刹车被踩住，汽车不可能跑得更

快。

当时，肿瘤学家们对于艾利森博士的研究结果反应平平。毕竟癌症已经多次在老鼠身上治愈了。而在经过许多次失败的试验之后，免疫疗法已被“流放”——在大型肿瘤学会议上它已经被驱逐到了小角落里。但在1999年，京都大学的本庶佑展示了一种叫PD-1的蛋白质的基因似乎也压制了免疫系统。当在小鼠身上切断这种基因时，它们中的一些出现了自体免疫性疾病——这是免疫系统被过度驱动的信号。本庶佑与哈佛大学的阿琳·夏普（Arlene Sharpe）以及戈登·弗莱曼（Gordon Freeman）合作，发现一些癌细胞的表面具有另一种叫做PD-L1的蛋白质，它通过与T细胞上的PD-1相互作用，保护了癌细胞免受T细胞的侵袭。本庶佑记得自己拿着这一成果联系了很多公司，但“没人愿意投资”。

不过，尽管制药公司对此普遍很谨慎，但针对CTLA-4和PD-1的疗法确实开始慢慢地发展起来。而后，到了2010年，百时美施贵宝（Bristol-Myers Squibb）发布了抗CTLA-4抗体益伏（Yervoy，伊匹单抗）在恶性黑色素瘤中的试验结果。与当时最先进的技术相比，它们真是太棒了。这是第一种显示改变了这种毁灭性疾病存活期的药物——将存活期中位数提高到了十个月。一些人存活时间大大延长。

这是怎么一回事？因为免疫系统是一头如此强大的猛兽，进化已经为它配备了一个制衡系统以免它失控。CTLA-4和PD-1都是该制衡系统的一部分。当一种免疫细胞将它发现的一种抗原“提呈”给另一种免疫细胞时，假如第一种细胞在此刻同时激活了其CTLA-4受体，那么第二种细胞将忽略这一抗原。不过，如果CTLA-4受体被益伏这样的抗体阻断，那么这个“检查点”系统就不起作用了。在未受约束的情况下，免疫系统就能对更广泛的抗原（包括肿瘤抗原）做出反应。因益伏而获自由的人体T细胞开始攻击黑色素瘤。而且，事实证明，它们会持续地攻击。也许，这种新的“检查点抑制剂”最显著的特征是有一小部分患者年复一年地幸存了下来。

尽管在黑色素瘤上看到了成功的迹象，但许多科学家认为检查点抑制剂机制不会广泛有效。黑色素瘤累积大量基因突变，因而比大多数癌症更可能

展现出会触发免疫反应的抗原。这种观点受到一个事实的支持——黑色素瘤比其他癌症更可能发生自发性缓解，想必是药物以外的因素触发了免疫系统反应。更重要的是，益伏有严重的副作用，有时会危及生命。

悲观主义者在癌症预后方面向来出色，但这次他们错了。曾经离开默沙东公司的免疫学家罗杰·佩尔穆特（Roger Perlmutter）后来又被请回这家公司领导一个研究实验室。他变得对一种当时被称为MK-3475的PD-1阻断剂非常感兴趣。不同于在免疫系统的控制链中处于更高位置的CTLA-4，PD-1是一个冲在前沿阵地的角色：假如一个癌细胞表面携带PD-1的对应物PD-L1，那么即使这个癌细胞可能携带任何可疑的抗原，T细胞都会忽略它（见图）。MK-3475似乎很好地阻止了两者的互动，而这可能使得免疫系统对癌细胞这种花招无动于衷。“无论你正在做什么别的项目，都停了。”佩尔穆特对他的临床开发小组成员们说。默沙东将测试该药物对晚期黑色素瘤疗效的一期临床试验扩展到1200多名患者，使之成为了肿瘤学历史上规模最大的一期临床试验。

扩大试验在一定程度上是对一项新发现的回应：早期证据表明，检查点抑制剂也可在肺癌中取得成果，而肺癌远比恶性黑色素瘤更致命，因而也代表了一个大得多的市场。纽约纪念斯隆-凯特琳癌症中心（Memorial Sloan Kettering Cancer Centre）的实体瘤肿瘤学主任路易斯·迪亚斯（Luis Diaz）回忆道：“这完全出乎意料。在这以前，我并不相信免疫疗法。”

| 治愈的低语

默沙东的PD-1药物在上市时最终得名齐求达（Keytruda，派姆单抗）。2014年，它成为美国这一全世界最大且最赚钱的药物市场上获批上市的第二个检查点抑制剂。奥德武（Opdivo，纳武单抗）很快加入了它的行列。这是小野制药（Ono Pharmaceuticals）在本庶佑的研究的基础上研发的一种PD-1药物，此前不久刚在日本获得许可。在一些案例中，齐求达的效果堪称奇迹。2016年，默沙东宣布这种药已经清除了转移到美国前总统卡特的肝脏和脑部的转移性黑色素瘤。

在肺癌和许多其他癌症中，对药物响应良好的患者身上往往带有较高的基

因突变积累，比如在黑色素瘤中。更多的抗原意味着免疫系统在药物的作用下摆脱束缚后会面对更多靶标。这一发现提供了一种方法来筛选出一些最有可能受益的患者。2017年，齐求达被批准用于任何具有错配修复基因功能缺陷的癌症，该缺陷意味着这种癌症会比大多数癌症累积更多的突变，因此产生更多可能成为标靶的抗原。

判断这种药物可能适用的另一项指标是肿瘤对PD-L1的表达。表达很多PD-L1的肿瘤通过这种方法来持续欺骗免疫系统。当PD-1系统被阻断时，这些肿瘤应该会变得尤其脆弱。2015年10月初，齐求达被批准用于其他治疗方法均告失败、且超过50%的肿瘤细胞都带有PD-L1的晚期非小细胞肺癌。米莉的评分为80%，她几乎立即开始了治疗。

纽约纪念斯隆-凯特琳癌症中心的肿瘤内科医生杰德·沃尔乔克（Jedd Wolchok）说，免疫疗法的疗效和其他类型的癌症疗法并不相同。在某些情况下，它们根本不起作用。在其他情况下，它们或者完全消除了癌症，或者使其稳定或减退。治疗起作用的时间通常比靶向药物更持久，而且往往会在患者停药后仍然持续（目前CTLA-4药物通常只需服用几个月）。

这种长期反应的本质引人思考。沃尔乔克的一些病人在八年前开始治疗恶性黑色素瘤。他发现一件特别有趣的事：在某些病例中，治疗开始前的肿瘤扫描结果（当时患者的预后为六七个月）和今天的扫描结果看起来差不多一样可怕。肿瘤活检显示出许多免疫细胞和大量死亡的肿瘤细胞。沃尔乔克说，看起来，“病人的免疫系统和癌症之间是一场长期抗战”。这种明显的制衡和我们在化疗中看到的效果非常不同。在化疗中，肿瘤要么敏感，要么耐药。这种差异似乎至少要部分归因于一个事实：免疫反应和癌症一样是会演变的。

虽然免疫疗法仍是新事物，但它已彻底改变了治疗和研究的格局。医药界正在测试各种药物组合以期改善疗效。在恶性黑色素瘤治疗中合并使用奥德武和益伏的一项试验显示，有六至七成患者的肿瘤缩小（虽然引发了严重副作用）。沃尔乔克说，目前尚不可能计算出受试人群的中位生存期，因为一半以上的患者都还活着。

相比之下，大部分靶向治疗可医治的病人范围都更有限，而免疫疗法似乎在许多癌症中都能起效。正如美国国家癌症研究所的沙伦所指出的，后者有时还能完全治愈癌症。然而，激动人心之余还要泼上一盆现实的冷水：在所有受试的癌症中，这种疗法仅对约20%的患者起效。不同癌症之间的比例差异很大。在接受常规治疗手段失败的霍奇金淋巴瘤患者中起效的比例为90%，而在胰腺癌和大多数结直肠癌中基本为零。

提升这一疗效或许是今天最大的肿瘤学挑战，它将比近期癌症领域内的任何发展都更令人兴奋并吸引更多的投资。解决方案有一部分将来自于更好地了解令免疫系统产生抗肿瘤反应所需的步骤，以及有哪些可用的治疗靶点。例如，位于特拉华州威尔明顿的生物技术公司Incyte的老板艾维·奥普诺（Hervé Hoppenot）说，一些肿瘤使用另一个检查点IDO1（IDO1是一种酶，最早是在人们寻找能保护胎儿不受免疫排斥反应影响的方法时被发现的）来保护自己免受免疫系统攻击。Incyte正在测试艾卡噪司他（epacadostat）这种已知可以抑制IDO1的现有药物，独用或与PD-1阻断剂联用来治疗癌症。

目前正在进行检查点抑制剂临床试验远超1000个。星星之火已呈燎原之势。一些人担心事情发展得太快走得太远。在旧金山主管新建的帕克癌症免疫疗法研究所（Parker Institute for Cancer Immunotherapy）的杰夫·布卢斯通（Jeff Bluestone）说：“许多这类试验都是建立在有关药物组合疗效的极少的数据和非常有限的临床证据之上。”有些人担心病人数量不够进行那么多试验，另一些人则担忧思考和规划太少、研究大量重复。哈佛大学的弗里曼说，有人告诉他有80多个中国团队正在开发不同的PD-1抗体。

这种热情可能会导致努力白费，甚至拖延进度。但毫无疑问，免疫疗法将从这里起步，成为越来越多癌症的关键治疗措施。也许最能体现其成功的一点，是一些肿瘤学家已经开始悄悄抱怨专科医生人数不足。病人不断地回到诊所，而不是死去。■



Molecular medicine

Progression, and how to stop it

Surgery, radiotherapy and cancer drugs are all becoming more tightly focused

MS MILLEY'S primary tumour was in the middle lobe of her right lung, which surgeons removed entirely. Surgery is an ancient form of cancer treatment and still a common one. Today's surgeons have everything from lasers to cryosurgery—the freezing of abnormal tissue—at their disposal. By and large, they use this expanding range of tools to cut out less and less. Ultrasound, magnetic-resonance imaging (MRI), X-ray tomography and positron-emission tomography (PET) scans have between them eliminated much of the need for “exploratory surgery” to understand the scope of a cancer.

Often surgery goes hand-in-hand with radiation therapy. Soon after the discovery of X-rays at the end of the 19th century it became clear that radiation which killed cells could be used as a cancer therapy. In its early days practitioners judged the correct dose by trying their machines out on their own arms, looking for a pink reaction on their skin. Many went on to develop leukaemia.

Today radiotherapy is considerably safer for its practitioners and more beneficial to its recipients. After a cancer is cut out, radiation is frequently used to kill the cancer cells the surgeon's knife has missed. It is also sometimes used to destroy the tumours themselves, particularly in places where surgery would be hard. In rich countries about half of patients with localised cancers receive radiotherapy. Two out of five of those treated for cancer and cured in Britain will have had treatment which consisted of radiotherapy either alone or in part. Breast and prostate cancers respond well to it.

To make all this possible, medical physicists produce beams of X-rays, gamma radiation, neutrons and, increasingly, protons; they have ever more sophisticated ways of ensuring that these cell-damaging energies are delivered to the tumours being targeted, rather than to healthy tissue nearby. Ms Milley experienced this when she had a superficial brain metastasis dealt with by stereotactic radio-surgery. The procedure uses 3D imaging to determine the exact location of a tumour, at which point a number of different beams are focused on it from various directions (see diagram). The idea is that only in the part of the brain where all the beams cross is the dose high enough to kill cells—the individual beams, on their way in and out, do comparatively little damage. The idea is to match the extent of the lethal criss-crossing as closely as possible to the location of the tumour. It is a way of achieving what Emma Harris, a medical physicist with the Institute of Cancer Research (ICR) in London, calls the current state of the art: “Shaping the beam and varying the intensity of the radiation dose to create exquisite volumes of radiation.”

Proton therapy offers another way to deal death to tumours while sparing the surrounding tissues. By choosing the right energy for the beam physicists can determine how deep into the tissue it will get before doing most of its damage. This specificity is seen as particularly useful in tumours that are near eyes, brains and spinal cords.

Radiation can also be emitted inside the body; radioactive pellets and seeds can be put right where they are needed. A new version of this approach is being developed by Nanobiotix, a biotech firm based in Paris, which is developing nanoparticles containing hafnium oxide which generate electrons when exposed to X-rays. When these nanoparticles are injected into tumours that are then zapped with X-rays they increase the damage done.

As well as surgery on the lung and radiation treatment for the tumour in

her brain, Ms Milley also had chemotherapy—the third of the 20th century’s medical responses to cancer. She was given a cocktail of cisplatin, a drug containing platinum that was approved in 1978, and Alimta (pemetrexed).

Chemotherapy’s origins can be traced back to the development of chemical weapons in the first world war. Looking into the records of soldiers affected by mustard gas, two doctors at Yale University, Louis Goodman and Alfred Gilman, noticed that many were short of white blood cells. They wondered if this meant that cancers in which white blood cells proliferate—lymphomas—might be treated with something similar. The first patient to receive this treatment was a man with advanced lymphoma who is known today by the initials “J.D.” His symptoms were greatly relieved.

The treatment worked because mustard gas damages cells’ DNA, stopping cell division. These effects are not specific to cancer cells; but because cancer cells divide a lot, such poisons are particularly bad for them. In 1947 aminopterin, a chemical which messes up cell division by interrupting the metabolism of folic acid, was found to produce remissions in children with acute leukaemia. This drug was a precursor to methotrexate, a treatment which provided the first cures of a metastatic cancer in 1956 and is still commonly used today. By the 1960s, chemotherapy had induced long-term remissions, and even cures, of Hodgkin disease, a lymphoma, and childhood acute lymphoblastic leukaemia. Cures of testicular cancer arrived in the 1970s. Though few cancers can be cured with chemotherapy on its own, many can be set back a long way and controlled for quite some time. Chemotherapies, like radiation therapies, are often used to mop up the cancer left over when primary tumours have been excised.

| *Elective affinities*

One problem with chemotherapy is that cancers can become resistant to it.

Most cancers are genetically heterogeneous, because the cells accumulate new mutations as they grow. Some of these mutations can make the cells less susceptible to the chemotherapy. As treatment continues, such cells become more numerous, and as they divide they go on to accumulate mutations that make them even more resistant—the cancer evolves resistance to chemotherapy rather as an infection can evolve resistance to antibiotics. This is why chemotherapies are now often used in combination; it is harder to evolve resistance to two or three drugs at the same time.

Another problem with chemotherapy is that it attacks cells that are dividing for perfectly legitimate non-cancerous reasons, too. Hence the side-effects, which include fatigue, hair loss, mood changes and nausea. The severity of the effects vary greatly from person to person, and some, such as nausea, can be treated with secondary drugs under some circumstances. But some chemotherapies can have long-term side-effects, damaging the heart, the nerves and fertility.

Before taking on her chemotherapy, though, Ms Milley was given another treatment: Tarceva (erlotinib). Tarceva is a small molecule which disrupts signals transmitted by a protein called the epidermal growth-factor receptor (EGFR). At least eight mutations that cause the EGFR to be constantly active have been tied to lung cancer, and Ms Milley had one of them. Her course of Tarceva saw all the tiny tumours across her body shrink, one by 60%. She went back to work.

A key tool for targeting cancer-specific pathways and molecules is the antibody. Antibodies are proteins made by the immune system which stick to a particular bit—the “antigen”—of a particular molecule. Turning them into mass-produced drugs has been one of the biotech industry’s triumphs. In the 1990s they started to come into use as cancer therapies. Aimed at antigens that crop up on cancers, but not other cells, they are far more

specific than older chemotherapies. Rituxan (rituximab), an antibody which targets a protein on the surface of the immune system's B-cells that misbehaves in B-cell non-Hodgkin lymphoma, was approved 20 years ago, in 1997. Other early targeted therapies that blocked growth signals in different cancers included Herceptin (trastuzumab) and Erbitux (cetuximab), which are both antibodies, and Iressa (gefitinib) and Gleevec (imatinib), which are smaller molecules like Tarceva. These drugs transformed the treatment of many cancers. Herceptin, for example, dramatically altered the outcome of breast cancer in patients with the HER2 mutation. With Herceptin as part of a two-drug therapy, a woman diagnosed with the metastatic form of the disease can hope to survive for almost five years; previously it was 20 months.

Another promising targeted approach involved aiming drugs at the creation of new blood vessels. If tumours are to grow beyond a few millimetres in size they need to encourage new blood vessels to bring them nutrients. Drugs which inhibit this process arrived in 2004 with Avastin (bevacizumab). It is currently used to treat advanced colorectal, kidney and lung cancers.

A third approach attacks DNA repair systems. Losing some of the ability to repair DNA helps cancers accumulate mutations, and is often part of how they get started. But the cancers need to keep some residual DNA repair functions; otherwise the cells will simply die. Thus cancers that have mutations in the BRCA1 and BRCA2 genes rely heavily on a backup DNA repair mechanism which uses proteins called poly-ADP-ribose polymerases (PARPs). Now targeted drugs have been designed to inhibit this repair mechanism. In its absence, massive genetic damage drives cancer cells to their death. Some of these PARP inhibitors have been shown to help in BRCA-linked breast cancers, and there are promising results in ovarian cancer. They seem also to have promise in some prostate and pancreatic cancers.

Finding targets for such therapies has been made far easier by the sequencing of the human genome and the remarkable reductions in the cost of sequencing DNA which followed on from it. With a baseline genome for comparison, identifying the mutations in cancers became much easier. Once found, these genes can be used to understand the molecular workings of the disease and, in theory, to find new targets for drug developers.

| *Imperfect chemistries*

Mike Stratton, director of the Sanger Institute, set up its cancer-genome project in 2000, when sequencing was still a comparatively arduous business. They were interested in looking at mutations of 40 different genes, but practical limitations meant they could only start working on 20. The third gene they looked at was BRAF; sequencing the genes from 500 cancers the researchers found that there were BRAF mutants putting yet another cell-growth-signalling pathway into overdrive in half or more of the malignant melanomas in their sample. By 2011 the first BRAF inhibitor, Zelboraf (vemurafenib), was approved for the treatment of melanoma. In a trial, the six-month survival was 84%, compared with 64% who were treated with chemotherapy. The drug was quite toxic—despite their targeting, such drugs do have side-effects—but it was still approved for use.

Hundreds of thousands of cancers have now been sequenced, and the hunt for targets is seeing diminishing returns. Though there are hundreds of genes that go wrong in cancers, only a limited number promote cancer development and are common to a number of cancers. A significant amount of work is now focused not on finding new targets but on second-generation drugs aimed at targets that have already proved vulnerable; these newer drugs aim for higher efficacy, lower side effects or, ideally, both. There are also ways to combine the specificity of antibodies aimed at a well characterised target with other forms of treatment—to bind the antibody to something poisonous, say, or to something radioactive, and use

it as an address label.

But there are still new targets being hit for the first time. In 2016, the drug Xalkori (crizotinib) was approved for ROS1-positive lung cancer. Louis Staudt, director of the centre for cancer genomics at the National Cancer Institute (NCI) in Bethesda, Maryland, says about 1-3% of cases of lung cancer are driven by a ROS1 mutation. Dr Staudt is working on a repository for genomic information called the NCI Genomic Data Commons, which hopes to identify more low-frequency drivers of cancer.

These targeted therapies are changing the way the doctors and regulators look at cancer. Typically cancers have been classified according to where they occur and how they behave. Now they can also be classified according to which genes are going wrong in them. This allows new sorts of investigation such as the NCI's MATCH trial, which matches patients to treatments based on the genetic changes in their tumours. More than 6,000 patients treated at more than 1,000 institutions have had their tumours sequenced as part of this trial. The large numbers are needed to pick out the rare mutations that drive cancers.

| *By their genes shall you know them*

A milestone in the transition to a genomic era for cancer therapy was reached earlier this year when America's Food and Drug Administration (FDA) approved a treatment based on a specific genetic indicator rather than the type of tumour, as determined by location and its tissue structure. A similar "biomarker"-based approval is expected soon for a drug which targets a defect in a family of signalling proteins called tropomyosin receptor kinases, proteins which play an important role in tumour growth. A rare mutation (it affects only about 1% of patients) sees the genes that code for TRKs become fused to other genes. Loxo Oncology, a biotechnology firm in Stamford, Connecticut, has developed a drug aimed at this aberration; the idea is that it should be licensed for use in anyone

with the relevant mutation.

Targeted therapies mark a significant advance over, and addition to, older chemotherapies. But they share their familiar weaknesses. In the 2000s Olivia Rossanese, a researcher at the ICR, worked on a BRAF inhibitor at the British pharma firm GSK. She says: “We made a drug to it, we said patients with this mutation are going to respond and that happened. It was a beautiful story ...right up until resistance.” To cancers, targeted therapies, including antibodies, are another constraint to evolve around, and in the end that is what they tend to do.

For 13 months Ms Milley responded wonderfully to Tarceva. Then her doctor at the Dana-Farber Cancer Institute in Boston noticed spots on her adrenal glands that indicated resistance. That was the point at which she started cisplatin chemotherapy. It worked for eight months. When it started to 从, she went back on to the Tarceva, which worked for another four months. That looked like the end of the road for approved treatments. The only remaining option seemed to be to take a chance with a clinical trial, and this she agreed to do.

In the middle of October 2015 her doctor called unexpectedly. She was not eligible for the trial she had been trying to enroll in. But the FDA had just approved a brand new drug for lung cancer: Keytruda (pembrolizumab). It was one of a very promising new class of treatment known as immunotherapies. ■



分子药物

恶化，以及如何阻止它

手术、放射治疗和癌症药物都越来越有针对性

米莉的原发肿瘤位于右肺中叶，外科医生将它整个切除了。手术是一种古老而仍然常见的癌症治疗方式。今天的外科医生拥有从激光到冷冻手术（冷冻异常组织）的一切手段。总体而言，拥有越来越多的工具让他们需要切除的组织越来越少。超声、磁共振成像（MRI）、X射线断层扫描和正电子发射断层扫描（PET）已经让用于了解癌症扩散范围的“探索性手术”变得基本没有必要。

手术通常与放射治疗相辅相成。在十九世纪末发现X射线后不久，人们已经确切知道，杀死细胞的辐射可被用来治疗癌症。早期，医生们在自己的手臂上尝试这种方法以判断正确的辐射剂量，他们在皮肤上寻找粉红色的反应，其中许多人继而患上了白血病。

今天，放射治疗对于医生来说已经安全了许多，对患者也变得更有益处。在切除肿瘤之后，医生们经常使用辐射来杀死外科手术刀下漏网的癌细胞。它有时也被用于破坏肿瘤本身，特别是在难以执行手术的部位。在富裕国家，约一半的局部癌症患者会接受放射治疗。在英国，五个治愈癌症的人当中会有两个单独或配合使用过放射治疗。乳腺癌和前列腺癌对其响应良好。

为了使这一切成为可能，医学物理学家会发射X射线、伽马辐射、中子和越来越常见的质子束；他们有前所未有的成熟手段来确保这些杀伤细胞的能量被传送到目标肿瘤而非附近的健康组织上。米莉在用立体定向放射手术处理表层脑转移时体验了这一点。手术使用三维成像来确定肿瘤的确切位置，来自各个方向的多个波束聚焦其上（见图）。其背后的逻辑是，只有在大脑中所有波束交叉的地方，剂量才高到足以杀死细胞——而各个波束在进出大脑时造成的伤害相对较小。波束的交叉射杀将尽可能地匹配肿瘤的位置。用伦敦癌症研究所（ICR）的医学物理学家艾玛·哈里斯

（Emma Harris）的话说，这是一种实现她所谓的当前最新技术的方式：“通过塑造波束形状并改变辐射强度来创造精致的辐射量。”

质子治疗提供了另一种在治疗肿瘤的同时保护周围组织的方式。通过选择合适的波束能量，物理学家可以确定波束在造成大部分破坏之前会进入组织多深。这种明确性被认为对眼睛、大脑和脊髓附近的肿瘤特别有用。

辐射也可以在体内发射：放射性小球和颗粒可以被放在正需要它们的地方。总部设在巴黎的生物技术公司Nanobiotix正在开发这种方法的新版本，这是一种含有氧化铪的纳米粒子，暴露于X射线下时会产生电子。把这些纳米颗粒注射到肿瘤中后再用X射线轰炸，可增加对肿瘤的破坏。

除了肺部手术和大脑肿瘤放射治疗外，米莉还接受了化疗——二十世纪针对癌症的第三种医学手段。她使用了结合顺铂（这种药含铂，于1978年获准上市）和力比泰（Alimta，培美曲塞）的鸡尾酒疗法。

化疗的起源可以追溯到第一次世界大战中化学武器的发展。在研究了遭芥子气影响的士兵的相关记录后，耶鲁大学的两名医生路易斯·古德曼（Louis Goodman）和阿尔弗雷德·吉尔曼（Alfred Gilman）注意到许多人缺少白细胞。他们想知道这是否意味着淋巴瘤这种会让白细胞增殖的癌症可以用类似的物质治疗。第一个接受这种治疗的人是一位晚期淋巴瘤患者，今天我们只知道他名字的首字母是“J. D.”。他的症状大大减轻了。

治疗之所以起效是因为芥子气破坏了细胞的DNA，阻止了细胞分裂。这种效应并不专门针对癌细胞，但因为癌细胞会大量分裂，此类毒药对它们尤其不利。1947年，人们发现化学物质氨蝶呤可以缓解儿童急性白血病，这种物质通过中断叶酸代谢扰乱了细胞的分裂。该药物又引出了甲氨蝶呤——这种疗法在1956年首次治愈了转移性癌症，在今天仍然普遍使用。到了20世纪60年代，化疗让霍奇金病（一种淋巴瘤）和儿童急性淋巴细胞白血病得到了长期缓解甚至治愈。70年代，睾丸癌也能被治愈了。尽管可以单靠化疗治愈的癌症不多，许多癌症都可以大大缓解，并在相当一段时间内让病情受到控制。和放射疗法一样，化学疗法通常用于清除原发肿瘤切

除后的癌症残留。

| 选择性亲和

化疗的一个问题是肿瘤可能出现耐药性。大多数癌症是遗传异质性的，因为细胞在生长时会积累新的突变。其中某些突变可能使得细胞对化疗不那么敏感。随着治疗的推进，这种细胞变得越来越多，并且随着分裂会继续累积突变，使其耐药性更强——癌症发展出对化疗的耐药性有点像感染可以发展出对抗生素的耐药性。这也就是为什么现在常采用联合化疗：要同时演变出对两种或三种药物的耐药性会更难。

化疗的另一个问题是它会攻击完全正常分裂的非癌细胞。因此它会带来副作用，包括疲劳、脱发、情绪变化和恶心。其严重程度因人而异，而有些症状（如恶心）可在某些情况下用其他药物治疗。但有的化学疗法可能会有长期的副作用，损害心脏、神经和生育能力。

在化疗之前，米莉接受了另一种治疗：特罗凯（Tarceva，厄洛替尼）。特罗凯是一种小分子，可破坏一种称为表皮生长因子受体（EGFR）的蛋白质所传输的信号。导致EGFR持续活跃的突变中至少有八个与肺癌相关，米莉就有其中之一。使用特罗凯让她身体各处所有的微小肿瘤都收缩了，其中一个收缩了60%。她回去上班了。

要瞄准癌症特异性的通路和分子，一个关键工具是抗体。抗体是由免疫系统产生的蛋白质，它会附着于特定分子的特定部分，即“抗原”。将其转化为批量生产的药物是生物技术行业取得的伟大胜利之一。在20世纪90年代，抗体开始被用于癌症治疗。它们瞄准了肿瘤上有而其他细胞没有的抗原，比早期的化疗针对性强得多。美罗华（Rituxan，利妥昔单抗）在20年前的1997年获批上市，这种抗体专门针对在B细胞非霍奇金淋巴瘤中作怪的免疫系统B细胞表面的一种蛋白质。其他阻止各种癌症生长信号的早期靶向疗法包括抗体赫赛汀（Herceptin，曲妥珠单抗）和爱必妥（Erbix，西妥昔单抗），以及类似于特罗凯的较小的分子易瑞沙（Iressa，吉非替尼）和格列卫（Gleevec，伊马替尼）。这些药物让许多癌症的治疗大为改观。例如，赫赛汀可以显著改变具有HER2突变的乳腺

癌患者的结局。将赫赛汀用于双药疗法后，确诊患有转移性乳腺癌的女性有望生存近五年，而这在以前是20个月。

另一个充满前景的靶向疗法则让药物瞄准了新血管的生长。如果肿瘤的尺寸超过几毫米，它们就需要催生新的血管来提供营养。2004年，抑制这一过程的药物安维汀（Avastin，贝伐单抗）面世了。它目前用于治疗晚期结肠直肠癌、肾癌和肺癌。

第三种方法攻击的是DNA修复系统。失去某些修复DNA的能力可以帮助肿瘤累积突变，这也常常是一开始会出现肿瘤的部分原因。但肿瘤也需要保留一些残存的DNA修复功能，否则癌细胞会死掉。因此，那些带有BRCA1和BRCA2基因突变的肿瘤严重依赖一种备用的DNA修复机制，这种机制利用了一种名为多聚ADP核糖聚合酶（PARP）的蛋白质。如今已有靶向药物来抑制这种修复机制。没有了修复机制，大量的基因损伤会把癌细胞推向死亡。一些PARP抑制剂已被证明对BRCA相关的乳腺癌有效，在卵巢癌方面也有了可喜的成果。它们似乎也为某些前列腺癌和胰腺癌的治疗带来了希望。

人类基因组测序的实现以及之后DNA测序成本显著降低，让上述疗法寻找靶标变得比以前容易多了。有了做比较的基准基因组，识别癌症中的突变也容易了许多。一旦发现突变，这些基因可以用于了解癌症的分子运作机理，在理论上也可以为药物开发商找到新的靶标。

| 不完美的化学品

桑格研究所所长迈克·斯特拉顿（Mike Stratton）于2000年成立了癌症基因组计划，当时测序仍是一项相当艰巨的任务。他们有意研究40个不同基因的突变，但现实的约束使他们一开始只能研究20个。他们研究的第三个基因是BRAF：对500个肿瘤进行基因测序后，研究人员发现，样品里半数以上的恶性黑色素瘤中都有BRAF突变体将又一种细胞生长信号通路置于过度驱动状态。2011年，第一个BRAF抑制剂Zelboraf（威罗菲尼）获准用于治疗黑色素瘤。在试验中，患者的六个月存活率为84%，而在接受化疗的患者中为64%。这种药物的毒性很大——虽是靶向药物，仍有副作用

——然而仍被批准使用。

成千上万的癌症已经经过了测序，追逐此类目标的收益正在下降。尽管肿瘤中有数百个基因出了问题，但只有有限数量的基因会促进癌症的发展，并且出现在多种癌症中。现在大量工作的重点不是寻找新的目标，而是针对已被证明可攻击的目标开发第二代药物。这些新药物旨在提高疗效，降低副作用，最好是二者兼备。还有方法可以将抗体针对明确标靶的特异性与其他形式的治疗结合起来——比如让抗体结合到有毒的物质或放射性物质上，并将其用作向导。

不过还是有首次被命中的新目标。2016年，药物Xalkori（克唑替尼）被批准用于治疗ROS1阳性肺癌。马里兰州贝塞斯达国家癌症研究所（NCI）的癌症基因组中心主任路易斯·司陶特（Louis Staudt）表示，大约1-3%的肺癌病例是由ROS1突变引起的。司陶特正在建立一个名为“NCI基因组数据共享平台”的基因组信息库，希望能够识别更多低频率的癌症病因。

这些靶向疗法正在改变医生和监管机构对癌症的看法。通常，癌症是根据发病位置和表现进行分类。如今也可以根据哪些基因出了问题来分类。这就让人们可以进行新型研究，比如NCI的MATCH试验根据患者肿瘤中的基因变化来匹配疗法。在这个试验中，已有在一千多个机构接受治疗的六千多名患者对肿瘤做了基因测序。需要这么多数据是为了识别引发癌症的罕见突变。

| 看基因识人

今年早些时候，美国食品和药物管理局（FDA）批准了基于特定遗传标记而非肿瘤类型（根据发病位置和组织结构判断）的疗法，这是癌症治疗过渡到基因组时代的里程碑。预计很快就会批准基于“生物标志物”的类似药物，它针对的是一类名为“原肌球蛋白受体激酶”（TRK）的信号蛋白的缺陷，这些蛋白质在肿瘤的生长中发挥重要作用。一种罕见的突变（仅出现于约1%的患者身上）会让编码TRK的基因与其他基因融合在一起。位于康涅狄格州斯坦福德的生物技术公司Loxo Oncology已经开发了一种针对这种畸变的药物；他们的设想是这种药物应当被授权用于任何携带相关突变

的人身上。

靶向治疗相对于早期的化疗是一个巨大的进步和补充，但化疗的老问题它也有。2000年代，ICR研究员奥莉维亚·罗萨尼斯（Olivia Rossanese）在英国制药公司GSK研究BRAF抑制剂。她说：“我们做出了一种药，我们说有这个突变的病人用了会有响应，也确实如此。这是一个美妙的故事……直到发生耐药。”对于肿瘤而言，包括抗体疗法在内的靶向治疗都只是它们需要通过进化来绕过的另一个障碍而已，到头来它们也往往会做到。

在13个月的时间里，米莉对特罗凯的响应都非常好。然后，波士顿达拉法伯癌症研究所的医生注意到她的肾上腺上出现了斑点，这意味着出现了耐药。这就是她开始顺铂化疗的时候。化疗起效了八个月。当化疗效果减弱时，她又回到了特罗凯，又起效了四个月。批准的疗法看起来已经山穷水尽了。剩下的唯一选择似乎是在临床试验上碰碰运气，她同意了。

2015年10月中旬，她意外地接到了医生的电话。她没有获得资格参加她想要加入的试验。但FDA已经批准了一种全新的肺癌药物：齐求达（Keytruda，派姆单抗）。它属于一类非常有希望的新疗法——免疫治疗。■



Unruly origins

Beginnings, and how to spot them

It all starts with a single cell

DIANE MILLEY, a teacher, remembers getting the small, dry cough just before school broke up for the summer in 2013. She wasn't worried: she considered herself generally healthy—she ran three times a week and went to the gym. Her doctor in Bradford, Massachusetts, put her on a course of antibiotics. When they didn't work she had an X-ray. It showed nodules across her lungs. A bronchoscopy was ordered to retrieve a tissue sample from her lung. As she came round from the anaesthetic she remembers overhearing two medical staff talking. One said "It's malignant." She had late-stage lung cancer.

Ms Milley's body, like all human bodies, contained tens of trillions of copies of her genome. In theory, all those copies should be more or less the same. In practice, over the years, they all get knocked around in different ways. The oxygen that powers cell metabolism damages the DNA on which the genes are stored as a matter of course; so do background radiation and exposure to the many low-level carcinogens; so do sunlight and infection with viruses; so do choices about diet and recreational drugs, notably alcohol and tobacco (from which Ms Milley abstained).

The vast bulk of this damage is quickly fixed by DNA-repair enzymes; fewer than one mutation in a thousand persists. But wear and tear builds up. Many such changes make little or no difference. A few will be of consequence to the cell concerned, reducing or eliminating its capacity to do its job. But the loss of a single cell's contribution matters not a jot.

There are some genes, though, where uncorrected damage can matter a lot. Foremost are the genes which control cell growth, such as HER2, which

tells the cell how to make a protein called human epidermal-growth-factor receptor type 2. This is a protein that, when it sees a particular hormone, tells the cell it is in to divide. Mutations in the HER2 gene can make cells proliferate when there is no need. When they do so their daughter cells, which will share that HER2 mutation, will go on to do the same.

Among some 20,000 genes in the genome there are dozens which, like HER2, can cause unwanted cell division when they go wrong. To forestall such problems there are various tumour-suppressor genes whose job is to make sure that cells damaged in this way shut themselves down. The best known is the gene for a protein called p53, which stops cells from reproducing if their DNA is damaged. But these tumour-suppressor genes, too, are subject to mutation.

| *The numbers game*

Thus over time, as genetic damage accumulates, the likelihood rises that somewhere in the body's trillions of cells there is one that has, through five or six mutations in key genes, developed the ability to grow without check. This likelihood is not the same for everyone. Some people start off with quirks in their genome which make them more susceptible. Take the genes BRCA1 and BRCA2, which describe proteins that repair DNA; people who inherit a damaged version of one or the other face a higher risk of cancer (in particular, breast and ovarian cancer) because, with one crucial function already compromised, it takes fewer mutations for a tumour to get going.

Once a cancer has begun its unruly growth it will pick up more and more mutations: the cancer genome project at the Sanger Institute, outside Cambridge in England, has found that cancers can have as few as ten mutations or as many as a few hundred. Though all the cells in the cancer are descended from one parent cell, they become increasingly diverse over time. Some cells come loose and start new tumours of their own elsewhere. The body's immune system will often recognise that something is amiss

and try to fight the cancer and slow its spread. Sometimes it wins, stopping the cancer or killing it. Sometimes it doesn't.

When Ms Milley's cancer was diagnosed all the things that could go wrong already had; the tumour was well developed and had spread through the lung and beyond. It would have been far better for her if it had been diagnosed earlier (see chart). But with lung cancer, as with many other forms of the disease, there are often few symptoms until the disease is already at an advanced stage. If cancer could be reliably detected earlier, many lives might be saved.

In some wealthy countries, some cancers—for example, those of the breast, prostate and cervix—are regularly sought out before they start to cause symptoms. Now researchers are trying to improve diagnostic tools even further, so that more types of cancer can be found early on (and with greater reliability). For some it is a terribly personal hunt. Billy Boyle, the president of a small biotech company, Owlstone Medical, based in Cambridge, in England, is one of them. He lost his wife Kate, mother to their two young boys, on Christmas morning in 2014. She died of colon cancer that had been picked up too late. Mr Boyle says that if colorectal cancer is detected early, 95% of sufferers survive. Only 6% survive if the cancer reaches stage four. For many cancers, early detection is “our greatest opportunity to improve survival,” says Mr Boyle.

Mr Boyle wants to detect cancer on the breath using an ion-mobility spectrometer—a gadget that weighs chemicals by passing them through an oscillating electric field. The breath contains a wide range of organic molecules that reflect what is going on in the body's metabolism. Cancers, which affect the metabolism, should in so doing change the pattern of molecules on the breath. Although Owlstone's system is very small—it fits on a chip the size of a coin—it is sensitive, identifying molecules at a level of a few parts per billion. The firm hopes that when it has identified

molecular “fingerprints” associated with particular cancers it will be able to detect the disease earlier than other tests do.

Improved diagnostics can do more than pick up cancers sooner. They can also reveal the cancers’ weaknesses. Because cancer drugs work in different ways, some will do well against a tumour with one set of mutations but leave unscathed one that has become cancerous by some other pathway. Troy Cox, head of Foundation Medicine, a diagnostics company based in Cambridge, Massachusetts, says that in America 14 cancer drugs now have “companion diagnostics”—tests that show whether a cancer is likely to be susceptible to them or not. Ms Milley’s lung cancer, for example, turned out to harbour a mutation which meant she could be treated with a drug that targets that specific protein (see next section).

So far, such genetic tests are used when planning therapy for 50% to 60% of solid tumours, according to Foundation. New drugs, new understanding of cancer mechanisms and new technologies that can scan many genes for mutations at once mean such testing will be more informative in the near future. Many, including England’s chief medical officer, Sally Davies, want cancer patients to be routinely offered genetic screening of their tumours. Foundation and ThermoFisher, a diagnostics firm in Waltham, Massachusetts, are hoping to encourage this by offering every gene of interest on a mass-produced chip. Some of these mutations will help doctors pick the best drugs for that particular cancer, others may indicate how it is likely to develop. The tests would also identify mutations for which there is not yet an approved therapy—but for which there is one in clinical trials.

David Hyman, at the Memorial Sloan Kettering Cancer Centre in New York, worked on a trial of an experimental drug, larotrectinib, that was expected to work in cancers where a gene called NTRK1 had undergone a specific mutation. Because that mutation is found in less than 1% of all cancer

patients, recruiting people to the trial was a “Herculean effort”, he says. It was worth it, though. The drug was tested on 50 patients with 17 different types of tumour. In results published in June, 78% of patients with 12 different tumour types responded to the drug.

Aside from picking the right drugs, genetic tests are also starting to reveal more about the outcome and risks of any individual cancer—something that is useful for deciding whether a cancer needs to be treated at all. The MammaPrint test, made by Agendia, based in Amsterdam, analyses the activity of genes in early-stage breast cancer. If women with early-stage breast cancer were routinely tested in this way, those who will not need chemotherapy after surgery could be picked out (a recent study of patients found 58% to be in this category). A similar test is available for prostate cancer from the firm Myriad Genetics, based in Salt Lake City, Utah. A recent study suggests that people who have inherited a mutation in the P53 tumour-suppressor gene might be well advised to have whole-body MRI scans to screen for cancers, since their unsafeguarded cells are at particular risk.

Identifying genes from tumours normally means retrieving cancer cells via biopsies. This is invasive and often done only once in the course of the disease. But cancers are both heterogeneous and labile; elsewhere in a tumour, and later in a tumour’s progression, things may look different.

These challenges are now being tackled with blood tests, a technique termed “liquid biopsy”. Tumours shed DNA into the blood, and these circulating fragments of DNA can be tested for mutations. Regularly testing this DNA could be a way of keeping track of a tumour’s mutations. The Institute for Cancer Research, based in London, recently showed that it could use a liquid biopsy to pick out whether a patient was likely to benefit from a new type of drug called a PARP inhibitor. Using liquid biopsies the researchers were able to find out if the drug was doing any good in just four

to eight weeks. Liquid biopsies are also a promising technology for the routine monitoring of patients who have been successfully treated for cancer, lest their disease return. Mark Roschewski, a researcher with America's National Cancer Institute, the NCI, thinks the technology could be "orders of magnitude more sensitive than radiographic imaging".

| *Biopsies optimised*

The big question for the firms developing these liquid biopsies is whether the technology will also be suitable for the early-detection market that Mr Boyle is chasing with his breath tests. Guardant Health, a firm based in Redwood City, California, currently offers a liquid biopsy that allows patients to obtain a genetic profile of their tumour. It is using the data it gathers to look at the feasibility of early detection. Helmy Eltoukhy of Guardant says the firm is "agnostic" about the markers it seeks in the blood, meaning that its researchers will not look just for DNA from tumours—if the data suggest that RNA (a relative of DNA) or proteins provide the telltale fingerprint, then that is what they will look at.

All diagnostic tests have to overcome two hurdles. They have to be sensitive enough to identify those who have the disease correctly and also specific enough that they do not see signs of the disease when it isn't actually present. The more widely they are used, the more important that second requirement gets; false positives are a pervasive problem with existing tests such as mammograms and PSA, a test for prostate cancer. (This is why PSA screening, while common in America, is much less prevalent in Europe.)

In liquid biopsies the challenge will be to detect cancer-specific signals against a noisy and confusing background. Barry Kramer, director of the division of cancer prevention at the NCI, warns that the same marker can have different functions in different organs. He notes that a programme screening infants for neuroblastoma was halted after it started to pick up too many growths that did not merit clinical concern and didn't reduce the

death rate. Specificity, says Mr Eltoukhy, is early detection's Achilles' heel. Others warn that liquid biopsies aimed at DNA will never be sensitive enough for early detection, because early tumours may shed very little DNA, or shed it only occasionally; other molecules might prove more telling.

Nonetheless, biotech is gung-ho about the idea. Grail, a liquid-biopsy startup in Silicon Valley spun out of Illumina, a sequencing firm, recently raised \$900m. Earlier this year Guardant raised \$360m, and Alphabet invested \$65m in Freenome, a San Francisco startup with similar plans. Grail has begun a trial of its technology which will enroll 120,000 women who are receiving mammograms to see if its technology really does offer early detection.

Whether it will make sense to adapt liquid biopsies to population screening will depend on their costs—currently still too high for widespread use—their sensitivity and, crucially, their false-positive rates. Unnecessary investigations after false positives are both worrying and debilitating for patients and costly for the health-care system. But some, such as Luis Diaz, an oncologist at Memorial Sloan Kettering, argue that initial overdiagnosis is a necessary part of moving ahead: “One never learns to ride a bike without falling off.”

The costs and difficulties of blood screening are one of the things that tiny Owlstone has going for it. Testing the breath for metabolites doesn't require the tumours to have started shedding DNA. Britain's NHS is running a £1.1m trial of the technology in patients suspected of having lung cancer who are also being examined by other means. If this finds the technology to be reliable it might be expanded for use in population screening. In July Owlstone said it would collaborate with academic partners to see if breath biopsies could be expanded to pick up bladder, breast, kidney, pancreatic, prostate, brain, and head and neck cancers.

There is no question that blood biopsies will be at the heart of the future of tracking and profiling tumours. But for early detection other options might yet win out; success will not hinge on which company starts with the most money but which offers the biggest bang for the buck. Health-care systems will seek to adopt technologies that work at scale. The benefit will be that more cancers can be cured with the most basic, oldest and most effective methods of cancer treatment. ■



放肆的开端

开端，以及如何发现它们

一切都始于一个细胞

戴安·米莉（Diane Milley）是一名教师。她记得2013年夏天学校临放假前，她开始轻微的干咳。她并没有放在心上——她觉得自己总体上很健康，每周跑步三次还去健身房。马萨诸塞州布拉德福德的医生对她用了一个疗程的抗生素。治疗无效后她拍了一张X光片，显示她的肺部存在结节。随后医生让她做支气管镜检查，从她的肺部提取组织样本。当她在麻醉中醒来时，听到两名医务人员在说话。其中一人说：“是恶性的。”她患的是晚期肺癌。

和所有人的身体一样，米莉的身体也含有自身基因的数十万亿个副本。理论上说，所有这些副本都应该是基本相同的。然而实际上，经年累月，它们以不同的方式遭到了破坏。为细胞代谢提供能量的氧会自然而然地破坏存储基因的DNA，背景辐射和接触许多低级致癌物也会如此，日晒和病毒感染也会如此，饮食选择和娱乐性药物，特别是酒精和烟草（米莉均不沾），也会如此。

绝大多数此类损害都很快被DNA修复酶修复了；一千个突变中只有不到一个会留存下来。但这种损耗会累积。很多此类变化都无足轻重，少数则会影响相关细胞，降低或完全消除其履行职责的能力。但损失一个细胞的贡献造成的影响微不足道。

然而，对于某些基因而言，未经修复的损害可能就大有关系了。首先是那些控制细胞生长的基因，如HER2，它告诉细胞如何生成一种名为人类表皮生长因子受体2的蛋白质。这种蛋白质在遇到某种特定的激素时会指示它所在的细胞进行分裂。HER2基因的突变可能导致细胞在毫无必要的时候增殖。如果发生这种情况，其拥有同样HER2突变的子细胞也会继续做同样的事情。

在基因组中的大约20,000个基因中，有几十个基因会像HER2一样，在出错时可能引起有害的细胞分裂。为了预防这类问题，身体里还有各种各样的肿瘤抑制基因，确保遭到此类损伤的细胞会自行关闭。最著名的是一种名为p53的蛋白质的基因，它可以阻止DNA遭损坏的细胞自我复制。但是，这些肿瘤抑制基因也可能发生突变。

| 数字游戏

因此，随着时间的推移和基因损伤的累积，在身体里的数万亿个细胞中，有一个细胞因为关键基因发生了五六次突变而能够无拘无束生长的可能性就变大了。这种可能性并不是人人平等的。有些人的基因组一开始就有些怪异，这让他们更容易受到影响。拿基因BRCA1和BRCA2来说吧，它们表达的是用于修复DNA的蛋白质。如果一个人继承的其中一个基因受损，就会面临更高的患癌风险（特别是乳腺癌和卵巢癌）。这是因为，既然一个关键功能已经受损，那么只需要更少的突变就可发生肿瘤。

一旦肿瘤开始肆意生长，它将会汇聚越来越多的突变。位于英国剑桥镇外的桑格研究所（Sanger Institute）的癌症基因组计划发现，癌症的突变数量少至十个，多达几百个。虽然肿瘤的所有细胞都是一个亲代细胞的子孙，但随着时间的推移，它们变得越来越五花八门。一些细胞会松脱，到其他地方再自己开始生长新肿瘤。身体的免疫系统通常会发现有些东西不对了，并且试图与癌症斗争并减缓其蔓延。有时它会赢，阻止甚至杀死癌症。有时它不会。

当米莉确诊患癌时，一切可能发生的糟糕情况都已发生：肿瘤发育完全，并扩散到整个肺部和身体其他部分。如果能更早诊断出来，她的情况会好得多（见图）。但是在肺癌以及许多其他类型的癌症中，在发展到晚期之前通常不会有什么症状。如果我们能够更早地、可靠地检测到癌症，也许能挽救许多生命。

在一些富裕国家，人们会在出现症状之前定期筛查某些癌症（例如乳腺癌、前列腺癌和宫颈癌）。如今研究人员正在努力进一步改进诊断工具，以便早日（并且以更高的可靠性）发现更多类型的癌症。对于某些人来

说，这样的探索是源于极其个人化的经历。位于英国剑桥的小型生物技术公司Owlstone Medical的总裁比利·博伊尔（Billy Boyle）就是其中之一。2014年圣诞节的早晨，他失去了他的妻子、两个小男孩的母亲凯特。她死于结肠癌，发现时已经太晚了。博伊尔说，如果结肠直肠癌能够在早期发现，95%的患者能活下来。如果癌症达到第四阶段，生存率只剩6%。博伊尔说，对许多癌症而言，早期监测是“提高生存率的最大机会”。

博伊尔想要使用离子迁移光谱仪（一种让化学物质通过振荡电场来称重的小机器）来通过呼吸检测癌症。呼出的气体中含有许多有机分子，反映了身体发生的新陈代谢。癌症会影响新陈代谢，所以应该也会改变呼出气体中分子的模式。虽然Owlstone公司的系统非常小——可以装在硬币大小的芯片上——它却十分敏感，可以在十亿分之几的水平上识别分子。该公司希望，在确定了与特定癌症相关的分子“指纹”后，它将能够比其他测试更早地检测到癌症。

改进后的诊断方法能做的还不只是更早地检测出癌症，它们也可以揭示癌症的弱点。因为癌症药物的起效方式各有不同，有些很善于对付由一种突变引发的肿瘤，但对于通过其他途径癌变的肿瘤却束手无策。总部位于马萨诸塞州剑桥市的基础医学公司（Foundation Medicine）的总裁特洛伊·考克斯（Troy Cox）表示，在美国，有14种癌症药物有了“伴随诊断”，这种测试可以显示个体的癌症是否比较可能对药物敏感。比如，米莉的肺癌被发现带有一种突变，这意味着她可以用针对那种特定蛋白质的药物来治疗（见下一节）。

根据基础医学公司的说法，到目前为止，有50%至60%的实体瘤治疗规划中会使用此类基因检测。新药物、对癌症机理的新认识，以及可以一次扫描许多基因突变的新技术，意味着在不久的将来此类检测将可提供更多信息。包括英格兰首席医疗官萨利·戴维斯（Sally Davies）在内的许多人希望癌症患者能够定期对其肿瘤进行基因筛查。为此，基础医学公司和位于马萨诸塞州沃尔瑟姆的诊断公司ThermoFisher希望利用批量生产的芯片来提供所有相关基因的检测。有些突变可帮助医生为这种特定的癌症挑选最适合的药物，其他的则可能提示癌症的发展趋势。这些检测也将发现那些

尚无疗法获准使用、但却有疗法正在进行临床试验的突变。

纽约纪念斯隆-凯特琳癌症中心的大卫·海曼（David Hyman）研究了实验药物拉罗替尼（larotrectinib），预计该药物可对NTRK1基因发生特定突变的癌症起效。他说，由于所有癌症患者中只有不到1%的人有这种突变，招募试验对象是一项“艰巨的工作”。不过这是值得的。他们对患有17种不同类型肿瘤的50名患者进行了药物试验。今年6月份发表的结果显示，这种药对78%的患者起效，涵盖12种不同类型的肿瘤。

除了选择正确的药物之外，基因检测也开始进一步揭示特定癌症的结局和风险——这有助于决定癌症是不是根本不需要治疗。阿姆斯特丹的Agendia公司创造的MammaPrint测试可分析早期乳腺癌中基因的活动。如果通过这种方式对早期乳腺癌患者进行常规检测，就可以选出术后不需要化疗的患者（最近的一项研究发现58%的患者属于此列）。总部位于犹他州盐湖城的万基遗传公司（Myriad Genetics）提供了一种针对前列腺癌的类似检测。近期一项研究表明，遗传了P53肿瘤抑制基因突变的人最好进行全身MRI扫描来筛查癌症，因为其未受保护的细胞风险尤高。

要识别来自肿瘤的基因通常需要进行活组织检查来提取癌细胞。这是侵入性的，并且通常在病程中只做一次。但癌症既多样又易变：在肿瘤的其他部分，或随着肿瘤的进展，情况可能会有所不同。

目前人们通过血液检查（称为“液体活检”）来解决这些难题。肿瘤将DNA散入血液中，人们可以检测这些循环中的DNA片段来发现突变。定期检测此类DNA或可作为跟踪肿瘤突变的一种方式。总部设在伦敦的癌症研究所最近发现，它可以使用液体活检来确定患者是否可能受益于一种名为PARP抑制剂的新型药物。利用液体活检，研究人员可以在短短四至八周内就得知药物是否有效。对于已成功治愈癌症的患者，液体活检技术在定期复查以防复发方面也很有前景。美国国家癌症研究所（NCI）研究员马克·罗舍夫斯基（Mark Roschewski）认为，该技术可能“比放射成像敏感几个数量级”。

| 活检优化

开发这些液体活检的公司要回答的最大问题是，该技术是否也适合博伊尔的呼吸检测所追求的早期检测市场。总部位于加州红木城的Guardant Health公司目前提供液体活检，可让患者获得其基因的遗传图谱。它正在使用它收集的数据来研究早期检测的可行性。Guardant公司的海尔米·艾尔图克（Helmy Eltouky）表示，公司对于其在血液中寻找的标记物持“不可知论”，这意味着其研究人员不仅仅会寻找肿瘤中的DNA——如果数据表明RNA（DNA的近亲）或蛋白质指纹能够揭示秘密，那这就是他们要找的。

所有诊断测试都必须克服两个障碍。一是必须足够敏感，能够正确地找出患者；同时要足够确切，不会发现实际不存在的疾病迹象。测试使用得越广泛，第二个要求就越重要——在乳腺X光片和PSA（前列腺癌检测）等现有检测中，假阳性是一个普遍问题。（这就是为什么虽然PSA检测在美国很普遍，但在欧洲却要少得多。）

对液体活检而言，困难在于要在嘈杂和混乱的背景中检测癌症的特异性信号。NCI癌症防治部主任巴里·克雷默（Barry Kramer）警告说，同一个标记在不同的器官中可以有不同的功能。他指出，一个给婴儿筛查神经母细胞瘤的项目在检测出太多不值得临床关注的增长而又未能降低死亡率后被叫停。艾尔图克说，特异性是早期发现的致命弱点。其他人警告说，针对DNA的液体活检的敏感度永远够不上早期检测的要求，因为早期肿瘤脱落的DNA可能很少，或者仅会偶尔脱落；其他分子也许更能说明问题。

然而，生物科技界对这个想法痴心不改。从测序公司Illumina分拆出来的硅谷液体活检创业公司Grail最近筹集了9亿美元。今年早些时候，Guardant筹集了3.6亿美元，而Alphabet则对有类似计划的旧金山创业公司Freenone投资了6500万美元。Grail已经开始对其技术进行试验，将招募12万名接受乳腺X光检查的女性，看看它的技术是否真能实现早期检测。

将液体活检用于全民筛查是否合理取决于成本——目前要广泛使用的话仍嫌价格太高——以及敏感度，更关键的是假阳性率。出现假阳性后接受本

不必要的检查让人忧心又伤身，也让医保体系开支巨大。但有些人，如纪念斯隆-凯特琳中心的肿瘤学家路易斯·迪亚斯（Luis Diaz）认为，初期的过度诊断是进步的必经之路，“怕摔永远学不会骑车”。

血液筛查的成本和困难恰恰让小小的Owlstone公司获得了优势。通过呼吸来检测新陈代谢不需要肿瘤脱落DNA。英国国民健康服务体系（NHS）正耗资110万英镑，对疑似患有肺癌的人测试这项技术，这些患者也同时接受其他手段的检查。如果该试验证明这项技术可靠，它可能会被进一步用于全民筛查。Owlstone公司在7月份表示，它将与学术伙伴合作，看看呼吸活检是否可以拓展到膀胱、乳腺、肾脏、胰腺、前列腺、脑部和颈部癌症的筛查。

毫无疑问，血液活检将成为未来跟踪和分析肿瘤的核心。但就早期检测而言，其他选择可能更好：成功不在于哪家公司开始时手里钱最多，而是在于哪家能带来最大的回报。医保体系将寻求能够大规模应用的技术。这样做的好处在于，我们可以用最基本、最古老和最有效的治疗方法治愈更多的癌症。■



Economic and financial indicators

Economic outlook

The Economist's latest poll of forecasters, September



经济与金融指标

经济前景

《经济学人》9月对各家预测机构的最新调查



Free exchange

Remote control

Stanley Fischer and the twilight of the technocrat

IN 2004 Stanley Fischer described the wonder he felt as an economics student in the 1960s. “You had a set of equations”, he said, “that meant you could control the economy.” Technocracy—the dream of scientific government by a caste of wise men—arose in the 20th century, as rapid change rendered the world unfathomably complex; in economics, it came of age in the Keynesian revolution of the 1930s. On September 6th, after a remarkably distinguished career in public service, Mr Fischer, an intellectual heir to Keynes, announced his imminent retirement as the vice-chairman of the Federal Reserve. It is tempting to see in his departure the end of the era and the ideal of technocracy.

A century ago, as physicists unlocked the secrets of the atom and biochemists probed the molecular basis of life, economists sought to systematise their own field. But the growing complexity of their work created a problem: laymen could not make head or tail of it. Government consultation with experts, or the delegation of authority to them, became critical to the management of the economy. War-time state planning empowered technocrats further. And in the years after the second world war, when Mr Fischer was a boy in what was then Northern Rhodesia (now Zambia), technocratic principles were enshrined in extragovernmental institutions like the World Bank and the IMF, and in panels of economic advisers whose systems of Keynesian equations produced forecasts and shaped policy.

These systems were flawed. Trouble struck in the 1970s. Slowing growth, wobbling currencies and rising inflation upset the status quo and bolstered sceptics of Keynesian ideas, like Robert Lucas. A dose of stimulus might

fool people into thinking the economy was doing better than it was, and so into working harder—but only for a while. People would catch on, and inflation rather than growth would result.

Mr Fischer questioned this fatalism and, in so doing, helped make the intellectual case for revitalising technocratic management. That work was centred on the Massachusetts Institute of Technology (MIT), the home of economic luminaries like Paul Samuelson and Rudiger Dornbusch and the theories that would become New Keynesianism. There, Mr Fischer and others explored when a deft intervention could do some good. In 1977, for instance, he argued that long-term contracts prevented prices and wages from adjusting quickly to changes in economic fortunes. Such frictions could lead to soaring unemployment unless trained economists were on hand to tend the government's policy levers. New Keynesianism became the orthodoxy in central banks and finance ministries around the world.

A parade of economic talent came to work with and learn from Mr Fischer. They included Ben Bernanke, who would later lead the Federal Reserve through the financial crisis; Mario Draghi, who now pilots the European Central Bank (ECB); Olivier Blanchard, until recently chief economist at the IMF, as well as his successor, Maurice Obstfeld. These men helped build modern macroeconomics, then went out into the world to apply it.

In that, they followed the example of Mr Fischer. In the late 1980s he joined the World Bank as chief economist. He could draw on his research on economic growth—and the policy errors that could waylay it. Later he became the deputy managing director of the IMF, putting him at the centre of battles to contain the financial crises that punctuated the 1990s. After a turn at Citigroup, he went to run the Bank of Israel, navigating the Israeli economy through the Great Recession. Then, in 2014, Barack Obama nominated him for the vice-chairmanship of the Fed.

Mr Fischer and his acolytes often operated under intense pressure. In the 1990s the IMF faced withering criticism for the terms it imposed on struggling borrowers. But it faced hard choices; more generous terms from the fund might have helped the citizens of beleaguered economies, but also given spendthrift governments licence to misbehave—or put support for the IMF itself at risk. Messrs Bernanke and Draghi have their detractors, but were instrumental in saving their respective economies from catastrophe. Recent electoral pratfalls argue for leaving critical decisions in the hands of well-trained, pragmatic technocrats.

Even so, technocracy is in retreat. The sway of the World Bank, the IMF and other international institutions is slowly waning. Their supporters, notably America, seem to be losing interest in their mission; China is building rival institutions as vehicles for its geopolitical ambitions. Central-bank independence is far from assured, not least at the Fed under President Donald Trump. German frustration with the ECB is a dormant threat.

The disenchantment stems in part from a failure of expertise. The mathematisation of economics did not always enhance understanding. The IMF's forecasters almost invariably fail to see recessions coming; the Fed, during Mr Fischer's tenure, repeatedly overestimated the risk of rising inflation. The New Keynesian consensus itself has fractured; disagreements flare among Mr Fischer's acolytes over how much deficits matter, or whether monetary policy can be effective when interest rates are near zero.

| *The invisible hand*

Technocracy's greatest vulnerability, however, is its fundamental premise, that complex decisions should be taken free of political influence. When officials unexpectedly face problems outside their intended purview—whether a global banking crisis or a period of chronic stagnation—public confidence in them erodes. The rub is that the complex

systems technocrats are expected to manage inevitably yield surprises. Amid such uncertainty, the expertise of men like Mr Fischer is as valuable as ever. But the hard choices which must then be taken also demand the legitimacy that democratic processes confer. ■



自由交流

微弱的控制

斯坦利·费舍尔与技术官僚的迟暮

2004年，斯坦利·费舍尔（Stanley Fischer）谈到了自己在上世纪60年代身为一名经济系学生发出的惊叹。“你有一套公式，”他说道，“凭着这些公式你就可以操控经济。”上世纪，快速的变化令世界变得复杂难解，专家治国的概念（即由一批智者科学治国的梦想）应运而生。在经济学领域，这一概念在30年代凯恩斯革命时期发展成熟。继承了凯恩斯衣钵的费舍尔在公共服务领域做出了杰出贡献，本月6日他宣布即将卸任美联储副主席。人们很容易将他的离任视作一个时代的终结以及专家治国这种理想的陨落。

一个世纪以前，随着物理学家解开原子的奥秘、生物化学家探索生命的分子基础，经济学家们也寻求将自己的领域系统化。但他们的研究日益复杂，造成了一个问题——让外行人摸不着头脑。政府向专家咨询或向他们授权成了经济管理的关键。战时政府规划赋予了技术官僚更大的权力。二战结束后的几年，费舍尔还只是一个生活在北罗得西亚（今天的赞比亚）的小男孩。当时，专家治国的理念被世界银行和国际货币基金组织（以下简称IMF）这类政府间国际组织奉为圭臬，在以凯恩斯公式体系预测经济并制订政策的政府经济顾问团里也是如此。

这些体系存在缺陷。到20世纪70年代，问题显现了。经济增长放缓，汇率不稳，通胀上升，这些因素扰乱了局面，为罗伯特·卢卡斯（Robert Lucas）等人对凯恩斯主义的怀疑论调提供了支持。一轮刺激措施可能令人们误以为经济没那么糟，并在此蒙蔽之下更努力地工作，但这只能收一时之效。人们会渐渐了解真相，结果将不是经济增长，而是通货膨胀。

费舍尔质疑这种宿命论，在反驳过程中，为重振专家治国做了学术论证。这项工作主要在麻省理工学院进行，保罗·萨缪尔森（Paul Samuelson）和鲁迪格·多恩布施（Rudiger Dornbusch）等经济学大师均任教于此，

后来发展新凯恩斯主义的理论也从这里发源。在麻省理工，费舍尔及其他人探索政府的娴熟干预在什么情况下能产生积极的效果。例如，在1977年，他提出，长期合同妨碍了价格和工资随经济形势快速调整。这种摩擦可能导致失业率飙升，除非有训练有素的经济学家来管理政府的政策杠杆。新凯恩斯主义成为了世界各国央行和政府财政部门的正统理论。

众多经济学人才纷至沓来，跟费舍尔共事并向他取经，其中有之后在金融危机期间领导美联储的本·伯南克（Ben Bernanke）、如今的欧洲央行行长马里奥·德拉吉（Mario Draghi）、前不久卸任的IMF首席经济学家奥利维尔·布兰查德（Olivier Blanchard）及其继任者莫里斯·奥伯斯法尔德（Maurice Obstfeld）。他们协力打造了现代宏观经济学，并到世界各地应用推广。

在这方面，他们循的是费舍尔的样板。上世纪80年代末，他加入世界银行担任首席经济学家，得以运用自己有关经济增长的研究——以及错误政策可能扰乱经济增长的研究。之后，他出任IMF的副总裁，在上世纪90年代遏制连番金融危机的保卫战中成为核心人物。在转投花旗集团一段时间，他又出任了以色列央行行长，带领以色列经济度过始于2007年的大衰退。然后在2014年，奥巴马提名他担任美联储副主席。

费舍尔与其追随者经常顶着极大的压力行事。90年代，IMF因对陷入困境的借款国施加的条款而遭受严厉的抨击。但它面临着艰难的抉择：放宽条款也许能帮助受困经济体的公民，但也可能放纵那些大手大脚的政府肆意妄为，或者还会危及IMF本身受到的支持。伯南克和德拉吉也不乏反对者，但在挽救各自的经济体免受灭顶之灾时均发挥了关键作用。近期当选的不着调的政客们证明，应该把重要决定交到那些训练有素且务实的专家手中。

即便如此，专家治国的潮流正在减退。世界银行和IMF等国际组织的影响力在慢慢消减。其支持者（尤其是美国）对这些机构的使命似乎兴趣渐失；中国则在打造对手机构，作为实现其地缘政治野心的工具。央行的独立性远未得到保证，美国总统特朗普指挥下的美联储更是如此。德国对欧

洲央行的不满也是一个潜在威胁。

专家治国魅力不再，一定程度源于专业知识的失败。经济学的数学化不一定总有助于理解问题。IMF的预测者们几乎从没能预见经济衰退的到来：在费舍尔任内，美联储一再高估通胀上升的风险。新凯恩斯主义共识本身已经分裂。费舍尔的追随者在多个问题上分歧严重，例如赤字的重要性，以及在接近零利率时，货币政策是否还会有效。

| 看不见的手

然而，专家治国的最大弱点在于其根本前提——做出复杂决策应免受政治的影响。当官员们意外面临超出自己预期范围的问题（无论是全球银行危机或是经济陷入长期停滞），公众对他们的信心便会削弱。问题是，技术专家们要管理的各个复杂体系无可避免地会出现意外。在这样的不确定性中，费舍尔这等专家的才能珍贵如昔，但此时必须做出的艰难抉择也需要民主程序赋予的合法性。 ■



Cyber-security

Learning the lessons of Equihack

The company handled its hack spectacularly badly. Other firms, take note

EQUIFAX, like all credit-monitoring firms, trades on its ability to handle sensitive financial information. So there was grim irony in the news that the firm has been the victim of a particularly big and damaging data breach. The company reckons that more than 143m people, mostly Americans, have been affected. The pilfered data include addresses, credit-card details and Social Security numbers. The Social Security numbers are especially valuable: they are the closest thing America has to a centralised national-identity system, and are far harder to change than a password on a compromised account.

A series of self-inflicted wounds made things much worse. A rickety website set up so that customers could check whether they had been affected seemed to require them to waive their right to sue (not so, insisted the firm, which later changed the site). Those who wanted to freeze credit checks were at first asked to pay. Senior managers sold shares after the breach had been discovered, but before it had been made public (the firm insists no insider trading has taken place). Lawyers and attorneys-general are right to want to investigate.

| *There but for the grace...*

The breach was big but Equifax is no outlier. Last year Yahoo revealed that hackers had swiped details from more than 1bn accounts; AdultFriendFinder, a casual-sex site, had more than 400m accounts compromised. Disruptions from cyber-attacks hurt investors on a regular basis. A.P. Moller-Maersk, a big shipping company, had its computers frozen by malware earlier this year; it reckons the losses could reach

\$300m. The same attack cost Reckitt Benckiser, a consumer-goods firm, £100m (\$133m) in lost sales. Firms that might once have been tempted to shrug off the dangers are increasingly at risk of regulatory action. New European laws envisage hefty fines for non-compliance with cyber-security standards; rules enacted by New York's financial regulator came into force in August.

The nature of the threat is changing, too. The computerisation of everyday objects, for instance, turns the whole world into a hacker's playground. One casino recently suffered a data breach after hackers gained access to an internet-connected fish tank, and jumped from there to more sensitive parts of the company's network. Hackers are also changing their business models. Instead of selling data on the black market, some are trying to hold companies to ransom, as Netflix, a video-streaming firm, discovered in April when thieves made off with an unaired episode of one of its hit programmes.

What to do? Two principles ought to guide the way that firms plan their cyber-security. The first is to take a layered approach to defence. That is how societies think about many other risks. Cars are dangerous machines, for example. Driving codes and road signs try to prevent accidents from happening. But that does not always work, so cars are engineered to protect their occupants in the event of a crash. If that is not enough, emergency services and hospitals try to fix the damage.

This sort of thinking is relatively new in the computer-security business, which has tended to focus mostly on prevention. As more attention is paid to mitigation and disaster recovery, firms should take a similar approach themselves. Walling off different chunks of sensitive data within a company, for instance, can reduce the impact of any hacks that do breach the outer defences. Planning in advance how to respond to a hack reduces the risk of Equifax-like botches.

The second principle is to think about data more intelligently, including how much is stored, and for how long. Firms mostly regard information as an asset. The attractions of technologies such as artificial intelligence encourage them to stockpile as much as possible. But the same digital infrastructure that makes piles of data useful makes them vulnerable to anyone who fancies trying to swipe them. That—and regulators' increasing impatience with leaks—makes data a source of business and legal risk. This newspaper has argued that, in powering the economy, data are today what oil was in the 20th century. The analogy is apt. Oil is valuable stuff. But it is also toxic and flammable—and spills can be disastrous. ■



网络安全

吸取Equifax被黑的教训

这家公司处理黑客袭击的方式太糟糕。其他公司要引以为戒

和所有的征信公司一样，Equifax做生意凭的是自己处理敏感金融信息的能力。所以当该公司沦为一次危害尤其严重的大规模数据泄露事件的受害者时，就有一种严酷的讽刺意味。该公司估计有超过1.43亿人受到影响，大部分是美国人。被窃取的数据包括地址、信用卡信息和社会安全号码。社会安全号码尤其重要：在美国，它们是最接近集中化的国民身份系统的东西，更改社会安全号码比更改受攻击账户的密码要困难得多。

公司自己引发的一系列创伤让情况变得更糟糕了许多。公司设立了一个简陋的网页，供客户查询自己是否受到影响，但该网页似乎要求客户放弃诉讼的权利（公司坚称并非如此，且之后更改了网页）。那些想冻结信用检查的人一开始还被要求付费。公司高管在发现数据泄露但公众尚未知晓之前抛售了股票（公司坚称没有发生内幕交易）。律师和州总检察长想要开展调查确有道理。

| 只是幸免于难

这是一次大规模泄露，但Equifax并非特例。去年雅虎披露曾被黑客窃取逾10亿账户的详细信息；一夜情网站AdultFriendFinder有超过4亿个账户的信息泄露。网络攻击造成的破坏经常伤害到投资者。今年早些时候，大型航运公司A. P. 穆勒-马士基（A.P. Moller-Maersk）因恶意软件入侵导致电脑瘫痪，公司估算损失可能达3亿美元。消费品公司利洁时（Reckitt Benckiser）也因同样的攻击损失了1亿英镑（1.33亿美元）的销售额。那些曾经更愿意对此类危险不予理会的公司，现在越来越有可能成为监管行动的对象。新的欧洲法律考虑对不符合网络安全标准的行为处以高额罚款；纽约金融监管机构制定的规则已于8月生效。

威胁的性质也在改变。例如，日常用品的计算机化让整个世界变成了黑客的游乐场。一家赌场最近遭遇了数据泄露，黑客在侵入赌场一个联网的鱼

缸后跳转到了该公司网络中更敏感的部分。黑客们也在改变自己的商业模式。有些黑客并没有在黑市上出售数据，而是试图让公司支付赎金。视频流媒体公司Netflix就遭到勒索：今年4月，窃贼偷走了它的一档热门节目中未播出的一集。

该如何应对？公司在规划网络安全时应遵循两大指导原则。第一是采取分层防御措施。这也是人类社会对待其他许多风险的方式。例如，汽车是危险的机器。驾驶规则和路标试图防止事故发生。但这并不总能奏效，因此在设计汽车时就要考虑如何在发生撞车事故时保护乘客的安全。如果这还不够，急救服务和医院就会设法修复损害，救治伤者。

这种想法在以预防为主的计算机安全行业中相对新颖。随着对缓解损害和灾难恢复的关注越来越多，公司自己也应该采取类似的方法。例如，在公司内部把不同的敏感数据分隔管理，这样就算有黑客攻破了外围防御，也可降低攻击的影响。如果提前规划应对黑客攻击的方法，出现像Equifax这样拙劣的补救措施的可能性就会降低。

第二个原则是更明智地看待数据，包括存储了多少数据，要保存多长时间。公司大多将信息视为一种资产。人工智能等技术的吸引力促使它们尽可能多地储存信息。但同样的数字基础设施既让成堆的数据变得有用，也让它们很容易就受到想窃取信息的人的攻击。再加上监管机构越来越不能容忍数据泄露，这让数据既成为一种商业机遇，又是法律风险的源头。本刊曾指出，在推动经济方面，数据之于今天就像石油之于20世纪。这个类比很恰当。石油确有价值，但它有毒且易燃，一旦泄漏还有可能引发灾难。 ■



Logistics

Freight gain

New rail routes between China and Europe will change trade patterns

ASTANA in Kazakhstan is one of the world's most remote capitals, surrounded by thousands of kilometres of empty steppe. This summer Astana attempted to launch itself onto the global stage by hosting the World Expo, which closed on September 10th and underwhelmed many attendees. But there are other ways to have an impact. On the city's north side, away from the Expo's exhibits, a series of diesel trains, each pulling dozens of containers, roll through the old railway station. Most are heading from China to Europe. Last year over 500,000 tonnes of freight went by train between the two, up from next to nothing before 2013. Airlines and shipping firms are watching things closely.

The trains rumbling through Astana result from a Chinese initiative, in tandem with countries like Kazakhstan, to build a "New Silk Road" through Central Asia. The earlier overland routes were once the conduits for most trade between Europe and China and India; they faded into irrelevance when European ships started circumnavigating the Cape of Good Hope.

China has long wanted to develop its inland regions and push industry to "go west", in order to spread economic growth more evenly. Manufacturers have been loth to shift, in part because of the higher cost of moving goods to ports for export. Developing a rail-freight network to Europe—an important part of China's "One Belt One Road" policy—opens up a new route to market for its poorest areas. The land route through Central Asia is relatively short. A container ship too large for the Suez canal must make a 24,000km journey to reach Europe. Trains travel no more than 11,000km to reach the same destination.

Kazakhstan has spent over 1.1trn tenge (\$3.2bn) on upgrading its railway lines and rolling stock since 2011. That includes \$250m on the Khorgos Gateway, a dry port at the border with China that lifts containers from Chinese trains onto Kazakh ones to overcome a change in track width (a problem that has stymied previous efforts to build railway routes between Europe and China).

Volumes of freight travelling between China and Europe by rail are rising quickly. Between 2013 and 2016 cargo traffic quintupled in weight. In the first half of this year the value of goods travelling by train rose by 144% compared with the same period in 2016. Western firms have been keen to embrace rail freight because it helps them to lower costs, says Ronald Kleijwegt, an expert on the industry. In the case of high-tech electronics, for example, which consumers like to receive quickly, making them on China's coast and air-freighting them to Europe is extremely pricey.

How worried should shipping firms and airlines be? Kazakhstan's national rail company, KTZ, says it will have capacity for 1.7m containers to pass through the country between Europe and China each year by 2020; that is a tenth of the volume currently carried by sea and air between the two. In the longer term, a full modernisation of the existing main three rail routes from China to Europe could produce 3m containers a year in capacity.

But there are reasons to doubt that will happen. For one thing, China plans to stop handing out government subsidies for additional rail-freight capacity from 2020, which will slow the network's expansion. Sea freight has little to fear in the near term, says Soren Skou, chief executive of Maersk, the world's biggest container-shipping line. Trains may take away some future growth from ships, he concedes, but not their existing business.

Air cargo is more vulnerable. Last year, 180,000 tonnes of cargo travelled on

trains to western Europe from China (the remainder was destined for Russia and eastern Europe). That is a small fraction of the 52m tonnes that came by sea, but a big chunk of the 700,000 tonnes that came by air. Much of that air cargo could switch to rail in future, says Mr Kleijwegt, with one important proviso—that Russia would need to lift the retaliatory sanctions it placed in 2014 on imports of Western food, which stop most foodstuffs from travelling by land between Europe and China. That is unlikely for the time being. But it was only a decade ago that people thought the idea of freight trains between Europe and China was a joke, says Mr Kleijwegt—and no one laughs at that any more. ■



物流

货运发展

中欧之间的新铁路线将改变贸易模式

哈萨克斯坦的阿斯塔纳（Astana）是世界上最偏僻的首都之一，周围是绵延数千公里的空旷大草原。今年夏天，阿斯塔纳主办了世博会，试图借此登上国际舞台。世博会于9月10日闭幕，并未给许多参会者留下深刻印象。不过，要想产生影响还有别的办法。在远离世博会会址的阿斯塔纳北部，一列列装运着几十个集装箱的柴油机车驶过老火车站，大多是从中国开往欧洲的。去年，中欧之间有超过50万吨货物经铁路往来，而2013年之前还寥寥无几。航空公司和航运公司正在密切关注这一发展趋势。

中国提出与哈萨克斯坦等国家一起打造一条贯穿中亚的“新丝绸之路”，这些隆隆驶过阿斯塔纳的货运列车正是这一倡议的产物。古丝绸之路曾是欧洲与中国及印度之间大多数贸易往来的通道。当欧洲船只开始绕行好望角之后，这一陆上贸易通道就渐渐衰落了。

长期以来中国一直希望发展内陆地区，推动产业“走向西部”，促进更均衡的经济发展。制造商一直不愿转移，部分原因是这样会拉高将货物运往出口港口的成本。发展一个通往欧洲的铁路货运网络是中国“一带一路”政策的重要组成部分，为中国最贫困地区开辟了一条通往市场的新路线。通过中亚到达欧洲的陆路通道相对较短。无法通过苏伊士运河的大型集装箱船必须航行2.4万公里才能到达欧洲，走铁路的话全程不超过1.1万公里。

自2011年以来，哈萨克斯坦已经为升级铁路线路和铁路机车投入超过1.1万亿坚戈（32亿美元），其中包括投向中哈边界的无水港霍尔果斯口岸的2.5亿美元。由于中哈铁路轨距不同（这一差异阻碍了过去在中欧之间修建铁路线的努力），中国列车上的集装箱要在此换装到哈萨克斯坦的列车上。

中欧之间的铁路货运量正在快速上升。2013年至2016年间，货运重量增长了四倍。今年上半年，经铁路运输的商品价值相比2016年同期增长了

144%。铁路货运行业专家罗纳德·克莱伊韦格特（Ronald Kleijwegt）说，西方企业十分欢迎中欧铁路货运的发展，因为这有助它们降低成本。以高科技电子行业为例，高科技电子产品的消费者希望能快速收到货物，而在中国沿海地区制造这些产品再空运至欧洲的成本极高。

航运和航空公司对此该多担心呢？哈萨克斯坦国家铁路公司（KTZ）表示，到2020年，它在经由哈萨克斯坦往返中欧的线路上将拥有每年170万个集装箱的运力，是目前两地间海运和空运年运输量的十分之一。而在更漫长的时间里，中欧之间现有三条主要铁路线的全面现代化将带来每年300万个集装箱的运力。

但有理由对此前景表示怀疑。一方面，中国计划从2020年起停止向新增铁路运力提供政府补贴，这将让铁路运输网络扩张的速度放慢。全球最大的集装箱航运公司马士基（Maersk）的首席执行官施索仁（Soren Skou）说，短期内海运业没什么可担心的。他承认，火车可能会抢走船舶的一部分未来增量业务，但其现有业务不会被抢夺。

空运更易受影响。去年，18万吨货物从中国经铁路运往西欧（其余运往俄罗斯和东欧），这在经海路运抵的5200万吨中只是个零头，但在经空运抵达的70万吨中却是很大一块。克莱伊韦格特说，未来大部分空运货物都可能转而走铁路，不过一个重要的前提条件是，俄罗斯需解除从2014年起对西方进口食品施行的报复性制裁措施，这一措施阻碍了中欧之间大多数食品的陆路运输。目前看来制裁不大可能取消。不过克莱伊韦格特说，仅仅十年前，中欧之间开通货运列车还被看作一个笑话，而如今再也没人取笑了。■



Buttonwood

Investor Caution Obligatory

A new craze attracts the attention of regulators

HERE is the deal. You can buy an entry in a computer ledger issued by a startup company on the basis of an unregulated prospectus. It is called an “initial coin offering” or ICO. But though the ledger entry is called a coin, you cannot spend it in any shop. And whereas the use of the term ICO makes it sound like an IPO (initial public offering), the process whereby a firm lists on a stockmarket, coin ownership does not necessarily get you equity in the company concerned.

This sounds like the kind of bargain that would appeal only to people who reply to e-mails from Nigerian princes offering to transfer millions to their accounts. But ICOs may well be the most popular investment craze since the dotcom boom of 1999-2000; even Paris Hilton, a celebrity heiress, has jumped on the bandwagon. The list of active, upcoming and recent ICOs on the website “ICO alert” covers 31 pages of A4 paper and includes around 600 companies. More than \$2bn has been raised in total.

There is a serious side to the craze, just as there was with the dotcom boom. The technology that underpins digital currencies—the blockchain—is an important development. This is a secure, decentralised ledger that everyone can inspect but that no single user controls. It seems likely to be adapted for use across the financial system—to record property transactions, for example.

Many ICOs are designed to finance applications that will make use of the blockchain—for trading currencies, lending money or searching for jobs. In some cases, the “coins” can be exchanged for services on the site. In a way, this is like selling air miles in a startup airline; investors can either use the

miles for flights or hope they can trade them at a profit. For the business, it is also a way of creating demand for the product they are selling.

But in plenty of cases, an ICO is just a way of raising capital without all the hassle of meeting regulatory requirements, or the burden of paying interest to a bank. Businesses are able to achieve this feat because investors hope that the coins will rise rapidly in value, as has been the case with bitcoin or ethereum, the best-known digital currencies, which have seen stellar gains in the past year. Nothing makes individuals more willing to take risks than the sight of other people getting rich.

But bitcoin is also different from ICOs. Its appeal is as a digital currency that can be used in a broad range of transactions. And the supply of bitcoin is designed to be limited, meaning some people regard it as an electronic version of gold.

So there is a chance that bitcoin or ethereum will come into widespread use, although their function as a means of exchange is undermined by the volatility of their prices. Currencies must be stores of value, at least in the short term. If you think a digital currency is going to rise by 20% tomorrow, you won't want to swap it for goods and services; if you think it is going to fall by 20% you won't want to accept it.

It is also worth remembering that governments set the rules regarding the nature of legal tender within their borders. They will always have the whip-hand when it comes to issuing currency. If they believe that a digital currency is being used for widespread tax evasion, or is distorting the financial system, they will crack down hard.

As far as business-related ICOs are concerned, a few may succeed. Investors may well be taking the "lottery ticket" approach, hoping that one big winner will offset a large number of losses. In a sense investors are acting

like venture capitalists. But the sultans of Silicon Valley's VC industry insist on a wide range of rights before they invest their capital, including protection against dilution of their stakes and (sometimes) the right to nominate board members. Investors in ICOs have nothing like that level of protection.

In the circumstances, it is hardly surprising that regulators are getting involved. In America, the Securities and Exchange Commission has ruled that these coins may, in some cases, be securities and thus subject to regulation. A British regulator, the Financial Conduct Authority, in September warned investors about the risks involved. The Chinese authorities have gone a lot further, declaring that new ICOs are simply illegal.

It is not easy to draw a line between financial innovation and reckless speculation. Perhaps an ICO will finance some breakthrough that boosts economic efficiency. If you work in the tech sector, you may be able to spot the occasional grain of wheat among the pile of chaff. Everyone else should assume that ICO stands for "It's Completely Off-limits". ■



梧桐

投资需谨慎

新热潮引来监管机构的关注

是这样一个交易：你可以根据一份不受监管的招股说明书，购买一家创业公司发行的计算机分类帐中的条目。这项发行活动被称为“首次代币公开预售”（ICO）。然而，虽然这种分类帐条目叫作“币”，却不能用它在任何商店中消费。而尽管ICO这个术语听起来和表示公司在股票市场上市的IPO一词很像，但购买这种币却并不一定会让你获得发行公司的股票。

这么奇怪的交易，应该只会吸引那些会回复来自“尼日利亚王子”的电子邮件、等着对方向自己转账数百万美元的人。但自1999至2000年的互联网热潮以来，ICO很可能是影响范围最广的一股投资热潮，就连豪门继承人、名媛帕丽斯·希尔顿（Paris Hilton）也在跟风。“ICO警报”（ICO alert）网站上罗列的正在融资、即将发行和近期发行完毕的ICO项目有31页A4纸之多，包括约600家公司。迄今为止总共融资超过20亿美元。

这股热潮和互联网热潮一样，有其严肃的一面。支撑数字货币的区块链技术是一项重要的技术发展，这是一个安全的、去中心化的分类帐，人人都能检查它，但没有哪个用户控制它。这一技术似乎可被调整用于整个金融系统，比如用于记录财产交易。

很多ICO是为了给那些将要利用区块链技术的应用融资，比如外汇交易、贷款或找工作。在某些情况下，“代币”可以当场兑换服务。在某种程度上，这就像出售一家刚成立的航空公司的里程数，投资者可以用里程数换机票，或者指望出售里程数来获利。对于这类企业来说，ICO也是为所销售的产品创造需求的一种方式。

然而在很多情况下，ICO只是筹集资金的一种方式，省去了为达到监管要求而要面对的各种麻烦，或向银行支付利息的负担。企业之所以能在ICO上大获成功，是因为投资者希望代币的价值会快速上涨，就像比特币或以

太币一样。过去一年里，这两种最知名的数字货币涨幅惊人。看到别人发财最能让人愿意承担风险。

但是比特币也不同于ICO。它的吸引力在于，作为一种数字货币，它可应用于广泛的交易。而比特币的供应总量有限，一些人因而视之为电子版的黄金。

所以，比特币或者以太币有可能会得到广泛使用，尽管它们作为交易工具的功能因其价格的波动性而受损。货币必须是储值工具，起码在短期内须如此。如果人们认为一种数字货币明天将上涨20%，就不会用它来交换商品和服务；如果认为它会下跌20%，就不会愿意接受这种货币。

另外需要记住的一点是，各国政府规定了本国法定货币的性质。在货币发行上，鞭子总是拿在政府的手中。如果政府认为某种数字货币被广泛用于逃税或者正在扭曲金融体系，就会对其严厉打击。

就那些有业务支撑的ICO而言，有几个也许会成功。投资者很可能有“买彩票”的心理，希望中一次大奖会抵消多笔损失。从某种意义上说，这些投资者的行为和风投资本家是一样的。但硅谷风投界的大佬在投入资本之前会坚持要求广泛的权利，包括签订反摊薄条款，有时还会要求提名董事的权利。ICO的投资者没有任何这种层级的保护。

在这种情况下，监管机构会介入就不足为奇了。在美国，证券交易委员会（SEC）裁定这些代币在某些情况下可能是证券，因而要受监管。英国监管机构金融行为管理局（FCA）9月就有关风险向投资者发出了警告。中国监管机构更进一步，宣布新的ICO完全是非法的。

要在金融创新和鲁莽投机之间划清界限并非易事。也许ICO将会为一些能大大促进经济效率的突破提供资金。如果你在科技行业工作，可能有眼力在一堆谷壳之中偶然发现一粒小麦。而其他所有人都应当假设ICO代表的意思是“不可涉足”（It's Completely Off-limits）。 ■



The Federal Reserve

Switching to autopilot

The Fed prepares for its balance-sheet—and its board—to shrink

NINE years ago, in the autumn of 2008, the Federal Reserve was fighting a financial collapse. To stave off disaster, it lent aggressively—to banks, to money-market funds, even to other central banks. As a result, its balance-sheet ballooned. At the start of September 2008, the month when Lehman Brothers collapsed, the Fed's assets totalled \$905bn (at the time, about 6% of GDP). By December they had more than doubled in size, to \$2.1trn. That was only the start. As its emergency lending unwound, the Fed began purchasing government debt and mortgage-backed securities (MBSs), in an attempt to support the real economy. Three volleys of so-called “quantitative easing” (QE) eventually swelled the balance-sheet to \$4.5trn by 2015.

On September 20th the Fed announced that it will start putting QE into reverse. It does not intend to sell its assets. Rather, as its securities mature, it will stop reinvesting all of the proceeds. The permitted monthly “run-off” will gradually rise until it reaches \$30bn for Treasury bonds, and \$20bn for MBSs and housing-agency debt (see chart). The process will not be entirely predictable. Treasuries mature on a known date. But how fast the MBS portfolio shrinks will depend on how many Americans move house or refinance their mortgages (which in turn largely depends on interest rates).

Exactly how QE worked—and hence the effects of unwinding it—remains a little mysterious. The consensus, however, is that asset purchases brought down long-term interest rates, and that the first programme, which began in 2009, had the biggest impact. Fed economists recently estimated that, combined, all the programmes lowered the ten-year Treasury yield by one percentage point.

So as the balance-sheet shrinks, this effect might be expected to go into reverse and interest rates to rise. But there are three reasons to doubt this. First, economists have speculated that some or even all of QE's potency came from its influence on traders' expectations for short-term rates. For example, when markets threw their so-called "taper tantrum" in mid-2013, after then-chairman Ben Bernanke said that asset purchases would be reduced, they were agitated in part by the prospect of faster interest-rate rises.

This time, however, there is little scope for the markets to change their assumptions about the path of rates. The Fed has clearly signalled its intentions in advance. Once balance-sheet reduction has started, it will "run quietly in the background", according to Janet Yellen, the Fed's current chairman. In any case, markets today view interest-rate rises and balance-sheet reduction as alternatives rather than complements, according to Daan Struyven of Goldman Sachs.

Second, markets have been relatively stable as the Fed has signalled its balance-sheet strategy. The ten-year Treasury yield is 2.1%, almost as low as it has been at any point in 2017. Prospects for tax cuts and new infrastructure spending seem to have moved the markets more than have the Fed's prognostications. Perhaps earlier QE announcements had an unusually large impact because markets were dysfunctional at the time; today, by contrast, traders can shrug-off balance-sheet policy.

Finally, the run-off will be gradual. Even if the Fed hits its redemption cap every month, it would take eight years to offload all its mortgage-backed securities. This is important if, as many traders believe, it is the flow of central-bank transactions more than its stock of assets that determines prices. (If the stock—which economists emphasise—matters more, the eventual impact on MBS markets looks unavoidable, since the Fed owns 21% of the market.)

The Fed will almost certainly shed its entire mortgage portfolio eventually. Few economists think it should meddle in housing markets in the long term. But how much of its Treasury holdings is sold depends on where the Fed wants its balance-sheet to end up.

That question will probably be resolved by a new chairman, and an almost entirely new Fed board, next year. After the departure of Stanley Fischer, the vice-chairman, in October (see Free exchange), the board might be left with just three members, rather than the intended seven—an unprecedented situation. A perverse effect, besides the higher workload, is that it could make it hard for board members to confer privately. Any two would constitute a quorum.

Even if the Senate soon confirms Randal Quarles, the president's nominee to be vice-chairman for bank supervision, three slots would still be open. The vacancies give President Donald Trump latitude to reshape the central bank, and hence, indirectly, its balance-sheet. For now, they increase the power of the five presidents of regional Fed banks who, with the board, vote on monetary policy. They tend to be more hawkish than board members (perhaps because, unlike the board, they are not appointed by politicians).

In February Ms Yellen's term will expire. Until recently, the favourite to replace her was Gary Cohn, Mr Trump's senior economic adviser, whose views on monetary policy are not clear. But Mr Cohn has reportedly fallen out of favour with the president, after criticising his response to a white-supremacist march. That might have boosted Ms Yellen's chances of reappointment. But she, too, has risked the ire of the White House, with a robust defence of financial regulations that Mr Trump wants to loosen. (Her backers hope that a recent breakfast with Ivanka Trump, the first daughter, helped to curry favour.)

The obvious beneficiary of these setbacks is Kevin Warsh, an ex-banker

who served on the Fed's board during the financial crisis and was a confidant of Mr Bernanke. Unfortunately, Mr Warsh's skills at making friends seem stronger than his monetary-policy acumen. During the financial crisis, he fretted needlessly about inflation. His criticism of asset purchases from 2010 onwards have not aged well. And his muddled writings on monetary policy betray his lack of economic training.

Under Mr Warsh, the Fed might shed assets, especially MBSs, faster. Worryingly, it might also hesitate to use QE again if, as is likely, interest rates hit bottom once more during a future recession—especially if Mr Trump appoints other QE-sceptics, such as Marvin Goodfriend, a professor at Carnegie Mellon University, to the board. Ms Yellen, despite her efforts to shrink the balance-sheet now, would be a better firefighter come the next conflagration. ■



美联储

切换到“自动驾驶”模式

美联储为缩减资产负债表及理事会缩水做准备

九年前，也就是2008年的秋天，美联储正在对抗一场金融崩溃。为了抵挡灾难发生，它积极向银行、货币市场基金甚至其他央行提供贷款，资产负债表因此大幅膨胀。到2008年9月初，也就是雷曼兄弟破产的那个月，美联储的总资产达到了9050亿美元，相当于当时GDP的约6%；到了12月再增加超过一倍，达到2.1万亿美元。这只是个开始。随着紧急贷款的解除，美联储开始购买政府债务和抵押贷款支持证券（MBS），试图支撑实体经济。经过三轮所谓的“量化宽松”后，最终其资产负债表在2015年扩张到了4.5万亿美元。

本月20日，美联储宣布将开始逆转量化宽松政策。它并不打算出售资产，而是会停止到期债券的再投资。每月允许的“缩表”水平将逐步上调，直到每月减持300亿美元的国债、200亿美元的MBS及住房机构债务（见图表）。这个过程并非完全可预知。国债到期的日期是可以确知的，但MBS资产的缩减速度将取决于有多少美国人会搬家或为自己的按揭贷款再融资（这一点又大体上取决于利率水平）。

量化宽松确切的作用机制仍带有一丝神秘色彩，解除它会带来怎样的影响也就不好确定了。不过人们普遍认为资产购买拉低了长期利率，其中以2009年开始实施的购买计划影响最大。美联储的经济学家近期估计，所有资产购买行动总共令十年期国债收益率下降了一个百分点。

因此，当资产负债表缩减时，或可预期上述影响力走向反面，造成利率升高。不过有三个理由对此表示怀疑。首先，经济学家猜测，量化宽松部分甚至全部的效力源于它会影响交易员对短期利率的预期。例如，2013年年中，时任美联储主席的伯南克宣布将减少购买资产后，市场出现了“缩减恐慌”，一定程度上是因为加息步伐加快的前景引发了市场的焦虑。

不过，这一次，市场几乎没可能改变自己对于利率走势的猜测。美联储提前明确释放了意欲“缩表”的信号。现任主席珍妮特·耶伦表示，一旦资产负债表缩减行动开始，将会“在后台悄悄进行”。不论如何，高盛的丹·斯特文（Daan Struyven）表示，如今在市场看来，加息和“缩表”这两种策略是非此即彼的关系，而非互为补充。

其次，在美联储预示了自己的资产负债表策略后，市场相对来说一直较平稳。十年期国债收益率为2.1%，几乎与2017年任何时候的低点相当。比起美联储的预告，对减税及增加基建支出的预期似乎对市场的触动更大。之前关于量化宽松的各种公告之所以会有异常大的影响力，也许是因为那时候的市场处于失灵状态。相比之下，如今交易员们大可对于资产负债表政策不予理会。

最后，“缩表”将会是渐进式的。就算美联储每个月都达到赎回的上限，也要花八年才能清理掉所有的MBS。如果真如许多交易员相信的那样，央行交易的流动比起资产存量更能决定价格，那么这种渐进性就很重要了。

（经济学家更强调资产存量的重要性，如果他们是对的，那么MBS市场到头来应该会不可避免地受到影响，因为美联储拥有该市场21%的份额。）

几乎可以肯定，美联储最终会将其资产负债表中所有的MBS资产都清理掉。没有几个经济学家认为美联储应该长期插手住房市场。而美联储会卖掉多少国债则要看它想让资产负债表最终达到怎样的规模。

到了明年，这个问题也许会由一位新主席和一个几乎全新的理事会来解决。等到下月副主席斯坦利·费希尔（Stanley Fischer）离任后，理事会也许将出现一个前所未有的局面：只剩下三位成员，而不是理应达到的七人。这除了会增加成员的工作量外，还有一个负面效应：他们可能难在私下做商议，因为任意两人都会达到使决议有效的法定人数。

特朗普提名兰德尔·夸尔斯（Randal Quarles）为美联储副主席，负责银行监管。即使参议院很快确认这项提名，理事会仍会有三个空位。这些空缺让特朗普有了重塑美联储的自由，也就有了间接影响其资产负债表的可

能。就目前来看，这些空位提升了五位和理事会一起就货币政策操作进行投票的地区性储备银行主席的影响力。与理事会成员相比，他们往往更偏鹰派——也许是因为他们与前者不同，并非由政客任命。

耶伦的任期将于明年2月结束。一直到前不久，最有可能接替耶伦的还是特朗普的高级经济顾问加里·科恩（Gary Cohn）——他对货币政策持怎样的观点尚不清楚。但据说他已在总统那里失宠，因为他批评了其对白人至上主义者游行的反应。这也许增加了耶伦获得连任的可能性。不过她坚定维护特朗普想要放松的金融监管，因此也可能惹恼了白宫。（耶伦最近和“第一千金”伊万卡·特朗普共进了一次早餐，她的支持者希望这能帮她讨些欢心。）

最有可能因这些人的挫败而受益的人是凯文·沃什（Kevin Warsh）。他以前是个银行家，曾在金融危机期间担任美联储理事，还是伯南克的密友。遗憾的是，沃什在货币政策方面的才干不如他交朋结友的本事。在金融危机期间，他对通货膨胀表达了不必要的担忧。自2010年起他开始批评美联储的资产购买行动，结果被这些行动的实际效果打了脸。他关于货币政策的含混文字也暴露出他缺乏经济学方面的训练。

如果是由沃什担任主席，美联储也许会加快清理资产的速度，尤其是对MBS。令人担心的是，假如将来发生衰退时利率再次触底——这很可能发生，美联储也许就不会轻易再使用量化宽松。如果特朗普任命卡内基梅隆大学教授马文·古德弗兰德（Marvin Goodfriend）这样的量化宽松怀疑论者担任理事，就更可能如此了。尽管耶伦目前正竭力缩表，但日后若再出现大麻烦，还是由她来救火更靠谱些。 ■



Global economy

Does China play fair?

Competition from China will only get fiercer. That calls for cool heads and wise policies

IF DONALD TRUMP had slapped punitive tariffs on all Chinese exports to America, as he promised, he would have started a trade war. Fortunately, the president hesitated, partly because he wants China's help in thwarting North Korea's nuclear ambitions. But that is not the end of the story. Tensions over China's industrial might now threaten the architecture of the global economy. America's trade representative this week called China an "unprecedented" threat that cannot be tamed by existing trade rules. The European Union, worried by a spate of Chinese acquisitions, is drafting stricter rules on foreign investment. And, all the while, China's strategy for modernising its economy is adding further strain.

At the heart of these tensions is one simple, overwhelming fact: firms around the world face ever more intense competition from their Chinese rivals. China is not the first country to industrialise, but none has ever made the leap so rapidly and on such a monumental scale. Little more than a decade ago Chinese boom towns churned out zips, socks and cigarette lighters. Today the country is at the global frontier of new technology in everything from mobile payments to driverless cars.

Even as China's achievements inspire awe, there is growing concern that the world will be dominated by an economy that does not play fair. Businesses feel threatened. Governments that have seen Brexit and the election of Mr Trump, worry about the effects of job losses and shrinking technological leadership. Yet if the outcome is to be good, they must all think clearly about the real nature of China's challenge.

| *Go, in three dimensions*

Undoubtedly, China has form. It kept its currency cheap for years, boosting exporters; it finances its state-owned giants with cheap credit; and its cyber-spies steal secrets. Yet depictions of corporate China as just an undemocratic, state-run monster, thieving and cheating to get ahead, are crude and out of date. Home-grown innovation is flourishing. The innovators are mainly private, not the many heads of a single creature called China Inc. To separate hype from reality, think of Chinese competition as having three dimensions: illegal, intense and unfair. Each needs a different response.

First, consider illegality. The best example is the blatant theft of intellectual property that makes for the most sensational headlines, such as the charges laid in 2014 against five Chinese military officers for hacking into American nuclear, solar and metals firms. The good news is such crimes are declining. An agreement with America in 2015 seemingly led to a marked drop in Chinese hacks of foreign companies and, as Chinese firms produce more of value, they are themselves demanding better intellectual-property protection at home.

The second dimension—intense but legal competition—is far more important. Chinese firms have proven that they can make good products for less. Consumer prices for televisions, adjusted for quality, fell by more than 90% in the 15 years after China joined the World Trade Organisation (WTO). China's share of global exports has risen to 14%, the highest any country has reached since America in 1968. That may fall as China loses its grip on low-value industries such as textiles. But it is gaining a new reputation in high tech. If data are the new oil, China's tech industry has vast reserves in the information generated by the hundreds of millions of its people online—unprotected by privacy rules. Whether you make cars in Germany, semiconductors in America or robots in Japan, the chances are that in future some of your fiercest rivals will be Chinese.

Last, and hardest to deal with, is unfair competition: sharp practice that breaks no global rules. The government demands that firms give away technology as the cost of admission to China's vast market. Foreign firms have been targeted in the biggest of China's anti-monopoly cases. The government restricts access to lucrative sectors, while financing assaults on those same industries abroad. Such behaviour is dangerous precisely because today's rules offer no redress.

| *Don't get angry. Get even*

Sorting Chinese competition into these categories helps calibrate the response. Blatant illegality is the most straightforward. Governments must prosecute and seek redress, whether through the courts or the WTO. Firms can better protect themselves against cyber-thieves—from China and elsewhere.

Though it is politically hard, the best response to intense competition is to welcome it. Consumers will gain from lower costs and faster innovation. Misguided attempts to hold back the tide would not only lose those potential gains but might also blow up the world trading system, with catastrophic results. Rather than try to stop the loss of jobs, governments should provide retraining and a decent safety net. Both companies and governments need to spend more on education and research. Six years ago Barack Obama said America faced a new "Sputnik moment" in China's rise. Since then not much extra has been devoted to research, training and infrastructure.

The hardest category is competition that is unfair, but not illegal. One approach is to coax China into behaving better by acting collectively. America, Europe and big Asian countries could jointly publish information about economic harm from China's policies—as they did by sharing details about overcapacity in the steel industry, nudging China into cutting its excesses. They should demand reciprocity, requiring China to give foreign

companies the same access that its own firms enjoy in their markets. Governments need to review their policies for screening investments from China so that they can block genuine threats to national security (though only those). And they should also require that investors with state backing report this in full, and punish those hiding their true identity.

Much of the responsibility for putting this right falls on China. It may ask why it should hold itself back. After all, 19th-century Germany and America grew rich behind subsidies and tariff walls; Britain and Japan were bullies. Yet, having done so well out of the global commercial ecosystem, China should recognise that it has become one of its custodians. Abuse it—illegally or by overburdening it—and it will break. ■



全球经济

中国在公平竞争么？

来自中国的竞争只会更加激烈。对此需要冷静的头脑和明智的政策

如果特朗普像他承诺过的那样，对中国出口到美国的所有商品征收惩罚性关税，那么他就会挑起一场贸易战。所幸这位总统犹豫了，部分原因是他需要中国的帮助来挫败朝鲜的核野心。但故事并未到此结束。中国的产业实力引发的紧张局势如今威胁到了全球经济的结构。本周，美国贸易代表称中国是“前所未有的”威胁，无法由现有的贸易规则制约。中国一连串的海外收购引发了欧盟的担忧，它正在起草针对外国投资的更严格规定。与此同时，中国经济现代化的战略也在加剧这种紧张局势。

这些紧张局势的核心是一个简单而又无法辩驳的事实：世界各地的公司都面临着来自中国对手的日益激烈的竞争。中国不是第一个工业化的国家，但从没有哪一个国家曾如此迅速地实现了如此大规模的飞跃。仅仅十多年前，中国新兴的城镇还在大量生产拉链、袜子和打火机。如今，从移动支付到无人驾驶汽车，中国在方方面面都处于全球新技术的前沿。

中国的成就令人敬畏，但同时人们也越来越担心世界将被一个不公平行事的经济体所主宰。各行各业感受到了威胁。已目睹了英国脱欧和特朗普当选的各国政府则担心职位流失和技术领先优势缩减的影响。不过，如果想要得到好的结果，它们都必须清楚地思考由中国带来的挑战的真正本质。

| 从三方面入手

毫无疑问，中国在不当竞争方面是有前科的。多年来它一直压低汇率以提振出口；它为国有巨头提供低息贷款；它的网络间谍窃取机密。但如果还是把中国企业描述成不民主的国营怪物，靠剽窃和欺骗冒头，就简单粗暴且过时了。中国本土的创新正在蓬勃发展。创新的主体是私营企业，而不是一个叫“中国有限公司”的生物的诸多分身。为区分炒作和现实，可以从三个方面看待中国的竞争：非法、激烈、不公平。每一面需要不同的应对方式。

首先来看非法。最好的例证就是中国明目张胆地窃取知识产权，一次次成为轰动的头条新闻。比如2014年，五名中国军官被指控入侵美国核电厂、太阳能企业和金属公司的电脑网络。好消息是此类犯罪正在减少。2015年与美国达成的一项协议似乎令中国对外国公司的黑客行为大幅减少，而且随着中国企业创造的价值越来越高，它们自己也要求在国内获得更好的知识产权保护。

第二个方面——激烈但合法的竞争——要重要得多。中国的公司已经证明，它们能以更少的成本做出好产品。中国加入世界贸易组织（WTO）的15年里，按质量调整后，电视机的零售价格下降了90%以上。中国在全球出口中所占的份额已经上升到14%，这是自1968年的美国以来的最高水平。随着中国失去对纺织等低附加值产业的控制，这一份额可能会下降。但它正在高科技领域赢得新的声誉。如果说数据是新的石油，中国的科技行业就有巨大的“储量”，这些信息由数亿网民产生，且不受隐私条款的保护。无论你是在德国生产汽车，在美国生产半导体，还是在日本生产机器人，未来某些最强劲的竞争对手很可能会是中国人。

最后，也是最难处理的，是不公平竞争：不择手段但又不违反全球规则的做法。中国政府要求企业出让技术，作为进入中国广阔市场的代价。在中国最大的一些反垄断案件里，被盯上的是外国公司。政府限制外企进入利润丰厚的行业，但却资助国内企业在国外突袭这些行业。这样的行为是危险的，原因正是今天的规则没有提供任何补救。

| 别生气，大家扯平

将来自中国的竞争分门别类有助于更准确地回应。对待公然违法的方法最简单。各国政府必须提起诉讼并寻求补偿，不管是通过法院还是世贸组织。公司可以更好地保护自己免受来自中国和其他地方的网络窃贼的攻击。

尽管在政治上很难做到，但对激烈竞争的最佳回应是欢迎它。消费者将从更低的成本、更快的创新中获益。阻挡这种趋势的错误尝试不仅会失去这些潜在的收益，还可能会摧毁世界贸易体系，造成灾难性的后果。政府应

该提供再培训和适宜的安全网，而不是试图阻止就业机会流失。公司和政府都需要在教育和研究上投入更多的资金。六年前，奥巴马曾说中国的崛起让美国面临一个新的“卫星时刻”。但那之后，用于研究、培训和基础设施的投入并没有增加多少。

最难应对的是不公平但并不违法的竞争。一种方法是通过集体行动让中国做事更合规矩。美国、欧洲和亚洲大国可以共同发布信息，指明中国政策带来的经济损害——就像它们分享中国钢铁行业产能过剩的详细信息，推动其削减过剩产能那次一样。它们应该要求互惠，要求中国让外国公司享有进入中国市场的权利，就像中国公司在它们的市场上所享有的一样。政府需要审查它们用于筛选中国投资的政策，以阻止对国家安全的真正威胁（但应仅限于这些威胁）。而且，它们还应该要求有政府背景的投资者充分报告这一情况，并惩罚那些隐藏真实身份的投资者。

要纠正这些问题，主要责任还是在中国身上。它可能会问，为什么它应该保持克制。毕竟，19世纪的德国和美国就是靠补贴和关税壁垒富裕起来，英国和日本从前也恃强凌弱。不过，既然中国从全球商业生态系统中获益良多，它应该认识到自己已经成为这个系统的守护者之一。滥用这个系统——无论是违法或是让它超负荷——都会让它崩溃。■



The power of tech firms

Monopoly is not a game

A crusade against the threats posed by the technology giants

PUBLIC scrutiny eventually stalks the kings of capitalism. Wall Street banks enjoyed decades of unfettered growth before coming to be seen, as Matt Taibbi, a journalist, described Goldman Sachs, as a “vampire squid wrapped around the face of humanity”. Today another backlash is gaining strength, this time against the giant digital squids, whose tentacles are encircling both public and personal life. In June the European Commission fined Google a record-breaking €2.4bn (\$2.7bn) for suppressing rival comparison-shopping sites. (The firm filed an appeal last week.) The tech giants continue to snap up or shamelessly copy smaller rivals.

A rising figure in the cohort of tech-company critics is Franklin Foer, a journalist at the *Atlantic*. His new book “World Without Mind” decries society’s capture by big technology companies, mainly Amazon, Facebook and Google. His criticisms are wide-ranging, but centre on the idea that they have become monopolies. Their dominance has gutted the financial health of publishers and music companies. He even charges tech firms with having bruised democracy: they serve up information based on opaque algorithms, suggesting what people should think, and so supplanting individual thought. Mr Foer compares tech’s lack of transparency to Italy, “where it’s never entirely clear how power really operates”.

The book flits between history, philosophy and politics, but it is also a first-hand tale. Mr Foer was editor of the *New Republic* under Chris Hughes, one of Facebook’s founders, who bought the well-respected but loss-making magazine in 2012. An amicable partnership soured as Mr Hughes tried to push the *New Republic* to chase superficial, bite-sized stories to win cheap digital advertising. Mr Foer and most of the staff left in protest. His

recounting of this clash between old and new media is authentic and absorbing.

But Mr Foer does not want to seem “fuelled by anger”, and he makes a few important points. One is that tech firms exert so much power that people demur from criticising them. Mr Foer saw this first-hand when he became an activist against Amazon’s treatment of authors and publishers. Because the online giant could influence the success of books, many lawyers and publishing executives feared speaking out.

Mr Foer’s concern about opacity is also spot-on. For example, Facebook and Google are not bound by requirements to report sales of political advertising as traditional media firms are. Recent revelations of Russian ad-buying on Facebook during America’s presidential election underscore the risk of so little oversight.

“World Without Mind” joins books such as “Move Fast and Break Things” by Jonathan Taplin, published earlier this year, and Tim Wu’s excellent “The Master Switch”, from 2010, in arguing that regulators need to look at these world-changing companies more critically. But readers looking for an enduring, well-researched manifesto about big tech’s dangers will be disappointed by the book’s lazy generalisations. Mr Foer is not a business journalist or economist, and he cares little for financial and legal details. He uses the word “monopoly” liberally but not specifically, consigning to a footnote that “My hope is that we revive monopoly as a core piece of political rhetoric that broadly denotes dominant firms with pernicious powers.”

Mr Foer also claims that the tech giants, compete only “on the fringes of empire”, betraying a weak grasp on their business models. Facebook and Google battle for digital advertising. They both, along with Amazon, compete vigorously to offer video—a growing segment. And he conflates

Amazon's control of so many sectors with Jeff Bezos's ownership of the *Washington Post*, without showing that Mr Bezos's business interests have influenced the paper's coverage. (Indeed, the *Post* recently published an excerpt from Mr Foer's book.)

When it comes to solutions, he is also breezy. He suggests that much as some consumers have shunned packaged, unhealthy foods in favour of artisanal options, they might opt for new ways to spend time online. This optimistic solution misses a critical point. There is no local-farming equivalent of a search engine or an online social network. And tech firms are pushing into new sectors, even buying up the local alternatives that Mr Foer suggested as solutions in his food analogy (this summer Amazon bought Whole Foods, a grocer). Examining tech firms is more urgent than ever. Mr Foer is right to be sceptical, but his is not the final word. ■



科技公司的势力

垄断非儿戏

对科技巨头威胁的讨伐

公众监督最终会盯上资本主义的霸王们。华尔街各大银行在享受了数十年无拘无束的增长后，在人们眼中成了“缠在人脸上的吸血乌贼”——这是记者马特·泰比（Matt Taibbi）对高盛的描述。如今，又一股抵制情绪正日渐强烈，这次针对的是巨大的数字乌贼，其触须把人们的公共和个人生活都牢牢裹缠。今年6月，欧盟委员会破纪录地对谷歌处以24亿欧元（27亿美元）的罚款，惩戒其打压对手比价购物网站的行为。（谷歌已于上周提出上诉。）这些科技巨头一直在争购或无耻地抄袭小型对手企业。

在科技公司的众多批评者中，《大西洋月刊》（Atlantic）的记者富兰克林·弗尔（Franklin Foer）声名渐起。在新书《失智世界》（World Without Mind）中，他谴责以亚马逊、Facebook和谷歌为首的科技巨头俘虏了整个社会。他的批评涵盖众多内容，但核心是这些公司已成为垄断寡头。它们的霸主地位已大大损害到出版商及唱片公司的财务状况。他甚至还指控这些科技公司破坏民主：它们根据不透明的算法提供信息，左右人们的想法，从而替代个人思考。弗尔把欠缺透明的科技公司比作意大利，“在那里，权力真正的运作方式从来都不尽清晰”。

本书在历史、哲学和政治之间跳转，但同时也是一部亲身见闻录。弗尔曾在《新共和》（New Republic）杂志担任编辑，这本备受尊崇但陷于亏损的杂志在2012年被Facebook的创始人之一克里斯·休斯（Chris Hughes）收购。随着休斯为争取廉价数字广告收入而迫使《新共和》追逐肤浅的快餐式新闻故事，原本和睦的合作关系恶化。弗尔和杂志的大部分员工离职抗议。他对这场新旧媒体冲突的叙述真实可靠，引人入胜。

但是，弗尔并不希望这本书被视作“愤怒之作”，并提出了一些重要观点。一是科技公司势力之大，令人们不敢加诸批评。之前他成为活动家，积极反对亚马逊对待作者及出版商的做法，过程中得到了这方面的亲身体会。

由于这家网络巨头能影响书籍的成功与否，许多律师和出版界高管都不敢畅所欲言。

弗尔对于不透明的担忧也是一针见血。例如，Facebook和谷歌不用像传统媒体公司那样汇报政治广告的销售情况。最近，俄罗斯客户于美国总统选举期间在Facebook上购买广告的情况曝光，突显了严重缺乏监管带来的风险。

《失智世界》与乔纳森·塔普林（Jonathan Taplin）在年初出版的《快速行动和打破陈规》（Move Fast and Break Things）及吴修铭在2010年出版的佳作《总开关》（The Master Switch）一样，都认为监管机构需要更加严格地检视这些足以改变世界的公司。如果读者期待的是一本阐明科技巨头危险之处、经得起考验且研究透彻的作品，那么这本书中各种泛泛的概括会让他们失望。弗尔不是商业新闻记者，也不是经济学家，而且他毫不在意财务及法律上的细节。他不加区分地随意使用“垄断”一词，只在脚注中表示“希望大家重拾‘垄断’一词作为核心政治辞令的语义，即泛指那些具有恶性影响力的霸权公司”。

弗尔还声称，科技巨头只在“帝国的边缘上”竞争，暴露出他对这些巨头的商业模式理解浅薄。Facebook和谷歌为争夺数字广告而斗法。这两家公司加上亚马逊都在不断增长的视频服务上激烈竞争。他还把亚马逊对诸多行业的控制与亚马逊创始人杰夫·贝佐斯对《华盛顿邮报》的掌控关联起来，却没有证明贝佐斯的商业利益确实影响到了这份报纸的报道。（事实上，《华盛顿邮报》最近还选登了弗尔书中的部分内容。）

谈到解决方案，他也是一派轻松自信。他以食物作喻，称正如消费者舍弃了不健康的包装食品而选择手工制作的食品，他们可能也会选择新的网络生活方式。这个乐观的解决方案忽略了关键的一点：就搜索引擎或社交网站而言，并不存在像本地农产品那样的替代品。而且科技公司正在攻入新的领域，甚至买下了弗尔在以食品作类比时建议用作解决方案的本地替代品——今年夏天亚马逊收购了食品零售商全食超市（Whole Foods）。对科技公司加以审视变得愈加迫切。弗尔的质疑是对的，但他所言却非最终

结论。■



Market indices

Big fingers

Index-makers are growing in power, and facing greater scrutiny

IT WAS in 1896 that Charles Dow, co-founder of Dow Jones & Company, created the index that still bears his name. Today, indices such as the Dow Jones Industrial Average and the S&P 500 (for shares listed in New York), or the FTSE 100 (for London), are among the best-known brands in financial markets. The role they play has expanded massively in recent years. Index-makers have become finance's new kingmakers: arbiters of how investors should allocate their money.

Stockmarket indices were devised as a measure of the overall market, against which those trading in shares could compare their performance. At first they were concocted by the press or by exchanges themselves. For bonds, indices were compiled by the banks that traded them. Except for a few of the very earliest indices, such as the Dow, which is weighted by share price, nearly all are weighted by market capitalisation or, in the case of bond indices, by the volume of debt outstanding.

Three large firms—FTSE Russell, MSCI and S&P Dow Jones Indices—dominate equity index-making. The amounts of money they influence are staggering. S&P Dow Jones reckons \$4.2trn in assets are invested in “passive” funds that track its indices, with \$3trn assigned just to the S&P 500. Another \$7.5trn in actively managed assets use its indices as “benchmarks”: that is, they measure their performance against them. The two other big index-providers command similarly vast sums: \$15trn in active and passive money follows FTSE Russell's indices, and \$11trn hug MSCI's.

Index-makers insist they are less powerful than they look. Alex Matturri,

head of S&P Dow Jones, points out that even though assets in exchange-traded funds (ETFs), virtually all of which are passive, have reached \$4trn globally, that is only a “small part of the global investable universe” (estimated at around \$300trn). Mr Maturri also emphasises the transparency and “rules-driven approach” of index construction and governance. Big changes are made only after consulting the market.

Moreover, argues Mark Makepeace, chief executive of FTSE Russell, index-making remains very competitive. Some smaller providers, such as Morningstar, give away data on most of their indices (on the weightings of their components, for example). They charge a fee only if a passive fund wants to track an index and use their brand. The big three charge both for access to data and for the use of their indices in passive funds.

Regulation also constrains the firms. From January 2018 index-makers in Europe will be directly regulated under the EU’s “Benchmarks Regulation”, which includes requirements such as an annual external audit for benchmarks deemed “critical”, and direct oversight by the EU regulator.

Nevertheless, index-makers’ power is considerable. It is boosted by the rise of passive investing. In America, for instance, three-tenths of assets are now in passive funds. And though some smaller competitors survive, the index industry is becoming more concentrated. Many banks have quit the bond-index business, selling their brands. Bloomberg acquired Barclays’ indices last year; FTSE Russell has nearly completed the purchase of Citigroup’s.

Despite harping on the objectivity and transparency of their rules, moreover, many of the decisions that index providers make are, ultimately, subjective. Take the decision in June by MSCI to include Chinese shares in its emerging-markets equity index (followed by around \$1.6trn in assets). Shares listed in mainland China had been excluded because of the opacity

of China's capital markets, and the restrictions foreigners face there. China's capital controls remain in place, but, after consulting market participants, MSCI decided to include the shares—albeit at a weighting of only 0.73% (and even that in two phases) so as not to disrupt the index's composition too quickly.

| *Snap slapped*

Similarly, both FTSE Russell and S&P, in the wake of Snap's listing on the New York Stock Exchange in March, chose to alter their rules to exclude companies that list only non-voting shares (as the tech firm did). This stemmed partly from pressure from investors such as Norway's sovereign-wealth fund. FTSE Russell said that the majority of asset managers it consulted wanted a company's shares to be included in an index only if the voting power of stockmarket investors passed a threshold of 25%, but the index-maker opted for a lower minimum of 5% and a gradual phase-in, again to avoid disruption.

The composition of bond indices has also come under scrutiny. Earlier this year, J.P. Morgan faced calls to exclude Venezuelan bonds from its emerging-market bond index (EMBI) in protest at the misdeeds of the government in Caracas. But index-makers are less mighty in the world of fixed income. Passive investment is less prevalent in bonds than in equities. Moreover, with so many bonds available, fund managers can replicate indices while maintaining some flexibility in the exact choice of assets. A bigger concern with bond indices is their weighting by volume: those who track them end up most exposed to the most indebted borrowers.

Index-makers enjoy the prestige that comes from compiling a market's most recognised benchmark. But they are keener to discuss their work in developing new and different sorts of indices (S&P says it now has over 1m), including for other asset classes. For example, a few indices are

starting to provide reliable benchmarks for opaque asset classes like private equity (see next article).

Other new indices slice up the universe of stocks and bonds in varied ways, such as whether the share prices are undervalued, whether firms are socially responsible or whether they are exposed to specific risks. Kensho, a startup, compiles share indices around trendy themes such as nanotechnology or drones. Some new products bear little resemblance to conventional indices. S&P Dow Jones's new STRIDE index encompasses different asset classes whose weighting varies over time, to suit the needs of a worker preparing to retire. A few verge on the absurd. In August S&P announced an index containing only companies from which the Indian government wants to divest.

For as long as indices have acted as shorthand for the markets they seek to capture, index-makers have received attention. Their importance has grown to match their profile. Being the source of "authoritative guidance" on what should even count as an asset class (as Norway's sovereign-wealth fund puts it) brings new responsibilities. Index-makers will have to get used to ever more scrutiny. ■



市场指数

大手指

指数制造者权力日增，面临更多监管

一八九六年，道琼斯公司的联合创始人查尔斯·道（Charles Dow）创立了一个迄今仍以他命名的指数。如今，道琼斯工业平均指数、标准普尔500指数（针对在纽约上市的股票）或者富时100指数（针对伦敦）都属于金融市场上最知名的品牌行列。近年来，它们的影响力大幅扩张。指数供应商已经成为金融界新的王者推手：投资者资金分配方式的仲裁者。

股票市场指数被设计为一个衡量整体市场的指标，股票交易者可以将自己的业绩与之比较。起初它们是由新闻机构或交易所自行设计，债券指数则由交易债券的银行编制。除了几个最早的指数之外（如道指以股价加权），它们几乎全部都是以市值加权计算，而债券指数则以未偿还债务总额进行加权。

三大公司——富时罗素、MSCI和标普道琼斯指数——主宰了股票指数的供应。它们能够影响的金额是惊人的。标普道琼斯估计有4.2万亿美元的资产投资于“被动”跟踪其指数的基金，其中仅标普500指数基金就有3万亿美元。另有7.5万亿美元的主动管理资产将它的指数用作“基准”，也就是衡量其绩效的标准。另外两家大型指数供应商也指挥了同样巨额的资金：有15万亿美元的主动和被动资金跟踪富时罗素的指数，MSCI则有11万亿美元的拥趸。

指数供应商坚称自己没有看起来那么强大。标普道琼斯的首席执行官亚历克斯·马蒂里（Alex Matturri）指出，即使几乎全是被动资产的上市交易基金（ETF）在全球达到了4万亿美元的规模，它也只是“全球投资界（估计约300万亿美元）的一个零头”。马蒂里还强调了指数构造和治理中的透明度和“规则驱动”。它们只有在咨询市场后才能做出重大改变。

此外，富时罗素的首席执行官马克·马克佩斯（Mark Makepeace）指出，

指数供应行业竞争一直十分激烈。一些较小的供应商（如晨星）免费奉送大部分指数的数据（例如其成分的权重）。只有当被动基金想跟踪其指数并使用其品牌时才收取费用。三大公司则在资料访问以及在被动资金中使用其指数时都要收费。

监管也令企业束手束脚。从2018年1月起，欧洲的指数供应商将根据欧盟“基准监管条例”接受直接监管，其中包括对被视为“关键”的基准进行年度外部审计，以及由欧盟监管机构直接监督等要求。

尽管如此，指数供应商的影响力仍相当可观。它是由被动投资的兴起推动的。例如，在美国，如今有30%的资产存于被动基金。虽然有一些较小的竞争对手生存了下来，但指数行业正在变得越来越集中。许多银行已经退出债券指数业务并出售其品牌。彭博去年收购了巴克莱指数，富时罗素对花旗集团指数的收购也已接近完成。

此外，尽管指数供应商反复强调其规则的客观性和透明度，归根结底，他们做出的很多决定都是主观的。就说6月份MSCI决定将中国股票纳入其新兴市场股票指数吧（有约1.6万亿美元的资产在跟踪这一指数）。此前由于中国资本市场的不透明以及外国人在那里面临的限制，在中国大陆上市的股票被排除在外。尽管中国的资本管制仍然存在，但在咨询了市场参与者之后，MSCI决定将这些股票包含进来——虽然只占0.73%的权重（即使是这么点也要分两个阶段实行），以便不会太快破坏指数的组成。

| *Snap*被打脸

同样，Snap于今年3月在纽约证券交易所上市之后，富时罗素和标普都选择修改自身规则，以排除仅有无投票权股份上市的公司（这家科技公司就是这样做的）。这在一定程度上源自挪威主权财富基金等投资者的压力。富时罗素表示，他们咨询的大多数资产管理公司都希望，只有股票市场投资者的投票权超过25%的门槛后才能被纳入指数，但指数公司却选择了更低的5%门槛和逐步实施，这同样是为了避免扰乱市场。

债券指数的组成也受到详细调查。今年早些时候，有人向摩根大通呼吁将

委内瑞拉债券从其新兴市场债券指数（EMBI）中排除，以抗议加拉加斯政府的不当行为。但在固定收入领域，指数供应商的势力没有那么大。债券的被动投资并不像股票那么普遍。此外，由于可选的债券如此之多，基金经理可以在复制指数的同时，在资产选择方面保持一定的灵活性。有关债券指数的一个更大的顾虑是其金额权重：到头来，那些跟踪债券指数的人面临的最大敞口是负债最多的借款人。

指数供应商因编制市场最受认可的基准而享有盛名。但是，它们更热衷于讨论开发不同种类的新指数的工作（标普表示，它目前拥有超过100万个指数），包括针对其他资产类别的指数。例如，目前有几个指数开始为不透明的资产类别（如私募股权）提供可靠的基准。

其他新指数则以各种方式划分股票和债券，比如股价是否被低估，企业是否承担社会责任，是否面临特定风险等。创业公司Kensho针对纳米技术或无人机等时尚主题编制股票指数。一些新产品与传统指数几乎毫无相似之处。标普道琼斯的新STRIDE指数涵盖了不同资产类别，其权重随时间变化，以适应准备退休的工人的需求。有些指数则近乎荒谬。8月，标普发布了一个仅包含印度政府希望剥离的公司的指数。

只要指数可作为其试图捕捉的市场的代表，指数供应商就会受到关注。其重要性已经追上了它们的声望。在决定什么应被算作一种资产类别上，它们提供了“权威的指导”（按照挪威主权财富基金的说法），而这又带来了新的责任。指数供应商必须习惯更多的审查。■



Free exchange

Always something new

Africans are leaving their fields, but not flowing into factories

IT IS easy to buy a rolex in Uganda—albeit not one that will tell the time. Sold at ubiquitous roadside stalls, the Ugandan rolex is a greasy snack, made from an omelette wrapped in a *chapati* (“roll eggs”). Sellers compete side-by-side for the same custom. So do the motorcycle-taxi drivers, hustling for rides; or the countless small shopkeepers, stocking near-identical goods. In Uganda, as in much of Africa, the informal service economy is a crowded place to be. But it is hard to find work anywhere else.

Last year GDP in sub-Saharan Africa grew by just 1.4%. Income per person fell. But growth in itself is not the issue that troubles policymakers and intrigues academics: for most of this century, after all, African economies have been among the fastest-growing in the world. What has flummoxed observers is where that growth comes from. In 1954 Arthur Lewis, a Nobel prize-winning economist, argued that development occurs as labour shifts from an unproductive “traditional” sector—activities such as subsistence farming, or petty trade—into modern, capitalist activities.

Research by Margaret McMillan, of Tufts University, and Dani Rodrik, of Harvard, investigates how far Africa has followed this pattern. They distinguish two traditions of thinking about growth. One focuses on raising labour productivity within sectors of the economy, by adding capital or improving skills and technology. The other stresses structural change, as workers move between sectors. The output of the average African manufacturing worker is five times that of his agricultural counterpart. Move people from farms to jobs in factories or high-value services and growth will follow. As a thought experiment, consider changing the sectoral distribution of African workers to match that in the advanced

economies, holding everything else constant. Productivity in Ethiopia would increase sixfold; in Senegal by a factor of eleven.

Things are rarely so simple, however. In the 1990s structural change in sub-Saharan Africa actually went into reverse; it was a drag on growth. In Zambia, for example, workers returned to their fields, as industries and mines shut down. But in the new millennium, momentum picked up again. Between 2000 and 2010 structural change accounted for almost half of productivity growth in a 19-country sample. The effect was especially strong in places with a lot of farmers, such as Ethiopia, Malawi and Tanzania. Overall, the proportion of Africans employed in agriculture fell by 11 percentage points.

This was no industrial revolution, however. For every ten workers to lay down their hoes, only two found their way into industry. The service sector absorbed the rest. Cities like Nairobi offered new jobs for skilled professionals in technology and finance. But most workers were more likely to be hawking phone credit than designing the next app; selling second-hand clothes, not stitching new ones. In the oil-soaked cities of Luanda and Lagos, they manned construction sites or waited on tables for the rich. “There’s been structural change,” says Yaw Ansu of the African Centre for Economic Transformation, a Ghana-based think-tank, “but not the type that really improves the lives of people.”

In East Asia both kinds of growth have occurred at once: workers have moved into more productive sectors, and productivity in those sectors has increased. So another puzzle is that in African countries that have seen large-scale structural change, productivity outside agriculture has often fallen.

From 19th-century Britain to 21st-century Vietnam, sustained growth has been built on manufacturing. Factories create lots of low-skilled jobs. And,

as Mr Rodrik has shown, manufacturing productivity in poor countries tends to catch up with the most advanced economies, even in places with shoddy institutions or bad geography. But African manufacturing has stagnated. Its contribution to GDP has changed little since the late 1970s.

Orthodox remedies, focused on trimming regulation and improving governance, have lost their appeal. So there has been a revival of interest in active industrial policies. Ethiopia, where manufacturing employment has quintupled this century (from a low base), is experimenting with this approach. A new paper by Cornelia Startiz and Lindsay Whitfield for the Centre of African Economies, at Roskilde University in Denmark, describes how the government has encouraged Asian apparel exporters to open factories in industrial parks, while protecting local firms in the domestic market. Foreign investment helps, if multinationals connect with local suppliers and share know-how.

| *Making it harder*

Yet the record of interventionist industrial policy elsewhere is mostly a sorry one. And old-style industrialisation is in any event becoming more difficult. Automation is transforming manufacturing, as it becomes a viable substitute for labour in countries at ever-lower levels of income per head. The result is that Africans are competing not just with low-wage workers in Bangladesh and elsewhere, but with even lower-wage robots. The development path followed by Japan, the East Asian tigers and, most spectacularly, China—moving from agriculture to low-margin labour-intensive manufacturing such as clothing and toys—may be fast closing. Trade patterns have changed, too. Instead of producing finished products in one country, African industries must slot into global supply chains.

Structural change is about more than factories. John Page of the Brookings Institution, an American think-tank, argues for the importance of “industries without smokestacks”: tradable, productive sectors, like cut

flowers, call-centres and tourism. Uganda, with its mountain gorillas and the Nile, is promoting even its edible rolex to tourists. Africa can learn from the successes of other regions, such as East Asia. But it will take a different path. ■



自由交流

世事如棋局局新

非洲人正在离开田地，但并没有流向工厂

在乌干达，随随便便就能买到一个劳力士——不过不是用来看时间的那种。那儿的劳力士是将煎蛋饼裹在恰巴提（薄饼）里做成的一种油汪汪的小吃。卖这种小吃的路边摊到处都是，小贩们比肩而立，争抢同一批顾客。如此这般的还有极力拉客的摩的司机、无数卖着几乎同样货品的小店主。和非洲许多地方一样，在乌干达，非正规的服务经济已经人满为患，但问题是，在其他任何行业都难以找到工作。

去年，撒哈拉沙漠以南非洲地区的GDP仅增长了1.4%，人均收入下降。但经济增长本身并没有让政策制定者烦恼，也没有激起学者的兴趣——毕竟本世纪大多数时候，非洲一直都是世界经济增速最快的地区之一。让他们困惑的是经济增长的来源在哪里。1954年，诺贝尔经济学奖得主阿瑟·刘易斯（Arthur Lewis）指出，当劳动力从非生产性的“传统”产业（比如自给农业或小商业等活动）向现代资本主义活动转移时，发展就应运而生。

美国塔夫斯大学（Tufts University）的玛格丽特·麦克米伦（Margaret McMillan）以及哈佛大学的丹尼·罗迪克（Dani Rodrik）的研究便是考查非洲在多大程度上遵循这种模式。他们将两种关于经济增长的认知传统区别开来：一种着重在产业内部通过增加资本或者改进技能及技术来提高劳动生产率；另一种强调产业结构调整，即工人们在不同产业之间流动。非洲一个普通制造业工人的产出是其从事农业生产的同伴的5倍。将劳动力从农场转移到工厂或者高价值的服务业，增长就随之而来。试想一下，如果其他所有因素保持不变，只改变非洲工人的产业分布使之与发达经济体相当，埃塞俄比亚的生产率将会提高6倍，塞内加尔将提高11倍。

但情况很少会如此简单。20世纪90年代，撒哈拉沙漠以南非洲地区的产业结构调整实际上反其道而行，拖累了经济增长。比如，在赞比亚，因为工厂和矿山关闭，工人们回归田地。但是新千年里产业结构调整又重拾动

力。一份针对19个国家的调查显示，2000到2010年间几乎一半的生产率增长都来自产业结构调整。这种效应在诸如埃塞俄比亚、马拉维和坦桑尼亚等农民众多的地方尤为明显。总体来看，非洲的农业人口比例下降了11个百分点。

然而这绝对算不上工业革命。每十个放下锄头的人中，只有两个在工业领域找到了出路。其余的都进入了服务业。在内罗毕这样的城市，拥有技术和金融领域专长的专业人员可找到新的工作岗位。但大多数人更有可能要沿街兜售电话卡，而不是设计下一个应用；要卖旧衣服，而不是缝制新衣服。在罗安达和拉各斯这些“浸泡在石油里”的城市，他们在建筑工地劳动或者服务富人用餐。总部位于加纳的智库非洲经济转型研究中心（African Centre for Economic Transformation）的亚乌·安素（Yaw Ansu）说：“已经有了产业结构调整，但不是真正改善人们生活的那种。”

在东亚，两种经济增长并存：人们转移到生产力更高的产业，那些产业的生产率也提升了。由此便产生了另一个谜题：在那些产业结构已经大规模调整的非洲国家，农业之外的生产率常常不升反降。

从19世纪的英国到21世纪的越南，经济的持续增长一直建立在制造业之上。工厂创造了很多低技能的岗位。并且，如罗迪克所解释的那样，贫穷国家制造业的生产率往往赶得上最发达的经济体，甚至在制度很不完善或者地理环境恶劣的地方也是如此。然而非洲制造业已经停滞，自上世纪70年代末以来它对GDP的贡献几乎没什么变化。

惯用的解决办法主要是靠减少监管和改善治理，不过已失去了吸引力。因此，积极的工业政策重新引发关注。埃塞俄比亚正在试行这种方法。本世纪该国制造业就业人数已经增加了四倍（基数低）。丹麦罗斯基勒大学（Roskilde University）下属非洲经济体研究中心（Centre of African Economies）的科妮莉亚·斯塔蒂兹（Cornelia Startiz）和林赛·维特菲尔德（Lindsay Whitfield）在一份新论文中描述了埃塞俄比亚政府如何鼓励亚洲服装出口商在工业园区开办工厂，同时在国内市场上保护本土企业。如果跨国公司能和本地供应商对接，并分享技术，外国投资就会有促

进作用。

| 雪上加霜

迄今为止，其他地方实施干预性政策的效果大多不理想。而老式的工业化道路无论如何都变得更困难了。自动化正在改变制造业，在那些人均收入水平更低的国家，它也已经可以替代劳动力。由此产生的结果是非洲人不仅要与孟加拉国等地的低收入工人竞争，还得与工资更低的机器人竞争。日本、亚洲四小龙以及最引人注目的中国，都曾从农业社会转型到低利润的劳动密集型制造业，例如服装和玩具制造。然而这样的发展道路可能很快就要走不通了。贸易格局也已发生变化。非洲的工业必须加入全球供应链，而不是在本国生产成品。

产业结构调整不仅仅关乎工厂。美国智库布鲁金斯学会（Brookings Institution）的约翰·佩奇（John Page）主张“无烟卤工业”的重要性。“无烟卤工业”指可交易的生产性产业，比如鲜切花、呼叫中心以及旅游业等。拥有山地大猩猩和尼罗河的乌干达正向游客推介自己，推介的内容甚至包括能吃的劳力士。非洲可以学习东亚等其他地区的成功经验，不过它将走上一条不同的道路。■



Buttonwood

Gone fission

Why are investors so relaxed about the behaviour of North Korea?

A ROGUE state has tested what may be a hydrogen bomb and has sent a missile over the territory of a neighbouring country. The American president has promised “fire and fury” if threats continue. The Security Council of the United Nations has been locked in debate. This sounds like the plot of a Hollywood thriller or a paperback potboiler in which the world is heading for conflagration.

But international investors are not thrilled, and seem barely disconcerted, by the crisis on the Korean peninsula. Gold has risen a bit, the yield on Treasury bonds has dropped and the MSCI World equity index has fallen since the start of August. However, the moves have not been huge. Even the South Korean stockmarket, surely the most sensitive gauge of war risk, is well above its level at the start of the year.

What explains this remarkable insouciance? One possibility is that the markets may simply not be very good at assessing political risk. After all, investors failed to foresee either the result of the Brexit referendum in Britain or the election of President Donald Trump.

Another possibility is that investors have learned in recent decades that geopolitical events—from the September 11th attacks and the invasion of Iraq to countless presidential elections—tend to have only very short-term impacts on the markets. Economic growth and corporate profits are far more important factors. For investors who use algorithms to trade, political risk probably has very little bearing on their calculations.

Go back far enough, however, and it is possible to find political events with

huge financial ramifications—after revolutions in their countries, the Russian and Chinese governments defaulted on their debts, for example. A war that engulfed the Korean peninsula, dragging in China and Japan as well, would surely be one of those “fat tail” events that the models struggle to assess. But a few brave analysts are now trying to contemplate the effects.

Besides the terrible humanitarian cost in both North and South Korea, there could be immense damage in certain industries. The global economy is a lot more integrated than it was during the Korean war of 1950-53. Capital Economics points out that South Korea produces 40% of the world’s liquid-crystal displays and 17% of its semiconductors. If Japan was the target of missile strikes from North Korea, as it might be, the disruption would be even greater. A war with conventional weapons would be bad enough; the lasting impact of nuclear weapons’ use would be immense.

The limited reaction of investors to this terrible possibility suggests that they do not believe it will happen and that they feel the heightened rhetoric on both the American and North Korean sides is simply bluster. A recent example was a tweet from Mr Trump on potential trade sanctions. Rabobank, a Dutch bank, says that American counter-threats are not perceived to be credible. “The distinctly limited likelihood of the US cutting all trading links with China should the country continue to do business with North Korea is a case in point,” the bank adds.

Just because a war would have disastrous economic consequences may not prevent political leaders from stumbling into conflict, either by accident or because they have other priorities. In 1909, Norman Angell wrote a book called “The Great Illusion” which posited that war between nations would be futile because of their economic interdependence. Five years later, war broke out anyway.

But in the early 20th century, many nations were still ruled by hereditary monarchs, for whom economic issues were not the highest priority. By the late 20th century, most developed countries were ruled by professional politicians who recognised that economic success was their surest route to staying in office. Recent conflicts in Afghanistan and Iraq did not involve the same level of commitment as either the Korean and Vietnam wars, and thus did not have big economic consequences. This may help explain investors' confidence that geopolitics will not interrupt the flow of goods and capital.

It is possible, in an age of populism and greater nationalism (and at a time when American hegemony is being challenged by China), that the calculations of political leaders have changed again, making conflict more likely. But no amount of number-crunching based on past data can properly assess whether this is the case; it is a judgment call. Investors have decided that a Korean conflict will not happen. Cross your fingers that this is one case where the "wisdom of crowds" will be proved right. ■



梧桐

无力的裂变

为什么投资者对朝鲜的举动不以为意？

有个无赖国家已经疑似试爆了一枚氢弹，还发射了一枚导弹飞越邻国的领土。美国总统承诺，如果威胁继续，该国将经受“烈焰与怒火”。联合国安理会已陷入争论。这听上去就像好莱坞惊悚片或是平装本恶俗小说的情节——在这类电影或书中，世界即将为战火吞噬。

但是全球各地的投资者并没有被朝鲜半岛的危机吓住，甚至好像并无不安。黄金价格微升，美国国债收益率下降，MSCI全球股票指数自8月初已经下跌。但动静都不大。就连必然是对战争风险最敏感的指标——韩国股市——也远高于年初的水平。

这种满不在乎叫人吃惊，该如何解释它？一种可能是市场并不擅长评估政治风险。毕竟投资者们既没预测出英国脱欧公投的结果，也没预料到特朗普会当选。

另一种可能是，近几十年来投资者已经了解到，地缘政治事件对市场的影响往往非常短暂，从911恐怖袭击、入侵伊拉克，到无数次总统选举，概莫如是。经济增长和企业利润这些因素要重要得多。对于使用算法进行交易的投资者来说，政治风险对他们的计算可能没有太大的影响。

不过，如果回溯得足够久远，也许就会发现有些政治事件曾对金融市场产生巨大影响。例如，在国内爆发革命后，俄罗斯政府和中国政府都曾发生债务违约。一场席卷朝鲜半岛、再拖上中国和日本战争必定会成为那些模型难以评估的“肥尾”事件之一。但一些无畏的分析人士正试着审视这种影响。

除了会在朝鲜和韩国造成可怕的人员伤亡和物质损失外，某些行业也可能会遭受巨大的损害。与1950年至1953年的朝鲜战争时期相比，如今全球经

济一体化的程度要高得多。凯投宏观（Capital Economics）指出，韩国生产的液晶显示面板占全球产量的40%，半导体占17%。如果按照可能发生的情形，日本成为朝鲜导弹袭击的目标，那么破坏将会更大。使用常规武器的战争已经够糟糕了，使用核武器将产生巨大而持久的影响。

投资者对这种骇人的可能性反应冷淡，表明他们不相信会发生这种情况，而且他们觉得美国和朝鲜双方强硬的措词都只是虚张声势。最近的一个例证是特朗普发推特表示可能将启动贸易制裁。荷兰合作银行

（Rabobank）称人们并不觉得美国的反威胁可信。“美国声称，如果中国继续和朝鲜做生意，它就要切断与中国所有的贸易联系，但这个威胁成真的可能性显然非常小。这就是个很好的例证。”该银行补充道。

仅仅因为战争会带来灾难性的经济后果可能并不会阻止政治领导人陷入冲突——这些冲突的发生或是因为意外，或是因为他们有其他的优先考虑。

1909年，诺曼·安吉尔（Norman Angell）在《大幻觉》（The Great Illusion）一书中表示，国家之间的战争是徒劳的，因为它们的经济相互依赖。五年后，战争还是爆发了。

不过在20世纪早期，许多国家仍由世袭君主统治，在这些人看来经济议题并非第一要务。到20世纪后期，大多数发达国家都是由职业政客统治，他们认识到经济成功是保持执政地位最稳妥的途径。近些年在阿富汗和伊拉克发生的冲突中，美国没有像朝鲜或越南战争时那么大的投入，因此也没有产生严重的经济影响。这或许可以解释投资者为何相信地缘政治不会中断商品和资本的流动。

在一个民粹主义兴起、民族主义更盛的时代（同时也是美国的霸主地位受到中国挑战的时代），政治领导人的考量可能又发生了改变，提高了爆发冲突的可能性。然而，即便有再多基于以往数据的分析也无法正确评估是否真的是这样——它是一个主观判断。投资者已经判定朝鲜半岛不会发生冲突。让我们祈祷这一次“群众的智慧”会是正确的吧。■



China's economy

Created destruction

Investors have found faith in China's capacity cuts. They should look more closely

STOCKMARKETS have been on a tear over the past 18 months. Shares are, on average, up by a third globally. Commodities have rallied. And the optimism has infected corporate treasurers, who, for the first time in five years, are spending more on new buildings and equipment. Plenty of factors have fed into the upturn, from Europe's recovery to early hopes for the Trump presidency. But its origins date back to a commitment by China to demolish steel mills and shut coal mines.

On the face of it, that is an unlikely spark for a change in sentiment. Normally, growth comes from the investment in new facilities, not the closure of those in use. In fact, China's case is a rare one. By taking on extreme overcapacity, its cutbacks have provided a boost, for itself and for the global economy. The risk, however, is that the way the country is going about the cuts both disguises old flaws and creates new ones.

| *Steel crazy after all these years*

China needs lots of material to build all its homes, trains and tunnels. Even so, it produces more than it can use. It accounts for roughly half of global production of steel, coal, aluminium, glass and cement. By one oft-cited gauge, China's unused steel capacity equals the total annual output of the next four biggest producers (Japan, India, America and Russia) combined. As the excesses piled up in China over the years, they weighed on global prices, depressing profits for all. However, unlike their international rivals, Chinese firms could carry on expanding, confident of state support.

Then, in early 2016, China unveiled plans to cut its steel and coal capacity by at least 10% over five years, reducing potential global supply by 5%. The

government's theory was that it could turn the vicious industrial cycle into a virtuous one. With less production, prices would rise, leading to higher profits and, ultimately, a healthier economy. There were plenty of doubts about China's ability to follow through; after all, pledges to cut capacity had featured in officials' plans since the early 2000s, and over-investment had continued unabated.

But the idea that things might be different this time has gradually caught on. Coal and steel prices have soared, as have profits in those industries. That set off a dramatic shift in market sentiment about China. Convinced that Xi Jinping, China's president, has the will and ability to impose capacity cuts, investors have shed their fears that damaging deflation might be China's next export. The yuan has appreciated; nominal growth is just shy of a five-year high. Economic policymakers in Beijing have regained some of their standing, which had been dented by a stockmarket crash and a ham-fisted currency devaluation in 2015. Global markets are reassured by the steady hand of Chinese central planners.

That confidence may be misplaced. Investors are overlooking two shortcomings in China's approach. The first is the nature of top-down diktats about supply, which lack flexibility and therefore tend to generate volatile outcomes. China wanted to puff up prices. But the surge that it has caused has gone well beyond what it intended, raising concerns that high prices will lead once more to surplus capacity. Local officials, still hungry for growth, have dusted off their plans for big new coal mines. Officials have started to warn about a speculative bubble in the steel market. In Chinese ports stocks of iron ore, a vital ingredient in steelmaking, are near record highs.

The second problem is that enforced production cuts are not a genuine solution to overcapacity. That firms listen to the government in China should never have been in doubt; the problem is that they still do not pay

sufficient heed to the market. In many cases the cuts are not all they appear. In the coal industry, for instance, officials last year simply decreed that mines should operate for just 276 days—a limit that they unwound this year.

More fundamentally, China has done little to tackle the underlying causes of overcapacity. The banking system continues to direct cheap capital at favoured projects and companies. State-owned firms can still be reckless in their investments, safe in the knowledge that they can always be bailed out. And the government's policy of earmarking bits of the economy for development sets off mad rushes into them. Even as China is fighting to rein in excess capacity in heavy industry, it is laying the groundwork for the same affliction in new fields such as robotics and advanced manufacturing.

China has done more to turn around its industrial sector than many expected, to the benefit of its own economy and the wider world. Investors are right to conclude that its planners are powerful. Even so, a tendency towards overcapacity still lurks, and Chinese officials are still fallible. ■



中国经济

人为破坏

投资者在中国去产能的举措中找到了信心。他们应该再看仔细些

过去18个月里各国股票市场一路走高。全球股票平均上涨三分之一。大宗商品价格回升。这种乐观情绪也感染了企业的财务主管，五年来他们首次在新建筑和新设备上增加了投资。带动市场好转的因素有很多，从欧洲经济复苏到初期对特朗普当选总统的期望都有影响。不过其起因可追溯到中国拆除钢铁厂、关闭煤矿的承诺。

表面看来，这样的承诺不太可能激起市场情绪的变化。通常来说，带来增长的是对新设施的投资，而不是关闭正在生产的设施。事实上，中国的情况很少见。中国政府努力应对产能极度过剩的问题，去产能提振了中国自身乃至全球的经济。然而风险在于，中国现在去产能的方式既掩盖了老问题，又创造了新问题。

| 历经多年，依旧疯狂

中国需要大量原材料来建住宅、造火车、修隧道。即便如此，中国的原材料生产仍然供大于求。钢铁、煤、铝、玻璃和水泥的产量约占全球一半。一个常被引用的衡量方法是，中国闲置的钢铁产能相当于排在其后的四大钢铁生产国（日本、印度、美国和俄罗斯）年产量的总和。中国过度的产能经年累积，压低了全球的价格和利润。然而，与其国际竞争对手不同的是，中国企业可以放心倚仗国家支持，继续扩大产能。

而到了2016年初，中国宣布计划在五年内将钢铁和煤炭产能削减至少10%，此举令全球潜在供应量降低5%。政府的想法是，这样可使恶性产业循环转为良性循环。产量减少，价格就会上涨，利润进而增加，最终实现更为健康的经济。外界对中国能否贯彻执行这一计划有很多质疑——毕竟，自21世纪的头几年起，削减产能就一直是政府计划的重要内容，但过度投资始终有增无减。

但是，越来越多人认为这一次情况可能有所不同。煤炭和钢铁价格飙升，这些行业的利润也水涨船高。这引发市场对中国的看法发生重大转变。投资者深信中国国家主席习近平有决心且有能力削减产能，因而不再担心破坏性通缩可能是中国的下一个出口产品。人民币升值，名义增长率也接近五年高点。北京的经济政策制定者曾因2015年的股市崩盘和拙劣的货币贬值举措而声望受损，现在他们已重新树立起一些威信。全球市场情绪因中国的中央决策者们稳健的管理而得到安抚。

市场信心可能放错了地方。投资者忽视了中国去产能的方式存在两大缺陷。第一个是依靠自上而下的强制命令控制供应，这种方式天生缺乏灵活性，往往会产生不稳定的结果。中国想要拉高价格，但由此造成的价格飙升已远远超出预期，让人担心高价会再度造成产能过剩。仍然渴望实现经济增长的地方官员又开始考虑兴建大型煤矿的计划。中央官员已发出警告，称钢铁市场出现了投机泡沫。中国港口的铁矿石（炼钢的重要原料）囤积量已接近历史最高水平。

第二个问题是强制削减产能并不能真正解决产能过剩的问题。在中国，企业要听政府的话，这一点从来都不用怀疑，问题在于企业对市场的重视仍然不足。在许多情况下，削减产能只是表面功夫。例如在煤炭行业，去年政府官员只是简单下令矿井全年只开工276天，而这个限制今年已经解除。

更根本的问题是，中国没有从根本上解决产能过剩问题。银行系统仍继续为受偏爱的项目和企业提供廉价资本。国有企业在投资方面仍然可以罔顾后果，高枕无忧，因为它们知道自己一旦有难，政府总会出手搭救。政府重点扶持经济中某些领域发展的政策又会引发资本疯狂涌入。中国努力在重工业部门抑制产能过剩，同时却又在机器人和先进制造等新领域里埋下了同样的隐患。

中国在扭转工业部门问题上付出的努力超出许多人预料，这对中国自身和全球的经济都有利。投资者因此得出结论，认为中国的决策者拥有强大的影响力，这没问题。但即便如此，产能过剩的苗头仍在经济中潜伏，中国

官员仍有可能犯错。■



Health care

Closing in on cancer

Science will win the technical battle against cancer. But that is only half the fight

THE numbers are stark. Cancer claimed the lives of 8.8m people in 2015; only heart disease caused more deaths. Around 40% of Americans will be told they have cancer during their lifetimes. It is now a bigger killer of Africans than malaria. But the statistics do not begin to capture the fear inspired by cancer's silent and implacable cellular mutiny. Only Alzheimer's exerts a similar grip on the imagination.

Confronted with this sort of enemy, people understandably focus on the potential for scientific breakthroughs that will deliver a cure. Their hope is not misplaced. Cancer has become more and more survivable over recent decades owing to a host of advances, from genetic sequencing to targeted therapies. The five-year survival rate for leukemia in America has almost doubled, from 34% in the mid-1970s to 63% in 2006-12. America is home to about 15.5m cancer survivors, a number that will grow to 20m in the next ten years. Developing countries have made big gains, too: in parts of Central and South America, survival rates for prostate and breast cancer have jumped by as much as a fifth in only a decade.

From a purely technical perspective, it is reasonable to expect that science will one day turn most cancers into either chronic diseases or curable ones. But cancer is not fought only in the lab. It is also fought in doctors' surgeries, in schools, in public-health systems and in government departments. The dispatches from these battlefields are much less encouraging.

| *Cell-side research*

First, the good news. Caught early, many cancers are now highly treatable.

Three out of four British men who received a prostate-cancer diagnosis in the early 1970s did not live for another ten years; today four out of five do. Other cancers, such as those of the lung, pancreas and brain, are harder to find and treat. But as our Technology Quarterly shows, progress is being made. Techniques to enable early diagnosis include a device designed to detect cancer on the breath; blood tests can track fragments of DNA shed from tumours. Genome sequencing makes it ever easier to identify new drug targets.

The established trio of 20th-century cancer treatments—surgery, radiation and chemotherapy—are all still improving. Radiotherapists can create webs of gamma rays, whose intersections deliver doses high enough to kill tumours but which do less damage to healthy tissue as they enter and leave the body. Some new drugs throttle the growth of blood vessels bringing nutrients to tumours; others attack cancer cells' own DNA-repair kits. Cancer may be relentless; so too is science.

The greatest excitement is reserved for immunotherapy, a new approach that has emerged in the past few years. The human immune system is equipped with a set of brakes that cancer cells are able to activate; the first immunotherapy treatment in effect disables the brakes, enabling white blood cells to attack the tumours. It is early days, but in a small subset of patients this mechanism has produced long-term remissions that are tantamount to cures. Well over 1,000 clinical trials of such treatments are under way, targeting a wide range of different cancers. It is even now possible to reprogram immune cells to fight cancer better by editing their genomes; the first such gene therapy was approved for use in America last month.

Yet cancer sufferers need not wait for the therapies of tomorrow to have a better chance of survival today. Across rich and poor countries, the survivability of cancer varies enormously. Men die at far higher rates than

women in some countries; in other countries, at similar levels of development, they do comparably well. The five-year survival rate for a set of three common cancers in America and Canada is above 70%; Germany achieves 64%, whereas Britain manages a mere 52%. Disparities exist within countries, too. America does well in its treatment of cancer overall, but suffers extraordinary inequalities in outcomes. The death rate of black American men from all cancers is 24% higher than it is for white males; breast-cancer death rates among blacks are 42% higher than for whites. A diagnosis in rural America is deadlier than one in its cities.

| *Practical as well as pioneering*

Variations between countries are partly a reflection of health-care spending: more than half of patients requiring radiotherapy in low- and middle-income countries do not have access to treatment. But big budgets do not guarantee good outcomes. Iceland and Portugal do not outspend England and Denmark on health care as a proportion of GDP, but past studies show wide variation in survivability in all cancers.

Instead, the problem is often how money is spent, not how much of it there is. To take one example, a vaccine exists against the human papillomavirus (HPV), which causes cancers of the cervix in women, as well as cancers of the head and neck. Rwanda started a programme of routine vaccination in 2011, and aims to eradicate cervical cancer by 2020. Other countries are far less systematic. Vaccinations could help prevent cervical cancer in 120,000 Indian women each year.

Policymakers are not powerless. More can be done to verify which treatments (and combinations thereof) work best. A £1.3bn (\$2bn) cancer-drug fund in England, which made expensive new medicines easier to obtain, did not assess the efficacy of the drugs it provided—a huge missed opportunity. Measuring the incidence and survival of cancer, through cancer registries, spotlights where patients are being failed. Access to

health care matters, too: the number of Americans whose cancers were diagnosed at the earliest possible opportunity went up after Obamacare was enacted. And prevention remains the best cure of all. Efforts to rein in tobacco use averted 22m deaths (many of them to cancer) between 2008 and 2014. Yet only a tenth of the world's population lives in countries where taxes make up at least three-quarters of the price of cigarettes, as recommended by the World Health Organisation.

Taxes and budgeting are a lot less exciting than tumour-zapping proton beams and antibodies with superpowers. But the decisions of technocrats are as important as the work of technicians. Cancer kills millions of people not simply for want of scientific advance, but also because of bad policy. ■



医疗保健

围攻癌症

科学将打赢抗击癌症的技术战。但那只是战场的一半

数字是惨烈的。2015年癌症夺走了880万人的生命，只有因心脏病死亡的人数比这更高。约40%的美国人一生中会被告知罹患癌症。对于非洲人来说，如今癌症比疟疾的杀伤力更大。但是统计数据远远不能体现癌症带来的恐惧——细胞变异悄无声息地发生着，却绝不留情。只有阿尔茨海默症能如此抓住人的想像力。

面对这样的敌人，可以理解人们为何如此关注科学取得突破、发现抗癌良方的可能性。他们的希望并没落空。从基因测序到靶向治疗，由于这些手段取得的进展，近几十年来癌症患者的存活率越来越高。在美国，白血病的五年存活率从上世纪70年代中期的34%提高到2006年至2012年间的63%，几乎翻了一番。美国有大约1550万癌症幸存者，今后十年这个数字将增至2000万。发展中国家也取得了相当大的进步：在中南美洲部分地区，短短十年内，前列腺癌和乳腺癌的存活率上升了五分之一。

从纯技术的角度看，我们有理由相信，有朝一日科学会将大多数癌症转化为慢性病或可治愈的病症。但是抗击癌症的战斗不仅仅是在实验室里展开，手术室、学校、公共卫生系统还有政府部门也是战场。从这些战场传来的讯息就远没那么令人欢欣鼓舞了。

| 实验室研究

先来看看好消息。如果发现得早，现在很多癌症都可以得到很好的治疗。上世纪70年代早期，被诊断为前列腺癌的英国患者中有四分之三活不过十年，而现在五分之四的患者可以再活十年。有些癌症较难发现也较难治疗，比如肺癌、胰腺癌和脑癌。但正如我们的《科技季刊》所报道的那样，在这方面还是取得了一些进展。有一项早期诊断技术是一种可通过呼吸来探测癌症的设备；血液测试可以追踪从肿瘤上脱落的DNA碎片。基因组测序也让确定新药标靶变得愈加容易。

二十世纪的标准抗癌“三重奏”——手术、放疗和化疗——都还在不断改进。放射科医师可以使用伽马射线立体定向治疗，其射线相交的辐射剂量足以杀死肿瘤，但当射线穿越人体时对健康组织的损害较小。一些新药能抑制为肿瘤输送营养物质的血管生长，还有一些新药会攻击癌细胞的DNA自我修复机制。癌症或许残酷无情，但科学也一样。

最令人兴奋的是前几年出现的一种新疗法：免疫疗法。人类的免疫系统配有一套“刹车”机制，而癌细胞可以踩下这个“刹车”。首个免疫疗法实际上是把“刹车”禁用了，好让白细胞去攻击肿瘤。该疗法还处于初期阶段，但在一小部分患者身上，它已经产生了长期的缓解作用，相当于治愈。这类疗法正在进行的临床试验远超过1000项，针对的癌症多种多样。现在甚至可以通过编辑基因组对免疫细胞重新编程，使其更好地抗击癌症。上个月，首个这类基因疗法在美国获准使用。

不过，癌症患者不需要等待未来的疗法来获得更大的存活机会。不管是富裕国家还是贫穷国家，国与国之间癌症患者的存活率差别很大。在有些国家，男性患者的死亡率远高于女性；而在发展水平相似的另一一些国家，男女患者的死亡率并无很大差别。在美国和加拿大，三种常见癌症的患者五年存活率高于70%，在德国达到64%，在英国仅为52%。国家内部也存在差异。美国癌症治疗方面总体情况较好，但取得的效果非常不均衡。美国黑人男性罹患各种癌症后的死亡率比美国白人男性高24%；黑人乳腺癌的死亡率比白人高42%；乡村居民的癌症死亡率高于城市居民。

| 既实用又富开创性

国家之间的差异一定程度上反映了医疗保健支出的差别：在低收入和中等收入国家中，超过一半需要放疗的患者没有接受治疗的机会。但是，巨额预算并不能保证良好的结果。冰岛和葡萄牙的医疗保健支出占GDP的比例并不比英国和丹麦高，但过去的研究显示，这些国家之间各种癌症的存活率差别很大。

相反，问题往往在于钱是怎么花的，而不是花了多少钱。举个例子，人乳头瘤病毒（HPV）会导致妇女罹患宫颈癌，还会引发头部和颈部的癌症，

现在就出现了一种针对该病毒的疫苗。2011年卢旺达启动了常规疫苗接种计划，目标是到2020年消灭宫颈癌。其他国家则远没有这样的系统性做法。接种疫苗每年可使12万印度妇女免于患宫颈癌。

政策制定者并非无能为力。他们可以做更多工作来验证哪种治疗方法（及其组合）效果最好。在英国，一个13亿英镑（20亿美元）的癌症药物基金让人们更容易获得昂贵的新药，却没有评估所提供药物的疗效，这是一个巨大的错失的机会。通过癌症病例登记来计算癌症的发病率和存活率，可以找出治疗在哪些环节上失败了。能享受医保也很重要：奥巴马医改实施后，及早诊断出癌症的美国人数目上升了。而预防仍然是最好的解药。2008年至2014年间，对烟草的控制让2200万人免于死亡（其中许多人可能会死于癌症）。然而世界上只有十分之一的人口所在的国家征收的烟草税占到香烟价格的四分之三——这是世界卫生组织推荐的税率。

比起消灭肿瘤的质子束和拥有超能力的抗体，征税和编预算要无趣得多。但技术官僚的决策和技术人员的工作一样重要。癌症夺走了数百万人的生命不仅是因为缺乏科学进展，糟糕的政策也是原因。■



Co-living models

Rent collective

Pricey housing markets in big cities have inspired a new kind of home

MONDAY is “Game of Thrones” night at The Collective’s Old Oak building. Millennials congregate in TV rooms around the 11-storey, 550-person block. Some gather at the cinema, lounging on bean bags decorated with old graphics from *Life* magazine. Nothing gets residents out of their rooms like the hit TV show. This is not a student dorm, however. It is home.

The Collective is a pioneer of a new property format known as “co-living”. Instead of self-contained flats, residents live in tiny rooms with 12 square metres of floor space. Most contain just a bed and a bathroom. During a two-night stay your correspondent could barely fit his shoulders into the shower cubicle.

It is outside these rooms that the building makes its pitch. It comes with a gym, spa, libraries, a good restaurant and a cinema. Residents get access to all of these amenities, as well as their room, for a rental payment of £800-£1,000 (\$1,033-\$1,292) a month. That includes all bills and high-speed Wi-Fi; they pay extra for meals in the restaurant. Residents have come up with their own services, too. The Collective houses a “library of things”, or a shared repository of useful objects—hammers, tape measures and even tents.

Rising rents have opened up a gap in the market. The ratio of average rents to incomes in London rose from a quarter to a third between 2004 and 2014. In New York, average rents have grown from 29% of average income in 2002 to 34% in 2014. Most young professionals moving to thriving cities face a difficult choice between spending a big share of their income on renting their own place, or moving in with strangers in a shared house to

save money. The Collective offers something different.

Old Oak, the firm's first building in north-west London, has been 97% occupied for most of this year. The Collective is putting up two more co-living buildings in London, one in Stratford and one in Canary Wharf. The notion of tiny rooms and shared luxury services is fairly new and little tested, but the property industry is paying attention. Jack Sibley of TH Real Estate, a property investment manager, calls it "one of the most promising ideas for the future of living to emerge for some time".

The next step for Reza Merchant, The Collective's founder, is expansion abroad. He is close to striking deals on buildings in Boston and New York, and is talking to developers in Berlin, where historically low rents have been rising fast for the city's young, creative types. The Collective has no real competitors in Britain but its move to America will see it run into Ollie, a co-living firm in New York.

Both of Ollie's existing co-living buildings are smaller than Old Oak (the largest of its kind in the world). But the American firm will soon run a co-living space over 13 floors of a building in Long Island City in the borough of Queens. It is being developed by Quadrum Global, a property investment company, whose financial models predict that co-living will substantially outperform conventional rented flats in future because the return per square foot is so high.

WeWork, a private firm that is the world's largest provider of shared workspaces and is valued at an estimated \$20bn, has a residential arm, WeLive, that is running co-living units out of a leased building on Wall Street in Manhattan. It has joined forces with a property firm in Seattle called Martin Selig to construct a new 36-storey building, 23 floors of which will be dedicated to co-living.

The model will get tweaked as developers see what works and what doesn't. Mr Merchant is using data gathered from Old Oak to refine The Collective's new buildings. Rooms will be slightly larger, because the tiny square footage is one of the main reasons residents give for moving on. Sensors monitor use of the common spaces, and in the new complexes the kitchens will all be on one floor, rather than scattered around the building. Most of Old Oak's shared spaces are in fact fairly empty; the liveliest area is the launderette, where residents mingle and watch TV as they wait for washing cycles.

Maria Carvalho, a social-sciences academic at the London School of Economics, moved into the building because she wanted to live with other people, but did not want to have to find roommates. "I would call it a hipster commune, not a hippy commune," she says. She particularly likes meeting friends walking home from the train station but says kitchen utensils often go missing. (With too many co-livers to be able to know everyone personally, CCTV is used in these areas as a guarantor of good conduct and cleanliness.)

The Collective and other companies like it have a choice to make, says Roger Southam of Savills, a property firm. They could continue focusing on incoming workers to big cities, providing minimal private living space alongside attractive shared areas. But Mr Southam sees much more potential if co-living spaces can give residents slightly more private space, allowing them to attract people already living in cities. Starting from the smallest of rooms and working up may let co-living firms hit upon the perfect balance of shared and private space. Who, after all, doesn't want a cinema in the basement? ■



共居模式

同一屋檐下

大城市的高房价催生了一种新型住所

英国地产公司 The Collective 开发的老橡树公寓（Old Oak）高11层，住着550人。星期一是《权力的游戏》之夜，千禧一代聚在楼内各处的电视室里。有些人则来到小影厅里，懒懒地躺在印着《生活》杂志（Life）旧图案的懒人沙发上。只有这部热门电视剧才有这么大吸引力让这些住客走出自己的房间。不过，这可不是学生宿舍，而是家。

The Collective 是一种被称为“共居”的新房产模式的先驱。它为住客提供的不是配套齐全的独立公寓，而是建筑面积12平方米的小房间。大多数房间只有一张床和一间浴室。本文作者在那住了两晚，在淋浴间里几乎转不开身。

房间外的空间才是公寓的卖点所在。公寓配有健身房、水疗中心、图书馆、一个不错的餐厅和一个电影厅。所有这些设施均向住客开放，连同房间，每月租金为800至1000英镑（1033至1292美元），这已包括水电煤费用和高速Wi-Fi，在餐厅用餐另计。住客自己也想出了一些互助的点子。公寓楼里有间“杂物库”，就是一个共享贮藏室，里面存放着各种用具，有锤子、卷尺甚至帐篷。

租金不断上涨，由此产生了一个市场空白。伦敦的平均租金收入比从2004年的四分之一升至2014年的三分之一。在纽约，这一比例从2002年的29%上升到了2014年的34%。大多数前往繁荣大城市就业的年轻专业人士都要做艰难的选择，要么花费大部分收入租房子自己住，要么为了省钱与陌生人合租。The Collective 的共居公寓给出了不同的选择。

老橡树公寓位于伦敦西北部，是The Collective公司的第一个项目，今年大部分时间里入住率高达97%。该公司正在伦敦兴建另外两栋共居公寓，一栋在斯特拉特福德（Stratford），另一栋在金丝雀码头（Canary

Wharf)。小房间和共享豪华服务的概念相当新颖，尚未经市场充分考验，但房地产业正在关注其发展。房地产投资公司TH房地产（TH Real Estate）的杰克·西布利（Jack Sibley）称之为“一段时间以来出现的最有前景的未来居住模式之一”。

The Collecitve公司的创始人雷扎·麦钱特（Reza Merchant）下一步计划向海外扩展。他在波士顿和纽约看中的物业已接近敲定交易，同时还在与柏林的开发商洽谈。柏林过去房租较低，但对那里的年轻创意人才来说，近年租金上涨太快了。The Collective在英国没有真正的竞争对手，但进入美国将会遭遇纽约的共居公司Ollie。

Ollie现有的两栋共居公寓都比老橡树小（老橡树是世界上最大的共居公寓），但它很快会将皇后区长岛市一栋建筑里的13个楼层用作共居公寓。该项目由房地产投资公司Quadrup Global开发，其财务模型预测，鉴于目前共居公寓的单位面积投资回报很高，未来该模式的盈利水平将大大超越传统租赁单位。

估值高达200亿美元的私营公司WeWork是世界上最大的共享工作空间供应商，它的住宅部门WeLive在曼哈顿华尔街一栋租赁的建筑中经营共居公寓。该部门正和西雅图的房地产公司马丁·塞利格（Martin Selig）联手兴建一栋36层高的厦，其中有23层将用于经营共居。

开发商将根据运营经验调整共居模式。麦钱特正在利用从老橡树公寓收集到的数据改进新公寓。房间会变得稍大一点，因为房间太小是租客给出的搬走的主要理由之一。传感器会监控公用空间的使用情况。在新建公寓中，厨房将全部集中在一个楼层内，而不是分散在各层。老橡树公寓的大部分共享空间实际上都空荡荡的。最有人气的区域是自助洗衣房，租客会在等衣服洗好的时间里聊天看电视。

伦敦政治经济学院的社会科学家玛丽亚·卡瓦略（Maria Carvalho）住进老橡树是因为她想和别人一起住，但又不想找室友。她说：“我把它称作潮人公社，而不是嬉皮公社。”她尤其喜欢从火车站回家时遇见可以同行

的朋友，不过她也提到厨房用具经常丢失。（共居租客太多了，不可能相互都认识，因此公寓在公共区域安装了监控摄像头，保证大家行为良好，保持整洁。）

地产公司第一太平戴维斯（Savills）的罗杰·索瑟姆（Roger Southam）表示，The Collective和其他类似的公司需要做出选择。它们可以继续把重点放在进入大城市工作的人身上，提供极小的私人生活空间配以吸引人的共享区域。但他认为有一种做法发展潜力要大得多：给租客提供稍微再大一点的私人空间，这样就可以吸引已经居住在城市里的人。从提供最小私人生活空间开始，逐渐将房间面积扩大，或许可以让经营共居的企业在共享和私人空间之间找到完美的平衡点。毕竟，谁不想在地下室有个电影厅？ ■



Overlapping generations

Kicking the can down an endless road

The final brief in our series on big economic ideas looks at the costs (and benefits) of passing on the bill to the next generation

IN THE spring of 1899 William Miller persuaded three members of his Brooklyn prayer group to invest their money with him, promising them unearthly returns. He would pay a dividend of 10% per week, plus a commission for each new investor they could recruit. Soon, William “520%” Miller was drawing throngs of depositors to his door. So “great was the crush”, by one account, his staircase eventually gave way. Miller attributed his success to “inside information”. But his real method was made famous 20 years later by the man who perfected it, Charles Ponzi.

Ponzi schemes like Miller’s pay a return to early investors with money raised from later ones. When they run short of new contributions, they collapse. A scheme as generous as Miller’s cannot last long. But what if the promises were less extravagant and the repayment intervals less tight? What if, for example, a scheme asked investors for money in their younger years in return for a payout in their dotage? Over that time scale, a Ponzi scheme need not limit its recruitment efforts to the people alive when it begins. It can repay today’s contributors with money from future participants not yet born. And since the next generation is never likely to be the last, the chain could, in principle, continue indefinitely. Barring a catastrophe, new marks will be born every day.

This intergenerational logic lies behind the “pay-as-you-go” (PAYG) pensions common in many countries. People contribute to the scheme during their working lives, and receive a payout in retirement. Many people fondly imagine that their contributions are saved or invested on their behalf, until they reach pensionable age. But that is not the case. The

contributions of today's workers pay the pensions of today's retirees. The money is transferred between generations, not across time.

America's Social Security, for example, is largely pay-as-you-go. For this reason, its critics often compare it to a Ponzi scheme in order to discredit it. But the comparison can also work the other way. If Social Security—a venerable entitlement that has spared millions from penury—bears some resemblance to a Ponzi scheme, then perhaps Ponzi principles are not always as diabolical as the name suggests.

In some cases, those principles might indeed redound to everyone's benefit. One such scenario was sketched by Paul Samuelson of the Massachusetts Institute of Technology in 1958. His thought experiment is easiest to understand when recast as an island parable (along lines suggested by Laurence Kotlikoff of Boston University). The island in this parable is home to unusually tall cacao trees, hungry people, and little else. Only the young can climb the trees and pick the fruit, which must be eaten quickly before it spoils in the hot sun. And only two generations (young and old) are alive at the same time.

On such an island, the elderly have no way to provide for themselves. They are physically incapable of picking fruit. They cannot buy fruit from the young, because they have nothing to offer in exchange. Nor can they live off any cacao pods saved from their youth, because their stockpile will have rotted by the time they are old. There are no durable, imperishable assets that might serve as a vehicle for their thrift.

The solution, of course, is an intergenerational Ponzi scheme. The young give fruit to the old on the understanding that the next generation will do the same for them when they grow frail. In effect, the young lend to their parents and collect repayment from their children. In so doing, they serve as a link between two generations that never otherwise coexist.

| *Great minds overlap*

The scheme works, Samuelson pointed out, only because “new generations are always coming along”. If reproduction were ever to cease, the last generation would get nothing out of the scheme. Knowing this, they would not put anything in. But their failure to contribute would also deprive the penultimate generation of a payout, leaving them no reason to take part either. Any anticipated future break in the chain causes the whole thing to uncouple. If the scheme must ever end, it cannot even start.

Samuelson’s paper was seminal but not wholly original. A similar model was described in 1947 by Maurice Allais, then working in a bureau of mining statistics in Paris, but his contribution had the “misfortune to be written in French”, as one scholar has noted. The neverendingness of these models plays havoc with a lot of economic common sense. Economists know in their bones that budget constraints eventually bind and that accounts must be settled at the end of the day. But what if the end never quite arrives?

Such parables may seem too contrived to be illuminating. Surely the islanders benefit from a Ponzi scheme only because the story arbitrarily denies them any way to save for their future. If the young could instead acquire a durable asset, they could take care of themselves in their old age by selling it for the things they need. Instead of eating a cacao fruit, islanders could plant it to grow a new tree, which they could later rent or sell to young climbers when they retire.

In most cases, this kind of saving and investing does indeed serve people far better. Capital accumulation enlarges the economy’s productive capacity, thereby creating wealth, unlike Ponzi schemes, which merely spread it around. Saving and investing both store value and add to it, turning one cacao fruit into a whole tree. Retirees can therefore expect to get more out of their investment than they put in.

In some unusual cases, however, other factors may weigh in the Ponzi scheme's favour. First, saving and investing may run into sharply diminishing returns. If a society is eager to transfer resources into the future, it will accumulate a large stock of capital, which may depress the return on further investment. Think of an orchard too densely packed with trees, each getting in the others' light and denuding their soil.

A second consideration is demography. A growing population creates a natural pyramid scheme. Each cohort of participants will receive the money contributed by a later, larger generation. Therefore they too can get more out of it than they put in. Future generations may also be better off than their predecessors. They may benefit from sources of economic advance (such as improved technology) over and above simple capital accumulation. This march of progress should allow a Ponzi scheme to pay a positive return to investors even if the scheme only takes a constant percentage from each generation's income. Thanks to economic growth, 10% collected from the incomes of today's young will be worth more than the 10% collected in the past from their parents' poorer generation.

To make things concrete, suppose a country's population grows by 1% a year and incomes per person grow by 4%. In this case, a Ponzi scheme can offer an annual return of about 5% indefinitely, simply by taking a steady share of each generation's income. If the economy already has a large stock of capital, the return on saving and investing might be less than that, especially given the risk involved. Such an economy would suffer from what economists call "dynamic inefficiency". In these circumstances, an intergenerational Ponzi scheme can be sustainable and desirable.

A PAYG pension is only the most obvious example of such a scheme. Government debt can play a similar role (a possibility entertained by Peter Diamond of MIT in a 1965 paper building on Samuelson's insights). If the government does not want to extract social-security contributions from the

young, it can sell them long-term bonds instead. When these bonds mature, the government can repay them by selling a fresh round of bonds to the next, richer generation.

A third, more anarchic way to transfer resources from young to old is a speculative bubble. In a bubble, people pay over the odds for an asset, such as a house, in the belief that subsequent investors will pay a higher price still. The overpayment amounts to a contribution to a Ponzi scheme, redeemed not by the earnings of the underlying asset, but by overpayments from later investors. If each generation is collectively richer than the last, then the asset's price can keep rising even if each buyer sinks only the same percentage of their (rising) income into it.

| *The younger-fool theory*

All these mechanisms have side-effects. Government debt can crowd out productive investment. Bubbles can do the same. But in an economy suffering from dynamic inefficiency, this crowding out is a good thing. Such an economy has accumulated too much capital. It requires heavy investment to keep this large stock of machinery, equipment, buildings and infrastructure growing in line with the economy. The young are tempted to add yet more capital in an effort to transfer resources to their future, older selves. Yet because the returns are so low, it is more efficient for them to transfer resources directly to today's elderly (by contributing to social security, buying government bonds or overpaying for the old people's assets), on the understanding that tomorrow's young will do the same for them.

Under certain conditions, then, Ponzi principles are efficient not maleficent. But are those conditions ever found in the real world? One way to look for them is to compare interest rates (which represent the return on capital) and GDP growth rates (which reflect both population growth and increases in income per person). An alternative, stiffer test (which works

well under certain assumptions) is to compare investment and profits. If national investment is greater than profits, a country is ploughing more into its stock of capital than it earns from it. It is as if the islanders are replanting all of the fruit they collect from the additional trees they have cultivated (minus whatever fruit they need to compensate themselves for their labour) plus a few more. The economy's efforts to save and invest for the future are overloading the available vehicles for thrift.

Economists used to be confident that most economies were on the right side of this test, earning far more in profit than they invested. Recent research is less definitive. François Geerolf of the University of California, Los Angeles believes that Japan suffers from dynamic inefficiency. And he cannot rule out the possibility that all the G7 countries (and nine others) suffer similarly. If so, the implications are provocative. They imply that G7 public debt is soaking up money that would otherwise be spent on further augmenting an overbuilt capital stock. Insofar as the proceeds of this government borrowing are spent on health care and pensions, the elderly benefit disproportionately. Perhaps, then, G7 public debt is diverting unfruitful efforts to provide for the future into providing for the elderly instead.

Several scholars, including Qian Liangxin of Anhui University, also point out that China often ploughs more into its capital stock than it earns from it. At China's stage of development, this may not be a bad thing, because the economy's capital-intensity is still in flux. But the combination of fast growth and repressed returns on saving may help explain why China is so prone to speculative bubbles, especially in property. Working-age Chinese overpay for houses, many of which stand empty, on the assumption that they will sell them at higher prices—not to a greater fool necessarily, but to a younger, richer one.

William Miller's proto-Ponzi scheme lasted less than a year. His banks

(including the Hide and Leather National Bank Of New York) closed his accounts and newspapers hounded him. He fled to Canada (eluding one pursuer by ducking into a Chinese laundry, according to Mark Gribben of the *Malefactor's Register*, a blog) before the police eventually caught up with him. But he never actually ran out of investors. Even as he was escaping the country, envelopes addressed to his syndicate piled up at the post office, filled with contributions from the next generation of believers. ■



代际交叠

无尽转嫁

“重大经济思想”系列末篇——账单留给下一代的弊（与利）

一八九九年的春天，威廉·米勒（William Miller）许以畸高的回报，成功说服了布鲁克林祈祷团的三名教友把钱交给他投资。他每周支付10%的红利，成员们每招揽到新投资者还会另得佣金。很快，号称“威廉·‘520%’·米勒”的他便客户盈门。据说，因“人潮蜂拥”，连他家楼梯最后也给踩塌了。米勒把自己的成功归因于“内幕消息”。但他真正运用的方法在20年后才闻名于世，将它发扬光大的是查尔斯·庞兹（Charles Ponzi）。

米勒的这种庞氏骗局利用后来投资者的资金偿付前期投资者。新资金枯竭时，骗局便会败露崩溃。像米勒这样回报丰厚的计划是无法持久的。但如果承诺的回报没那么夸张，偿付周期也没那么紧凑呢？比方说，有这样一个投资计划，让人们在年轻时投资，年老时取得资金回报，情况会如何？在这样的时间跨度上，庞氏骗局在招揽投资者时就不必限于计划开始时已经活在上的人，它可以利用尚未出生的未来投资者的资金偿付目前的投资者。而下一代决不可能是人类末代，所以理论上说，资金链可以无限延续。新的入彀者将生生不息，除非爆发灭绝性灾难。

这种代际转移正是许多国家普遍采用的“现收现付制”养老金背后的逻辑。人们在工作时向养老金计划缴款，退休后得到退休金。许多人天真地以为自己的缴款是被存起来或是被代为投资，直至他们年届退休时返还。实际并非如此。当前退休人士的退休金是以目前在职人士的缴款支付的。资金在代际之间转移，而非跨时间转移。

美国的社保基本上就是这样一种现收现付模式。为此，批评者经常将其比作庞氏骗局，加以贬损。不过这种比对也可以反向观之。如果社保这种让数百万人免受贫困之苦的可贵津贴和庞氏骗局有些相似，那么庞氏骗局的原理或许并不总像其名字所传达的那般险恶。

在某些情况下，这些原理或许真的有益于大众福祉。麻省理工学院的保罗·萨缪尔森（Paul Samuelson）在1958年就构想出了这样一种情形。要理解他的思想实验，最简单的方法是按波士顿大学的劳伦斯·克里寇夫（Laurence Kotlikoff）的思路，用岛屿作比喻。岛上除了异常高大的可可树和饥肠辘辘的人们，再无他物。只有年轻人可以爬到树上摘取果实，而天气炎热，这些果实不及时食用就会腐败。岛上共存的只有两代人——年轻人和老人。

在这样的岛上，老人无法自力谋生。他们没有体力摘取果实。由于没有可供交换的东西，他们无法从年轻人那里买果实。老人也不能靠吃年轻时储藏的可可果度日，因为这些存粮到这会儿早已腐坏了。岛上没有耐久且不腐坏的东西可充当老人积蓄的载体。

解决方法自然是庞氏骗局式的代际转移。年轻人会给老人果实，因为他们明白自己年老体衰时下一代也会做同样的事。实际上这等于年轻人借给父母钱，然后从自己子女那里收取还款。如此一来，他们成为纽带，把永远不会并存于岛上的两代人连接了起来。

| 英雄所见代代同

萨缪尔森指出，这个方案行之有效，只因“新世代会源源不断地出现”。假如人类停止繁衍后代，最后一代人在该方案中将一无所获。如果他们知道这一点，将不会作任何投入。但如果最后一代人不做贡献，倒数第二代人也会丧失收益，他们同样也没理由参与其中了。任何认为链条未来可能破裂的预期都会导致整个计划崩溃。假如这项计划必有终结，那它根本就无法开始。

萨缪尔森的论文影响深远，但并非完全原创。1947年，在巴黎一个矿业统计机构工作的莫里斯·阿莱（Maurice Allais）就描述过类似的模型，只可惜如一位学者所说，他的贡献“不幸是用法语写就的”。这些模型中的无限递延与经济学的许多常识相违。经济学家们深知预算限制最终会发挥约束力，账目终有清算之日。但如果这个终点永远不会到达，情况又如何？

岛屿这类比喻可能显得太过牵强，启发性不大。确实，故事中的岛民从庞氏骗局式的养老计划中获益，只是因为他们被强行设定成没有任何办法为未来积谷防饥。相反，假如年轻人可以购入一种耐用资产，年老时便可出售这种资产换取所需，从而自主养老。比如岛民可以少吃一个可可果，拿它来种出一棵新的可可树，等到退休后出租或出售给年轻人。

在大多数情况下，这种储蓄和投资确实对人们更有利得多。资本积累扩大了经济体的生产能力，从而创造出财富，不像庞氏骗局那样仅仅是财富的转移。储蓄和投资既储存价值也增加价值，把一颗可可果变成了一整棵可可树。这样，退休人士可望得到高于投入的回报。

然而，在一些不寻常的情况下，其他因素可能会促使人们宁愿选择庞氏骗局。首先，储蓄和投资可能遇到回报大幅缩水的情况。假如一个社会迫切想把资源转移至未来，就会形成巨大的资本存量，这可能会使未来投资回报降低。就像一个果园里，树木种得太密集会导致互相遮蔽阳光，剥蚀土壤。

第二个因素是人口结构。人口不断增长为金字塔式的骗局创造了天然条件。每一批参与者都将获取人数更多的下一代参与者贡献的资金。因此他们能获得高于当初投入的回报。而且，未来世代可能比前人更富裕。在单纯的资本积累之外，他们还可能从经济发展的源泉上得益，比如科技进步。这些发展能使庞氏骗局给投资者带来正收益，即使骗局从每一世代手中只提取固定比例的收入。由于经济增长，从今天年轻人的收入中收取的10%的价值将高于过去从他们较穷的父辈那里收取的10%。

说得更具体些，假设一个国家的人口每年增长1%，人均收入增长4%。这样，一个庞氏骗局只需从每一代人的收入中持续收取固定份额，便可无限期提供约5%的年回报。假如经济体内存量资本已经很大，储蓄和投资的回报便可能低于上述比率，特别是考虑到风险因素。这样的经济体会陷入经济学家所说的“动态无效率”。在这类情况下，庞氏骗局的代际投资计划就是可持续和可取的。

现收现付制退休金只是这类计划中最明显的一个例子。政府债务也可以发挥类似的作用，麻省理工学院的彼得·戴蒙德（Peter Diamond）根据萨缪尔森的见解在1965年发表的一篇论文中提出了这一可能性。如果政府不想从年轻人那里收取社保费，也可以转而向他们销售长期债券。等这些债券到期时，政府可通过向更富裕的下一代人群销售新一轮债券来进行偿付。

第三个把资源从年轻一代向老一代转移的方式并非政府的有序操作——投机泡沫。在泡沫中，人们高价购入资产（例如房子），相信随后的投资者将为之付出更高的价格。多出的金额就等于庞氏骗局中的一份投资，它不是通过相关资产的收益来收回，而是靠后续投资者多付的资金来兑现。假如每一代人整体都比上一代富裕，那么即使每个买家只从（不断上升的）收入中拿出固定的比例用于该投资，这份资产的价格也会持续上涨。

| “愣头青”理论

所有这些机制都有副作用。政府债务可能会挤出生产性投资。泡沫也可能有同样的效应。但对陷于动态无效率状态的经济体，这种挤出倒是件好事。这类经济体已积累了太多资本，需要大量投资来让业已巨量的机械、设备、建筑及基础设施随经济发展而增加。年轻人会很想投入更多资本，努力将资源转移到未来，为自己年老时所用。但因为回报率低下，更高效的方法是把资源直接转移给今天的老人（通过缴纳社保、购买政府债券，或以溢价购入老人的资产），凭的是认为以后的年轻人也会做同样的事。

因此，庞氏骗局原理在某些条件下高效而无害。但现实世界里能找出这些条件吗？一个寻求它们的办法是比较利率和GDP增速，前者显示资本回报率，后者反映人口及人均收入的增长。另一种难度更大的检验方法（在某些假设条件下效果较好）是比较投资和利润。假如国家投资大于利润，说明这个国家对资本存量的投入大于从中赚取的收益。这就像岛民们把新种果树的果实全部拿去栽种（减去他们需要用来补偿自己劳动的部分）外，还要再多种几颗种子。经济体为未来储蓄和投资的努力已经令可用的储蓄工具超负荷。

经济学家们曾深信，在这项测试上，大多数经济体都会有积极的表现，即赚取的利润远超投资。最近的研究显示情况没那么绝对。加州大学洛杉矶分校的弗朗索瓦·基罗夫（François Geerolf）认为日本经济正陷于动态无效率状态。而且他不排除七国集团的所有成员国（以及其他九个国家）可能有类似问题。如果是这样，这其中隐含的意味就会引发争议了。这意味着七国集团的公共债务正在吸走的资金原本会被用于进一步扩大过剩资本存量。只要这笔政府借款的收益用于医疗和养老，老年人就会多多受益。也许，七国集团的公债正把徒劳的长远投资转移到供养老年人上来。

包括安徽大学的钱良信在内的几位学者也指出，中国对存量资本的投入经常大于收益。就中国目前所处的发展阶段来看，这也许不是坏事，因为中国的资本密集度仍在不断变化。而快速增长加上储蓄收益被压低可以解释中国为何非常容易出现投机泡沫，尤其是在房地产领域。中国的劳动年龄人群高价购入房产（许多只是空置），就是认为日后能以更高的价格售出，接盘的倒不一定是更傻的人，而是更年轻、更富有的人。

威廉·米勒始创的庞氏骗局只延续了不到一年。他被多家银行（包括美国纽约皮革国民银行）查封账户，又被报纸追踪揭发。他逃到加拿大，据博客“罪犯名册”（Malefactor's Register）的博主马可·格里本（Mark Gribben）称，米勒在途中为躲避追捕者，还曾躲进一家中国人开的洗衣店，但最终还是被警方捕获。但事实上，他的投资者从未断绝。就在他逃亡之际，邮局里还是堆满了寄给其集团的信封，里面全是下一代信徒们的投资款。■



Quantum cryptography in space

The early bird

The world's first quantum-cryptographic satellite network is likely to be Chinese

IN THE never-ending arms race between encryptors and eavesdroppers, many of those on the side that is trying to keep messages secret are betting on quantum mechanics, a description of how subatomic particles behave, to come to their aid. In particular, they think a phenomenon called quantum entanglement may provide an unshakable way of determining whether or not a message has been intercepted by a third party. Such interception, quantum theory suggests, will necessarily alter the intercepted message in a recognisable way, meaning that the receiver will know it is insecure. This phenomenon depends on the fact, surprising but true, that particles with identical properties which are created simultaneously are entangled in a way that means one cannot have its properties altered without also altering the other, no matter how far apart they are.

Researchers in several countries have experimented with the idea of quantum encryption, with some success. They have sent quantum-entangled messages through optical fibres, and also through the air, as packets of light. This approach, though, suffers from the fact that the signal is absorbed by the medium through which it is passing. The farthest that a quantum signal can be sent through an optical fibre, for example, is about 100km. Sending one farther than that would require the invention of quantum repeaters, devices that could receive, store and re-transmit quantum information securely. Such repeaters are theoretically possible, but so technologically complex that they remain impossible in practice.

An alternative is to beam entangled photons through the vacuum of space, where there is nothing to absorb them. This would mean transmitting them

via satellite. Whether that can be done while preserving entanglement was, for a long time, unclear. But it is clear now. Experiments conducted recently, by Pan Jianwei, a physicist at the University of Science and Technology of China, in Hefei, have shown that it can.

| *The keys to the high castle*

Such tests have been made possible by the launch, in August 2016, of *Micius*, the world's first quantum-communication satellite. *Micius* (named after a Chinese philosopher of the 5th century BC, who studied optics) now orbits Earth at an altitude of 500km. Using it, Dr Pan and his colleagues have been testing the protocols that a global quantum-communications network will need to work.

Their first study, published in June, showed that entangled photons sent by the satellite to pairs of ground stations remain entangled, even when those stations are as much as 1,200km apart. Following that success, they attempted to use entanglement to “teleport” information from the ground to orbit. Information teleporting, so called because it happens without anything physical passing from one place to another, involves the sender changing a quantum aspect of one photon of an entangled pair that he has control over, and the receiver observing the same change in the other member of the pair, over which he has control. A series of such changes on successively transmitted photons can carry information, provided a code has been agreed on in advance.

To minimise the amount of atmosphere in the way, and thus the risk of signal disruption, Dr Pan and his team put their ground station for this experiment in Ngari, a region of south-western Tibet that has an altitude of 5,100 metres. They beamed one of an entangled pair of photons to *Micius* and kept the other on the ground. They then entangled the grounded photon with a third photon, and measured how this altered its polarisation and the polarisation of the photon on the satellite. The result, reported in

July, was that the two do, indeed, change in lockstep. The team had thus succeeded in teleporting information from the ground to the satellite.

In a third study, also published in July, Dr Pan showed that *Micius* is able to transmit useful information, in the form of quantum-encryption keys, to a ground station in Xinglong, near Beijing. The transmission of such keys is crucial to quantum cryptography. Quantum-encryption keys are the quantum states of long strings of photons. Using one, a receiver can decrypt a message which has been encrypted with the key in question.

The security of quantum cryptography relies on the fact that eavesdropping breaks the entanglement by observing what is going on. It is a real-life example of the thought experiment known as Schrödinger's cat, in which a cat in a box remains both dead and alive until someone opens the box to look—at which point it becomes one or the other. Though entanglement-breaking will not be noticed by the receiver of a single photon, doing it to a series of photons will be statistically detectable, alerting him that the line is insecure.

This third demonstration of *Micius's* capabilities paved the way for a subsequent, successful, attempt to share a secure key between Xinglong and a station 2,500km away in Nanshan, a town in Xinjiang, China's westernmost province. To do so, *Micius* sent one half of a stream of entangled photon pairs to Xinglong when it passed over the place, and held the other half on board for two hours until it passed over Nanshan on its succeeding orbit.

The next stage, scheduled to happen in about five years' time, will be to launch a quantum-communications satellite in a higher orbit than *Micius's*. The altitude Dr Pan has in mind is 20,000km, which will permit the satellite to communicate simultaneously with a much bigger part of Earth's surface and allow him to test the feasibility of building a practical

quantum-communications network. He is also hoping to put an experimental quantum-communications payload on board China's space station, which is scheduled for completion by 2022. Having this device on board the station will mean it can be maintained and upgraded by human operators—a rare example of space-station crew doing something that could not easily be accomplished by robots. If all this goes well, the ultimate goal is a world-spanning ring of satellites in geostationary orbits.

One question Dr Pan and his colleagues particularly want to answer with their next experiments is whether entanglement is affected by a changing gravitational field. They could do this by comparing photons that stay in the weaker gravitational environment of orbit with their entangled partners sent to Earth. He also has other questions about the basic physics underlying entanglement—in particular, how it is that an entangled particle “knows” the result of changes made to its far-distant partner? That would be Nobel-prizeworthy stuff. Albert Einstein, famously, called the phenomenon of quantum entanglement “spooky actions at a distance”. Dr Pan's work is helping to exorcise those particular ghosts. ■



太空量子密码学

早起的鸟儿

中国很可能建成世界首个量子保密卫星网络

加密者和窃听者之间的军备竞赛永无止境。在努力为信息保密这一方，如今有许多人押注量子力学能够帮助他们——这一理论主要描述微观粒子的运动规律。他们尤其认为一种叫做量子纠缠的现象或许可以提供一条绝对可靠的途径，用以判断信息是否曾遭第三方拦截。根据量子理论，这类拦截必定会以可识别的方式改变被拦截的信息，从而令信息的接收端认识到信息是不安全的。这种现象基于一个令人吃惊但确切的事实：无论相距多远，同时生成、属性完全相同的粒子会形成纠缠态，其中一方状态的改变必将导致另一方状态相应改变。

已经有几个国家的研究人员尝试了量子加密的构想并取得了一些成果。他们通过在光纤或空气中传输光来发送纠缠量子信息。但这种方式有一个问题：信号会被传播它的媒介吸收。比如，量子信号能在光纤中传送的最远距离约为100公里。要传得再远些就需要发明量子中继器——一种能安全地接收、存储并重新发送量子信息的设备。这样的中继器在理论上可行，但技术上太过复杂，因而在现实中仍不可能实现。

一个替代方案是在太空真空环境中传送纠缠光子，那里没有任何东西会吸收它们。这就需要通过卫星来传送了。很长时间内，人们并不清楚是否能做到这一点而仍然保持光子的纠缠态。但现在已经明确了——位于合肥的中国科学技术大学的物理学家潘建伟近年开展的实验已经证明这是可能的。

| 高堡密钥

2016年8月，世界首颗量子通信卫星“墨子号”成功发射，令上述实验成为可能。“墨子号”（以公元前五世纪研究光学的中国哲学家墨子命名）如今在距地球500公里的太空轨道上运行。潘博士及其同事用这颗卫星来测试创建一个全球量子通信网络所需的协议。

他们于今年6月发表的首个研究显示，从“墨子号”发送至两个地面站的纠缠光子仍保持纠缠态，即便两个地面站相隔1200公里之遥。这项实验取得成功，他们尝试利用量子纠缠态从地面向太空轨道“隐形传输”信息。之所以称之为信息的“隐形传输”，是因为并没有任何有形的东西从一处传到另一处。在这个过程中，发送端改变了一对纠缠光子中由它控制的那个光子的量子态，接收端随即观察到自己控制的另一个光子发生了同样的改变。只要传输的两端事先商定一套信息编码，在连续传输的光子上发生一系列这样的变化就能传输信息了。

为尽可能地减少传输途中接触到的大气，从而减小信号中断的风险，潘博士和他的团队将这项实验中的地面站设在了西藏西南部海拔5100米的阿里地区。他们将一对纠缠光子中的一个发射到“墨子号”上，将另一个留在地面。而后用第三个光子来和地面上的那个光子制备出纠缠态，检测这如何改变了地面光子的偏振，以及卫星上光子的偏振。于7月发表的实验结果显示，两个光子确实都相继改变了。这样，研究团队成功地将信息从地面隐形传输到了卫星上。

在同样发表于7月的第三项研究中，潘博士演示了“墨子号”能将量子密钥这种有用信息发送到位于北京附近的兴隆地面站。这类密钥的传送对量子密码技术至关重要。量子密钥是长串光子的量子态。信息接收端可以使用一个量子密钥来解密用该密钥加密的信息。

量子加密的安全性基于这样一个事实：窃听者在观察传送的信息时会破坏量子纠缠态。它是思想实验“薛定谔的猫”的现实版：箱子中的猫既是死的也是活的，直到有人打开箱子一探究竟，它才变成或生或死的确定状态。虽然单个光子的接收端不会注意到纠缠态被破坏，对一系列光子状态的影响将在统计数据上显现出来，提醒接收端传输线路不安全。

这第三次对“墨子号”能力的展示为接下来又一项成功的尝试铺平了道路。研究团队在兴隆站和距其2500公里、位于中国最西部省份新疆的南山地面站之间分享了一个密钥。“墨子号”在经过兴隆上空时向其发送一串成对纠缠的光子中的一半，而后继续搭载剩余的另一半沿轨道飞行，直至两小时

后经过南山的上空。

下个阶段的计划是发射一颗量子通信卫星到比“墨子号”更高的轨道上，将在五年左右实现。潘博士设想的高度是两万公里，这将使卫星能同时和地球表面大得多的区域展开通信，让他能测试打造一个实用的量子通信网络的可行性。他还希望能在将于2022年建成的中国太空站上装设实验性的量子通信设备。在空间站装载这套设备将意味着它能由人类操作员维护和升级，这会成为一个罕见的例子——由空间站的工作人员来执行一些无法由机器人轻易完成的任务。假如这一切进展顺利，最终目标是发射一系列卫星到地球同步轨道上，环绕覆盖全世界。

潘博士和他的同事们尤其想通过日后的实验解答一个问题：量子纠缠是否受引力场的变化影响？这可以通过将处于轨道弱重力环境中的光子，与它被送到地球上的量子纠缠对象做比对来实现。他也想探究量子纠缠背后的物理原理，尤其是一个纠缠态粒子是如何“得知”其遥远的纠缠对象改变后的结果的？这将是诺贝尔奖级别的成就了。众所周知，爱因斯坦把量子纠缠现象称作“鬼魅般的超距作用”，潘博士正在努力驱魔。■



Schumpeter

Making money in India

As it gets easier to do business, it will get harder to earn huge profits

IF YOU run a big firm in India you must straddle different worlds. The country's leading bosses can wax lyrical about artificial intelligence and debate returns on capital with foreign fund managers. But they have also mastered India's poor infrastructure and huge informal economy. Shiny campuses sit beside open sewers. Millions of customers can be reached only by dirt tracks. Suppliers and distributors often operate in the shadows. In a typical month an Indian boss might have wheatgrass shots in Silicon Valley, slug bootlegged single malt with a local politician and sip masala chai from clay cups with villagers.

India's gross domestic product (GDP) is the world's seventh-largest and its stockmarket the ninth-biggest, but the country is like no other major economy. The informal sector accounts for about 50% of output, 80-90% of jobs and at least 90% of firms. Red tape and bad roads mean the country comes 130th in the World Bank's ease-of-doing-business rankings.

However, firms that overcome these challenges are exceptionally profitable. Since 2001 the return on equity (ROE) of listed Indian firms has averaged 19%, eight percentage points above the figure for companies in rich markets and five percentage points above those in emerging ones.

India is a terrible and brilliant place to do business. Just as investors talk about a "Korea discount", to describe *chaebols'* lousy profits, so there is an "India premium". The leading private lender, HDFC Bank, has an 18% ROE, ranking tenth among the top 100 global lenders. Hindustan Unilever, a consumer-goods firm, has a 77% ROE, over twice that of its parent, Unilever. Even in basic industries, such as cement, returns have been

relatively high.

This record reflects good management: most firms know how to allocate capital well, unlike their profligate Chinese peers. But India's informality and bad infrastructure also create obstacles for new entrants. Inputs such as capital, land and energy can be nightmarishly hard to secure. It takes 10-20 years to build dense national supply chains and distribution networks. For example, Maruti-Suzuki, the biggest car firm (with a 22% ROE), has over three times more dealerships than its nearest competitor.

Now, a quarter of a century after India first liberalised, the pace of formalisation is picking up. A breakthrough came in 2012, when the courts began to crack down on crony capitalists, especially firms that used graft to get access to natural resources and land. Now a new stage is in full swing, says Sanjeev Prasad of Kotak, a bank (14% ROE). A new value-added tax, known as the GST, requires firms to reconcile their tax returns with those of their suppliers and customers, forcing millions of companies into the tax net. The GST is complex but replaces a patchwork of local taxes, helping to create a single national market. A government decision to retire old bank notes at the end of 2016 has made it riskier to hoard illicit cash. E-commerce accounts for only 3% of retail sales but provides a new way to distribute products. New digital identities for all Indians mean that more can open bank accounts.

Measuring the share of economic activity that is informal is tricky. Still, the signs are encouraging. In the past year there has been a 13% increase in formal savings such as bank deposits, life-insurance policies and mutual funds. Cash in circulation has fallen from 12% of GDP to 10%. The value of digital payments have risen by over 40% and the number of taxpayers has almost doubled.

Make no mistake: parts of India are in a time warp. The north and east of

the country lag behind. Courts have a backlog of 30m cases. Nonetheless, formalisation is happening. Firms of all sizes are responding to the GST: one fund manager recalls meeting a huge poultry business hidden away in Chhattisgarh, a remote state, which is planning to come into the tax net.

For tens of millions of informal firms—shoe factories, plywood manufacturers, drinks wholesalers supplying roadside stalls—tough times are ahead. If they stay in the shadows they will be cut out of formal firms' supply chains. If they enter the formal economy, their tax costs will climb. Some will fail, causing unemployment to rise. Others will consolidate. For example, the fragmented haulage industry could merge into a few big firms that take advantage of a single national market. They may also take out more formal loans to lease trucks.

For big companies, formalisation could boost profits in the short term. They may take business from smaller firms: at least 40% of India's tea, 85% of its jewellery and 70% of its dairy products are sold in the grey economy. Tata Steel, a metals producer, has said it expects to gain market share from informal smelters.

However the risk is that the "India premium" eventually crumbles along with long-standing barriers to entry. The assault on crony capitalism, along with lower commodity prices, has already reduced the ROE of listed Indian firms from 26% in 2006 to 13% (this is still well above the 11% global average). At least half of this fall is due to a slump at firms with reputations for graft, which often operate in the basic-materials, infrastructure, property and energy sectors—and the state-owned banks that financed them.

| *An uncomfortable seat in the premium economy*

In most consumer-facing industries, returns remain high. But in the long run big Indian firms may be hurt by better-functioning markets for capital,

land and natural resources, as well as more efficient supply and distribution chains. The advantages that they have assembled over years could be eroded. To maintain high profits, they may have to spend more on innovation.

Investors don't seem to be thinking about this much. India's stockmarket is valued at three times book value. That makes it the dearest big market in the world and implies, roughly, that long-term ROEs will be 17-20%. India's consumer-facing firms trade on higher multiples of their profits than Facebook or Alibaba, and its best banks are not far behind. Formalisation is a giant step forward for India's economy, but investors could be in for a shock. ■



熊彼特

在印度赚钱

生意更好做了，要赚大钱变得更难了

如果你是在印度经营一家大公司，你得游走于不同的世界。该国的大老板们可以高谈阔论人工智能，也能和外国基金管理人讨论资本回报率。但他们对印度薄弱的基础设施和庞大的非正规经济也门清得很。光鲜的园区就盖在裸露的下水道旁；要送货给数百万客户只能走土路。供应商和经销商常来自非正规部门。在平常的一个月里，一位印度老板可能会在硅谷喝小杯的小麦草汁，在本国与当地政客豪饮私售的单一麦芽威士忌，和村民们一起用陶杯啜饮马萨拉茶。

印度的国内生产总值（GDP）排名世界第七，股市规模位列第九，但该国与其他大型经济体都不同。非正规部门贡献了大约50%的产出，提供了80%到90%的职位，囊括了至少90%的企业。繁文缛节和糟糕的道路让印度在世界银行的营商便利度排名中位列第130位。

不过，能够克服这些挑战的企业格外赚钱。自2001年来，印度上市公司的股本回报率（ROE）平均达19%，比富裕市场中的公司高出八个百分点，比新兴市场的公司高出五个百分点。

要做生意，印度非常不理想，但同时又是个绝佳的地方。正如投资者用“韩国折扣”来形容韩国财阀差劲的股票收益，还有一个说法叫“印度溢价”。该国领先的私营贷款机构HDFC银行的股本回报率为18%，在全球前100家银行中排名第十。消费品公司印度斯坦联合利华（Hindustan Unilever）的股本回报率高达77%，是其母公司联合利华的两倍还多。即使是在水泥这样的基础产业，收益也相对较高。

这样的成绩显示出良好的管理水平。与大手大脚的中国同行不同，大多数印度公司都了解如何得当地配置资本。不过印度经济欠正规、基础设施差，这也对新进者构成了障碍。要获得资本、土地及能源等投入极为困

难。要花十到二十年的时间才能打造出密集的全國供应链和销售网络。比如，印度最大的汽车公司马鲁蒂铃木（Maruti-Suzuki，股本回报率为22%）的经销商数量是其最大竞争对手的三倍还多。

如今，距印度首次实行经济自由化已有25个年头，经济正规化的步伐正在加快。2012年迎来了一次重大突破：印度法院开始打击裙带资本主义，尤其是那些通过腐败行为获取自然资源及土地的企业。科塔克银行

（Kotak，股本回报率14%）的桑吉夫·普拉萨德（Sanjeev Prasad）表示，现在一个新阶段正在全面展开。一项新的增值税，即商品及服务税（GST），要求企业报税时提供的信息须与供应商及客户提供的相一致，迫使数百万家公司进入税网。GST制度颇复杂，但可以取代各地标准不一的税制，帮助建立起单一国内市场。2016年年底，政府废除旧纸币的决定令囤积非法现金成了更加冒险的行为。电子商务只占到3%的零售额，但提供了销售产品的新途径。全民数字身份系统的建立让更多人得以开立银行账户。

要衡量非正规经济活动所占的比重并非易事。不过一些迹象颇令人鼓舞。过去的一年中，正规储蓄例如银行存款、人寿保险以及共同基金等增长了13%。流通中的现金占GDP的比重从12%下降到10%。数字支付的数额已增长超过40%，纳税人的数量几乎翻番。

毫无疑问，印度一些地方还停留在过去。北部及东部被甩在了后面。法院里堆积的未决案件达3000万件。然而，经济正规化的进程已经开启。大大小小的公司均对GST税制做出响应：一位基金管理人回想起与一家大型家禽养殖企业的会面。对方隐藏在偏远的恰蒂斯加尔邦（Chhattisgarh），如今计划进入税网。

制鞋厂、胶合板生产商、为街边小摊供货的饮料批发商——对于数千万家这样的非正规企业来说，接下来的日子会很艰难。如果它们还游离在正规经济之外，将不会被纳入正规企业的供应链。如果它们进入正规经济，税收成本将会攀升。有些企业会倒闭，进而造成失业率上升。其他一些企业将面临整合。举例来说，该国分散的运输行业或许可以合并成少数几家大

公司，从一个单一国内市场获益，或许还可以获得更多正规贷款来租借卡车。

对于大公司来说，经济正规化将在短期内促进利润增长。它们也许会从较小的公司那里抢夺业务：印度至少有40%的茶叶、85%的珠宝还有70%的奶制品是在灰色经济中销售的。金属生产商塔塔钢铁公司（Tata Steel）表示，预计自己会从非正规的冶炼厂手中获取市场份额。

然而风险在于，“印度溢价”最终会与存在已久的准入门槛一道消失。政府对裙带资本主义的打击加上大宗商品价格下降，已令印度上市公司的股本回报率从2006年的26%下降至13%（仍远高于11%这个全球平均水平）。至少有一半的下跌是由于那些有着腐败名声的企业及为其提供资金支持的国有银行陷入衰退。这些企业通常都来自于基础材料、基础设施、房地产及能源部门。

| 超级经济舱也不舒坦

在大多数面向消费者的行业里，收益率仍旧较高。但从长远看来，随着市场对资本、土地、自然资源调配得更好，供应及销售链变得更高效，印度大型公司也许会因此受到打击。它们历经多年积累起来的优势有可能会被削弱。为了维持高利润，它们或许得增加投资以寻求创新。

投资者对此似乎并没想那么多。目前印度股市的估值是其账面价值的三倍，这使其成为世界上最昂贵的大型市场，也意味着长期股本回报率大致将在17%到20%之间。印度面向消费者的企业的市盈率比Facebook或阿里巴巴还高，最好的几家银行也差不太多。对印度经济来说，正规化是向前迈出的一大步，不过投资者们可能会大吃一惊。■



Indian business

Toppling the tycoons

Undue reverence for company founders harms both Indian firms and the wider economy

THE chairman of Microsoft, John Thompson, occasionally reminds one of its directors, a fellow by the name of Bill Gates, that his vote in board meetings is no more or less important than that of other members. Contrast that with Infosys, an Indian technology firm, whose own retired founder succeeded in getting its boss to quit on August 18th, after a months-long whispering campaign. The board was dismayed, but the outcome was all too predictable, given India's penchant for treating corporate founders as latter-day maharajahs.

Indian companies come in all shapes and sizes, from clannish outfits whose tycoon bosses routinely stiff minority investors, to giants like Infosys whose corporate governance (usually) matches Western norms. What unites them is that they accord undue deference to "promoters", as India dubs a firm's founding shareholders. The exalted status bestowed on promoters is a pervasive feature of the Indian corporate landscape. Of the 500 largest listed Indian firms, according to IiAS, an advisory firm, 344 are controlled in practice not by boards answerable to all shareholders, but directly by promoters.

Founders can exert unhealthy influence over Western firms, too, but they typically do so using their shareholdings. The sway exercised by Indian founders has its roots in a unique mix of moral suasion, regulatory advantage and the trickiness of doing business in India. In many industries, the promoter has relationships with people who matter. Only he knows which palms need to be greased to keep a power plant open, or which union boss has to be co-opted to avoid strikes. This knowledge

makes the promoter central to the running of the firm, even if it belongs mostly to other shareholders.

Sometimes that leads to dominant promoters bilking the firms they run. They give family members juicy contracts, pay themselves excessively and get the firm to provide private yachts, London flats and much else besides. United Spirits, a booze firm promoted by Vijay Mallya but owned mainly by outsiders, used to pay for 13 properties for him and his family (he is now in Britain, trying to avoid extradition to India).

The promoter's perch is bad for the companies themselves, and not just their shareholders. It is harder to recruit good managers when power lies elsewhere. Balance-sheets get stretched as investment is funded more by debt than equity—because debt is cheaper and promoters can thereby avoid being diluted to the point of losing certain privileges.

Promoter power is also bad for the economy. Inefficient firms that should be taken over by a rival stumble on, as promoters seek to preserve their perks. The promoter culture is partly to blame for the nearly one-fifth of all loans made by Indian banks thought unlikely to be repaid. When promoter-led firms cannot service their debts, dominant owner-bosses tend to skip repayments. They understand that banks cannot easily foreclose on them and later hope to sell the firm on, because any new owner would lack a promoter's hold over the business. This has harmed the Indian banks and, in turn, the finances of the government that owns many of them.

| *Demotion guide*

Promoters will not willingly give up their power. But others can help limit it. The original owners of companies will soon account for less than half of the shareholdings of India's largest listed firms, down from 59% around a decade ago, according to IiAS. Much of the rest has been picked up by domestic institutional investors such as insurance companies and mutual

funds. These investors have a duty to stand up to promoters, no matter how rich or politically connected they may be. Institutions should act as owners continuously, not just during a crisis. They should recognise the pre-eminence of boards of directors that represent all shareholders. And they should demand higher returns from promoter-dominated firms, in recognition of the higher risks.

The tide has begun to turn against promoters. Newish rules force them to secure a majority of minority shareholders' approvals in some instances. Authorities are leaning on banks to restructure defaulting firms' debt, or push them into insolvency. Some tycoons have had to sell prized assets to keep afloat, a once unthinkable affront. Founding shareholders can be a resource for a company, but only if they know their place—in the boardroom, perhaps, but not on a pedestal. ■



印度商业

把大亨拉下神坛

对公司创始人的过度尊崇令印度公司和更广泛的经济都受损

微软董事长约翰·汤普森（John Thompson）偶尔会提醒公司的一位董事——一个叫比尔·盖茨的人，他在董事会上的一票并不比其他人的一票更重要。再来看看印度科技公司印孚瑟斯（Infosys）：经过几个月的造谣中伤，该公司已经退休的创始人成功使现任老板于8月18日宣布辞职。董事会感到沮丧，不过考虑到印度喜欢把公司创始人奉为现代版土邦主，这样的结果毫不意外。

印度的公司架构各异，规模不一，有那种具宗派性质的企业团体，其大亨老板时不时就会冷落中小投资者；也有公司治理水平（通常都）能达到西方标准的巨头，例如印孚瑟斯。有一点将这些公司统一起来：它们都对“发起人”（promoter，印度对公司创始股东的称呼）过分尊崇。纵观印度公司，一个普遍现象是它们都赋予发起人崇高的地位。根据咨询公司IiAS的数字，印度上市公司500强中，有344家实际上由发起人直接控制，而不是由对所有股东负责的董事会控制。

在西方，创始人也可能对公司施加有害的影响，不过通常都是利用手中的股权达到目的。印度公司创立者的影响力源自于一种独特的组合：道德说教、监管特点，以及印度复杂的经商环境。在很多行业，发起人和重要人物有交情，只有他才知道，要让一家发电厂持续运转，该给哪些人好处，或者得去笼络哪个工会领袖才能避免发生罢工。拥有这种“学问”的发起人成为公司运营的核心，哪怕公司大体上仍属于其他股东。

有时，这会导致位高权重的发起人从自己运营的公司那里坑钱。他们给家人利润丰厚的合同，给自己极高的薪水，还让公司提供私人游艇、伦敦的公寓以及其他许多东西。酒业公司United Spirits由维贾伊·马尔雅（Vijay Mallya）发起，不过主要归外部人士所有。该公司曾为马尔雅及其家人的13处房产买单（他现在人在英国，正设法避免被引渡回印度）。

发起人高高在上，不仅有损公司股东的利益，对公司本身也有害。如果管理职位被架空，发起人在幕后控制实权的话，要聘请优秀的经理人会更难。资产负债表也会捉襟见肘，因为公司更多是通过债务而非股权来融资。这是因为债务更便宜，而且发起人也能避免自己的股权被稀释以致失去某些特权。

发起人手握大权，对经济也有不利影响。他们一心要保住自己的特权，结果本该被竞争对手接手的低效率公司继续蹒跚前行。印度银行的所有贷款中，将近五分之一被认为偿还无望，发起人文化要为此负一部分责任。当发起人主导的公司无法偿还债务时，绝对大股东兼老板往往会逃避还债。他们明白银行不会轻易取消他们的抵押品赎回权，然后再寄希望于将公司转卖，因为新主人不管是谁，都不会像发起人那样对公司有那么大的掌控力。印度的银行已因此而受损，进而又损害了政府的财政状况，因为其中多家银行归政府所有。

| 降级指南

发起人是不会主动放权力的。不过其他人可以帮助限制他们的权力。IiAS的数字显示，在印度最大的上市公司中，原始所有人的持股比例将很快从大约十年前的59%下降至不到一半。剩余股本中已有相当一部分由国内机构投资者获得，例如保险公司和共同基金。这些投资者有义务对抗发起人，不管后者多富有、政治后台有多硬。机构应一直充当公司的所有人，而不是只在危机时期才是如此。它们应承认代表所有股东的董事会占据最重要的地位。它们还应要求发起人主导的公司产生更高的回报，作为更高风险的报偿。

大势已开始朝着不利于发起人的方向发展。根据一些较新的规则，在某些情况下，发起人必须获得大多数中小股东的同意方可行事。当局也在向银行施压，要求其重组违约企业的债务，或迫使企业破产。一些大亨不得不出售自己的宝贵资产来保住公司，这样的耻辱在以往简直无法想象。创始股东可以成为公司的资源，但前提是他们清楚自己的位置在哪——可能是在董事会会议室里，但不会是在神坛上。■



Facial recognition

Nowhere to hide

Facial recognition is not just another technology. It will change society

THE human face is a remarkable piece of work. The astonishing variety of facial features helps people recognise each other and is crucial to the formation of complex societies. So is the face's ability to send emotional signals, whether through an involuntary blush or the artifice of a false smile. People spend much of their waking lives, in the office and the courtroom as well as the bar and the bedroom, reading faces, for signs of attraction, hostility, trust and deceit. They also spend plenty of time trying to dissimulate.

Technology is rapidly catching up with the human ability to read faces. In America facial recognition is used by churches to track worshippers' attendance; in Britain, by retailers to spot past shoplifters. This year Welsh police used it to arrest a suspect outside a football game. In China it verifies the identities of ride-hailing drivers, permits tourists to enter attractions and lets people pay for things with a smile. Apple's new iPhone is expected to use it to unlock the homescreen.

Set against human skills, such applications might seem incremental. Some breakthroughs, such as flight or the internet, obviously transform human abilities; facial recognition seems merely to encode them. Although faces are peculiar to individuals, they are also public, so technology does not, at first sight, intrude on something that is private. And yet the ability to record, store and analyse images of faces cheaply, quickly and on a vast scale promises one day to bring about fundamental changes to notions of privacy, fairness and trust.

| *The final frontier*

Start with privacy. One big difference between faces and other biometric data, such as fingerprints, is that they work at a distance. Anyone with a phone can take a picture for facial-recognition programs to use. FindFace, an app in Russia, compares snaps of strangers with pictures on VKontakte, a social network, and can identify people with a 70% accuracy rate.

Facebook's bank of facial images cannot be scraped by others, but the Silicon Valley giant could obtain pictures of visitors to a car showroom, say, and later use facial recognition to serve them ads for cars. Even if private firms are unable to join the dots between images and identity, the state often can. China's government keeps a record of its citizens' faces; photographs of half of America's adult population are stored in databases that can be used by the FBI. Law-enforcement agencies now have a powerful weapon in their ability to track criminals, but at enormous potential cost to citizens' privacy.

The face is not just a name-tag. It displays a lot of other information—and machines can read that, too. Again, that promises benefits. Some firms are analysing faces to provide automated diagnoses of rare genetic conditions, such as Hajdu-Cheney syndrome, far earlier than would otherwise be possible. Systems that measure emotion may give autistic people a grasp of social signals they find elusive. But the technology also threatens.

Researchers at Stanford University have demonstrated that, when shown pictures of one gay man, and one straight man, the algorithm could attribute their sexuality correctly 81% of the time. Humans managed only 61%. In countries where homosexuality is a crime, software which promises to infer sexuality from a face is an alarming prospect.

| *Keys, wallet, balaclava*

Less violent forms of discrimination could also become common. Employers can already act on their prejudices to deny people a job. But

facial recognition could make such bias routine, enabling firms to filter all job applications for ethnicity and signs of intelligence and sexuality. Nightclubs and sports grounds may face pressure to protect people by scanning entrants' faces for the threat of violence—even though, owing to the nature of machine-learning, all facial-recognition systems inevitably deal in probabilities. Moreover, such systems may be biased against those who do not have white skin, since algorithms trained on data sets of mostly white faces do not work well with different ethnicities. Such biases have cropped up in automated assessments used to inform courts' decisions about bail and sentencing.

Eventually, continuous facial recording and gadgets that paint computerised data onto the real world might change the texture of social interactions. Dissembling helps grease the wheels of daily life. If your partner can spot every suppressed yawn, and your boss every grimace of irritation, marriages and working relationships will be more truthful, but less harmonious. The basis of social interactions might change, too, from a set of commitments founded on trust to calculations of risk and reward derived from the information a computer attaches to someone's face. Relationships might become more rational, but also more transactional.

In democracies, at least, legislation can help alter the balance of good and bad outcomes. European regulators have embedded a set of principles in forthcoming data-protection regulation, decreeing that biometric information, which would include “faceprints”, belongs to its owner and that its use requires consent—so that, in Europe, unlike America, Facebook could not just sell ads to those car-showroom visitors. Laws against discrimination can be applied to an employer screening candidates' images. Suppliers of commercial face-recognition systems might submit to audits, to demonstrate that their systems are not propagating bias unintentionally. Firms that use such technologies should be held accountable.

Such rules cannot alter the direction of travel, however. Cameras will only become more common with the spread of wearable devices. Efforts to bamboozle facial-recognition systems, from sunglasses to make-up, are already being overtaken; research from the University of Cambridge shows that artificial intelligence can reconstruct the facial structures of people in disguise. Google has explicitly turned its back on matching faces to identities, for fear of its misuse by undemocratic regimes. Other tech firms seem less picky. Amazon and Microsoft are both using their cloud services to offer face recognition; it is central to Facebook's plans. Governments will not want to forgo its benefits. Change is coming. Face up to it. ■



人脸识别

无处躲藏

人脸识别不只是另一种技术。它将改变社会

人类的脸是一件杰作。面部特征之纷繁各异令人惊叹，它让人们能相互辨认，也是形成复杂社会群体的关键。人脸传递情感信号的功能也同样重要，无论是通过下意识的脸红还是有技巧的假笑。人们在清醒时花费大量时光研读一张张面孔——在办公室，在法庭，在酒吧，在卧室，寻找着兴趣、敌意、信任和欺骗的迹象。他们也花大把的时间试图掩饰自己的神色。

科技正迅速赶上人类研读脸孔的能力。在美国，教堂使用人脸识别来追踪教徒做礼拜的出席情况；在英国，零售商用它来辨认有扒窃前科的顾客。今年，威尔士警方利用人脸识别在足球场外逮捕了一名嫌疑犯。在中国，人脸识别被用于验证网约车司机的身份、让游客刷脸进景点、让顾客微微一笑就能刷脸买单。苹果的新款iPhone预计将用这一技术来解锁屏幕。

与人类的技能相比，这样的应用看似只是锦上添花。飞行或互联网这样的重大突破明显改变了人类的能力，而人脸识别似乎只是对面孔进行编码。尽管人的面孔为个人独有，但也是公开的，因此乍看起来，技术并没有侵犯隐私之嫌。但是，低成本、快速、大量地记录、存储和分析人脸图像的能力终有一天会使隐私、公平和信任等观念发生根本性的改变。

| 终极战线

先说隐私。人脸相比指纹等其他生物特征数据的一个巨大区别就是它们能够远距离起作用。人们只要有手机就可以拍下照片，供人脸识别程序使用。俄罗斯的一款应用FindFace抓拍陌生人的照片与社交网络VKontakte上的照片比对，识别人的准确率达70%。Facebook的面部图片库不能被其他人提取，但是，举个例子，这家硅谷巨头可以获得汽车展厅内到访者的照片，然后使用人脸识别技术在自己的网站上找到这些人，向他们发送汽车广告。即使私人公司无法将照片和身份联系起来，国家往往可以做到。

中国政府有公民的面部记录；美国半数成年人口的照片储存在数据库中，可供FBI使用。如今，执法机关在追踪罪犯方面拥有了一个强大的武器，但它可能会令公民隐私遭受巨大的损害。

人脸不仅仅能表明身份，它还显示了许多其他信息，同样能由机器读取。这同样带来了一些益处。一些公司正通过分析脸部特征来自动诊断罕见遗传疾病，比如Hajdu-Cheney综合症【译注：颅骨发育不良伴肢端溶骨症】，和其他可能的手段相比，早早就发现了病情。测量情绪的系统也许能让自闭症患者更好地理解对他们来说难以捉摸的社交信号。但这项技术也造成了威胁。斯坦福大学的研究人员已经证明，面对一个男同性恋者和一个异性恋者的照片时，算法识别他们性取向的准确率可以达到81%。人类只能达到61%。在那些视同性恋为犯罪的国家，一个能从面部推断出性取向的软件让人恐惧。

| 钥匙，钱包，头套

不那么暴力的歧视也可能变得普遍。雇主本来就可能会根据自己的偏见来拒绝雇用某个人，而人脸识别也许会让这种偏见成为常态，令公司能够通过种族以及显现智力水平和性取向的特征过滤所有工作申请。夜总会和体育场馆也许会受到压力，可能需要扫描访客的脸来识别暴力威胁，从而保护人们——尽管由于机器学习的性质，所有的人脸识别系统都不可避免地面对概率问题。此外，这类系统可能会对那些非白色皮肤的人有偏见，因为用来训练算法的数据集里大部分是白人面孔，这样的算法不太适用于其他种族。在影响法院保释和量刑决定的自动评估工具中，已经出现过这样的偏见。

最终，持续的面部记录和用计算机数据测量真实世界的小工具可能会改变社交互动的本质。掩饰有助于润滑日常生活的齿轮。如果你的伴侣能发现每一个强压下去的哈欠，你的老板能觉察每一丝恼怒的表情，婚姻和工作关系都会变得更真实，但也更不和谐。社交互动的基础可能也会改变，从基于信任的一系列承诺，变成对风险和回报的算计，这些算计则源自于计算机对人们面部信息的解读。人际关系可能变得更理性，但也变得更像交易。

至少在民主国家，立法可以帮助改变利弊之间的平衡。欧洲监管机构已在即将出台的数据保护法规中嵌入了一套原则，规定包括“脸纹”在内的生物信息属于其所有者，使用这些信息需要征得本人同意。这样，Facebook在欧洲就不能像在美国那样，直接向参观汽车展的人推送广告了。反歧视法律可以适用于筛选求职者照片的雇主。商业人脸识别系统的供应商可能要接受审核，证明它们的系统没有无意中传播偏见。使用这些技术的公司也应该被问责。

然而这类规定并不能改变发展的方向。随着可穿戴设备的普及，摄像头只会越来越普遍。从太阳镜到化妆，试图欺骗人脸识别系统的种种努力已被挫败。剑桥大学的研究表明，人工智能可以重建伪装之下的面部结构。谷歌已经明确表示不会将面部信息和身份匹配，担心这会被非民主政权滥用。其他的科技公司似乎没那么讲究。亚马逊和微软都在使用它们的云服务来提供人脸识别，这项技术也是Facebook计划的核心。政府不会想放弃自己的利益。改变即将到来。直面它吧。■



Schumpeter

Suspicious minds

The economic consequences of Americans' distrust

AMERICA is a grumpy and confused place. For an overarching explanation of what has gone wrong, a decline in trust is a good place to start. Trust can be defined as the expectation that other people, or organisations, will act in ways that are fair to you. In the White House and beyond there is precious little of it about. People increasingly view institutions as corrupt, strangers as suspicious, rivals as illegitimate and facts as negotiable.

The share of Americans who say “most people can be trusted” fell from 44% in 1976 to 32% in 2016, according to a survey from the University of Chicago. In a new book, “The Retreat of Western Liberalism”, Edward Luce, a commentator for the *Financial Times* in Washington, argues that distrust will contribute to America’s decline and eventually, even, to autocracy. Lack of faith is chewed over in boardrooms, too. In his latest letter to shareholders, Jamie Dimon, JPMorgan Chase’s boss, describes trust as America’s “secret sauce” and worries that the bottle is running dry.

The tricky bit is reconciling this distrust with the rosy business outlook. The S&P 500 index is near an all-time high, even though many economists say that distrust is toxic for prosperity because transactions become dearer and riskier. An OECD study of 30 economies shows that those with low levels of trust, such as Turkey and Mexico, are far poorer. Three scholars, Luigi Guiso, Paola Sapienza and Luigi Zingales, have shown that pairs of countries (such as Britain and France) whose populations say they distrust each other, have less bilateral trade and investment.

America’s mistrust outbreak can be split into two parts: what consumers think, and what firms think. The share of folk who have “little or no

confidence” in big business has risen from 26% in 1976 to 39% in June, according to Gallup. For banks it has risen from 10% in 1979 to 28% today. Over decades big firms have broken implicit promises to their employees, such as providing a job for life and paying generous pensions. That has probably soured the public’s view. And the financial crisis of 2007-08 blew a giant hole in the reputation of big business and finance.

Yet despite their customers’ distaste, big firms mint huge profits. One explanation is declining competition over the past 20 years. If markets are working, firms that are perceived to behave badly lose market share. In concentrated industries this discipline is lacking. Two recent scandals in oligopolistic bits of the economy illustrate the point. Wells Fargo, a bank, created millions of fake accounts, yet in the three months to June its year-on-year profits rose by 5%. In April a United Airlines passenger was assaulted, causing an outcry. Its underlying profits later rose by 5%, too. In such industries Americans are inured to mistreatment.

Trust between firms, and between firms and investors, is more resilient, but there is evidence of greater wariness. Banks charge corporate borrowers a spread of 2.6 percentage points above the federal-funds rate, compared with 2.0 points in the 20 years before the crisis. The equity-risk premium, or the annual excess return that investors demand to hold shares rather than bonds, is 5.03 points, against a pre-crisis average of 3.45 points, notes Aswath Damodaran of the Stern School of Business at NYU.

The median firm in the S&P 500 holds 62 cents of cash on its balance-sheet per dollar of gross operating profit, up from 45 cents in 2006 (this yardstick excludes America’s giant technology companies, which hoard money). In a sign that more corporate deals end in tears, litigation costs are rising. The revenues of legal firms rose by 103% in 1997-2012, according to the Census Bureau, more quickly than nominal GDP growth, of 85%. And spending on corporate lobbying, a signal that firms think politicians are corruptible, has

risen faster than GDP, too.

In the long term it is possible that firms could become as mistrustful as consumers. Though individual companies can gain from cronyism, overall confidence will fall if there is sustained political meddling in the courts and regulatory system. And companies as well as people can be trapped into doing business with monopolies that are inept or shifty. In 2016 Facebook said that for the past two years it had overstated how long its users watched videos for, but advertisers have little choice but to stick with the social-media firm. Its profits rose by 71% in the latest quarter.

If the bleak predictions of observers such as Mr Luce come true, how might America Inc adjust? One guide is the work of Ronald Coase, an economist who theorised that the boundary of a firm is set according to whether an activity is best done in-house or can be outsourced to the market. If counterparties are less reliable, and contracts expensive to enforce, firms will become “vertically integrated”, bringing their supply chain in-house.

If there is deeper decay of America’s legal system and greater political corruption, then firms would go further and spread “horizontally” too, expanding into new industries where their political contacts, and access to favours and capital can be used. This is how business works in much of the emerging world.

| *Gotta have faith*

America is nowhere near such an outcome, at least not yet. Still, a concerted effort to shore up trust between consumers and firms, and between firms, would be healthy. If you subscribe to Silicon Valley’s Utopianism, technology can fill the gap, manufacturing mutual faith where none existed before. Uber’s system of scoring drivers and passengers allows strangers to have confidence in each other. E-commerce sites such as eBay and Alibaba work by creating networks of trust between merchants and

customers.

In the end, however, government has a vital role. By enforcing competition rules, it can ensure that poor conduct is punished. And by observing the independence of courts and regulators, it can demonstrate that contracts are sacred and that firms operate on a level playing-field. Suspicion is not about to bring American capitalism to its knees. But the country's vast stock of trust, built up over a century or more, is being depleted quickly. ■



熊彼特

疑心重重

美国人缺乏信任的经济后果

美国是一个暴躁而又迷茫的地方。要整体把握到底什么地方出了问题，我们不妨从信任度的下降入手。信任可以定义为“预期其他人或组织将公平地对待自己”。在白宫内外，这一点弥足珍贵。人们越来越认为机构腐败，陌生人可疑，对手非法，而事实也可以商量。

根据芝加哥大学的一项调查，认为“大多数人可以信任”的美国人比例从1976年的44%下降到2016年的32%。《金融时报》驻华盛顿评论员爱德华·卢斯（Edward Luce）在新书《西方自由主义的退却》（The Retreat of Western Liberalism）中指出，不信任将加速美国的衰落，甚至最终导致独裁。公司董事会也在琢磨缺乏信任的问题。摩根大通的老板杰米·戴蒙（Jamie Dimon）在最近给股东的信中将信任称为美国的“秘方”，并担心装秘方的瓶子快要空了。

这种不信任与美妙的商业前景放在一起似乎很不协调。标准普尔500指数目前接近历史高点——尽管许多经济学家认为不信任会扼杀繁荣，因为交易的成本会更高，风险会更大。经合组织对30个经济体的研究表明，信任水平较低的国家，比如土耳其和墨西哥等，要比美国贫穷得多。路易吉·圭索（Luigi Guiso）、佩奥拉·萨皮恩扎（Paola Sapienza）和路易吉·津加雷斯（Luigi Zingales）等三位学者证明，如果两个国家的民众对彼此都表示不信任，它们之间的双边贸易和投资也较少，比如英国和法国。

不信任在美国的爆发可以分为两部分：消费者的想法和企业的想法。根据盖洛普的数据，对大企业“几乎或完全不信任”者的比例从1976年的26%上升到了今年6月份的39%。对于银行，这一比例则从1979年的10%上升到今天的28%。几十年来，大公司已经打破了对员工的隐性承诺，如提供终身职位和慷慨的养老金。这可能已令公众心怀怨恨。2007至2008年的金融危机则让大企业和金融业名誉扫地。

然而，尽管不受消费者认同，大公司还是创造了巨大的利润。一个解释是过去20年来竞争越来越少。如果市场正常发挥作用，公众眼中行为不良的公司将失去市场份额。这个规律不适用于集中的行业。最近在寡头垄断行业中发生的两桩丑闻就说明了这一点。富国银行虚开了数百万个账户，但在截至6月份的三个月中，其利润同比增长了5%。4月一名美联航乘客遭到殴打，引发强烈抗议。然而自此之后公司的基本利润上涨了5%。在这样的行业里，美国人已经逆来顺受惯了。

公司之间以及公司与投资者之间的信任更为坚挺，但证据表明它们也变得更加谨慎了。银行向贷款企业收取高于联邦基金利率2.6个百分点的差价，而危机前20年这个差价只有2.0个百分点。纽约大学斯特恩商学院的阿斯沃斯·达摩达兰（Aswath Damodaran）指出，股票风险溢价（投资者持有股票而非债券时要求的年度超额收益）为5.03个百分点，而危机前的平均水平为3.45个百分点。

标准普尔500指数的中位数公司每产生1美元毛营业利润，就会在资产负债表上持有62美分的现金，高于2006年的45美分（这个标准不包括囤积现金的美国技术巨头）。面对越来越多的企业交易惨淡收场的迹象，诉讼费用正在上升。根据美国人口调查局的统计，1997至2012年律所收入增长了103%，高于85%的名义GDP增长率。企业游说支出（体现企业认为政客可收买的程度）也比GDP增长更快。

长此以往，企业有可能变得和消费者一样多疑。虽然个别公司可以从裙带主义中获益，但如果法院和监管体系中持续存在政治干预，整体信心会下降。公司以及人们都可能不得和无能或是诡诈的垄断公司打交道。2016年，Facebook称它在过去两年中夸大了用户观看视频的时间，但广告客户别无选择，只能继续使用这家社交媒体公司。最近一季度它的利润增长了71%。

如果卢斯等观察家的晦暗预测成真，美国公司可能如何做出调整呢？一个指导方针是经济学家罗纳德·科斯（Ronald Coase）的研究成果，他提出了一个理论，称企业的边界取决于某项活动是该内部完成还是外包给市

场。如果交易对手不再可靠，执行合同的费用高昂，企业将“垂直一体化”，将供应链收进内部。

如果美国的法律体系腐烂更深，政治腐败更甚，企业也会进一步“横向拓展”，进入新的行业以利用其政治联系和可以获得的照顾和资本。这正是大部分新兴市场的经营方式。

| 须有信心

美国还远没到这一步，至少现在还没有。然而，通过共同的努力来增强消费者与企业之间以及企业和企业之间的信任会大有好处。如果您认同硅谷的乌托邦主义，那么技术可以弥补缺失，制造出以前不存在的相互信任。优步的司机和乘客打分系统让陌生人相互信任。电子商务网站，如eBay和阿里巴巴，都靠建立商家和客户之间的信任网络而存在。

然而归根结底，政府起着至关重要的作用。通过执行竞争规则，它可以确保恶劣行为受到惩罚。通过确保法院和监管机构的独立性，它可以证明合同是神圣的，公司的竞争环境是公平的。怀疑的影响还没到让美国资本主义瘫痪的程度。但是，这个国家用一个多世纪建立起来的庞大信任库存如今消耗得十分迅速。 ■



The natural rate of unemployment

Central bankers' holy grail

Policymakers have spent half a century in search of the natural rate of unemployment. The fifth in our series on big economic ideas

WHY does unemployment exist? If there is a central question in macroeconomics, this is it. There are few bigger wastes than the loss to idleness of hours, days and years by people who would rather be working. Unemployment can ruin lives, sink budgets and topple governments. Yet policymakers do not wage all-out war on joblessness. Most, like the Federal Reserve, America's central bank, target what is known as unemployment's "natural" rate, at which inflation is stable.

The importance of this concept is hard to overstate. The Fed's argument for its recent interest-rate rises, for example, hinges on stopping unemployment from falling too far beneath the natural rate. Yet the natural rate is in many respects an article of faith, always sought but never seen. Where does it come from?

There are several reasons why unemployment cannot simply be eradicated fully. It takes time for people to move from one job to another: this is said to cause "frictional" unemployment. If people cannot find jobs because they have outdated skills—think hand weavers after the invention of the loom—they might become "structurally" unemployed.

But it is the trade-off between unemployment and inflation that most preoccupies central bankers. John Maynard Keynes, the great British economist, took a first step towards the natural-rate hypothesis when he focused minds on "involuntary" unemployment. In his book "The General Theory", published in 1936 in the aftermath of the Depression, Keynes noted that many people could not find jobs at the going wage, even if they

had comparable skills to those in work. Classical economics blamed artificially high wages, perhaps caused by trade unions. But Keynes pointed to lacklustre economy-wide spending. Even if wages fell, he reasoned, workers would have less to spend, making the demand deficiency worse. The answer, he thought, was for governments to manage aggregate demand in order to keep employment “full”.

Keynes was not the father of all that is now thought of as “Keynesian”. Inflation, for instance, barely entered his analysis of unemployment. But by the late 1960s Keynesianism had become associated with the idea that when managing aggregate demand, policymakers are not just choosing a rate of unemployment. They are simultaneously choosing how fast prices rise.

The relationship between inflation and unemployment was first studied by Irving Fisher in 1926. But the “Phillips curve”, as it came to be known, owes its name to a study in 1958 by William Phillips of the London School of Economics. In his study, Phillips traced the relationship between unemployment and wage growth in Britain over the course of almost a century. He found that from 1861 to 1957 the relationship had been pretty stable: the lower the unemployment rate, the faster wages rose. This was remarkable, given the changes over that period in workers’ rights. In 1861 most workers could not vote; by 1957 the post-war Labour government had nationalised much of the economy.

Paul Samuelson and Robert Solow, two other economic luminaries, subsequently investigated the relationship in America, and reported that there was no such stability there. The Phillips curve shifted around. But in any given era, Samuelson and Solow wrote, “wage rates do tend to rise when the labour market is tight, and the tighter the faster.” They described the relationship as a “menu”, encouraging the idea that the job of Keynesian policymakers was to pick a point on the curve that best aligned with their

preferences. How low unemployment could fall, in other words, depended only on what level of inflation was tolerable (for rising wages would surely end up lifting prices, too).

It is unclear whether policymakers actually thought of the relationship between inflation and unemployment as a menu. But the idea was prominent enough by the late 1960s to attract withering criticism. Its two main detractors, Edmund Phelps and Milton Friedman, would each go on to win a Nobel prize.

Mr Phelps began writing groundbreaking models of the labour market in 1966. A year later, Friedman gave what became the canonical criticism of the old way of thinking in an address to the American Economics Association. In it, he argued that, far from there being a menu of options for policymakers to pick from, one rate of unemployment—a natural rate—would eventually prevail.

Suppose, Friedman reasoned, that a central bank prints money in an attempt to push unemployment lower than the natural rate. A larger money supply would lead to more spending. Firms would respond to increased demand for their products by expanding production and raising prices, say by 5%. This inflation would catch workers by surprise. Their wages would be worth less than they bargained for when they had negotiated their contracts. Labour would, for a while, be artificially cheap, encouraging hiring. Unemployment would fall below the natural rate. The central bank would achieve its goal.

The next time pay was negotiated, however, workers would demand a 5% raise to restore their standard of living. Neither firm nor worker has gained or lost negotiating power since the last time real wages were set, so the natural rate of unemployment would reassert itself as firms shed staff to pay for the raise. To get unemployment back down again, the central bank

could embark on another round of easing. But workers can be fooled only for so long. They would come to expect 5% inflation, and would insist on commensurately higher wages in advance, rather than playing catch-up with the central bank. Without an inflation surprise, there would be no period of unexpectedly cheap labour. So unemployment would not fall.

The implication? For a central bank to keep unemployment below the natural rate, it must keep outdoing itself, delivering inflation surprise after inflation surprise. Hence, Friedman reasoned, Keynesians were wrong to pin a low rate of unemployment to a given, high rate of inflation. To sustain unemployment even a little below the natural rate, inflation would need to accelerate year in, year out. Friedman's and Phelps's natural rate became known as the "non-accelerating inflation rate of unemployment" (NAIRU).

No society could tolerate endlessly rising, or falling, inflation. Phillips had observed a correlation in the data, but it was not one that policymakers could exploit in the long run. "There is always a temporary trade-off between inflation and unemployment," Friedman said. "There is no permanent trade-off." Nearly 50 years on, that remains the premise on which rich-world central banks operate. When officials talk about the Phillips curve, they mean Friedman's temporary trade-off. In the long run, they believe, unemployment will come to rest at the natural rate.

The idea has such influence partly because Friedman's and Phelps's contributions were so well timed. Before 1968, America had had two years with unemployment below 4% and inflation below 3%. But when Friedman spoke, prices were indeed accelerating; inflation rose to 4.2% in 1968. The next year it hit 5.4% even as unemployment changed little. The "stagflation" of the 1970s killed off the idea of a stable Phillips curve. Successive shocks to oil prices, in 1973 and 1979, sent both inflation and unemployment surging. In 1975 both were above 8%; in 1980 inflation hit 13.5% even as unemployment exceeded 7%. The idea of the NAIRU looked a

little shaky, too; inflation was meant to fall so long as unemployment was too high. But Friedman's followers could argue that bad supply-side policies, in conjunction with the oil-price shocks, had pushed the NAIRU up.

Around the same time, however, the concept of the NAIRU came under attack from theorists. It was built, in part, on the idea that inflation expectations are "adaptive": to predict inflation, firms and workers look at its current value. But the doctrine of "rational expectations" decreed that firms and consumers would, to the greatest extent possible, anticipate policymakers' actions. Whenever the public suspected that central bankers would try to push employment below the natural rate, inflation would rise immediately. On the other hand, a credible promise not to seek any unsustainable jobs booms should keep inflation under control, simply by "anchoring" expectations.

That proposition was put to the test after Paul Volcker became Fed chairman in 1979. Mr Volcker was set on getting inflation down. As it turned out, he would need to prove his mettle. His tight monetary policies—the federal funds rate reached almost 20% in 1981—contributed to a double-dip recession, which pushed unemployment above 10%. It got the job done; inflation tumbled. Since Mr Volcker's time at the Fed, it has rarely exceeded 5%.

To this day, some economists point to the Volcker recessions as proof that inflation expectations are adaptive. The public did not believe inflation would fall just because the Fed said it would. America had to suffer high unemployment to bring inflation down. Policymakers had to grapple with a short-term Phillips curve after all, as Friedman and Phelps had argued.

Yet the experience of the 1980s would not be repeated. In the decades that followed, central banks committed to inflation targets. As they gained

credibility, the trade-off between inflation and unemployment weakened. Economists wrote “New Keynesian” models incorporating rational expectations. By the mid-2000s some of these models showed a “divine coincidence”: targeting the best possible path for inflation, after an economic shock, would also result in the best possible path for unemployment.

Few economists think the divine coincidence holds in practice. New Keynesian models usually struggle to explain reality unless they are tweaked to incorporate, for example, at least some people with adaptive expectations. A cursory examination of the data suggests expectations follow inflation (they sank, for instance, after oil prices fell in late-2014).

| *Odd jobs*

Inflation has behaved strangely over the past decade. The recession that followed the financial crisis of 2007-08 sent American unemployment soaring to 10%. But underlying inflation fell below 1% only briefly—nothing like the fall that models predicted. Because the only way economists can estimate the natural rate is by watching how inflation and unemployment move in reality, they assumed that the natural rate had risen (an estimate in 2013 by Robert Gordon, of Northwestern University, put it at 6.5%). Yet as labour markets have tightened—unemployment was 4.3% in July—inflation has remained quiescent. Estimates of the natural rate have been revised back down.

Such volatility in estimates of the natural rate limits its usefulness to policymakers. Some argue that the wrong data are being used, because the unemployment rate excludes those who have stopped looking for work. Others say that the short-term Phillips curve has flattened as inflation expectations have become ever more firmly anchored. The question is: how long will they remain so? So long as low unemployment fails to generate enough inflation, central banks will face pressure to keep applying

stimulus. Their officials worry that if inflation suddenly surges, they might lose their hard-won credibility and end up back in 1980, having to create a recession to get inflation back down again.

This recent experience has led some to doubt the very existence of the natural rate of unemployment. But to reject the natural rate entirely, you would need to believe one of two things. Either central banks cannot influence the rate of unemployment even in the short term, or they can peg unemployment as low as they like—zero, even—without sparking inflation. Neither claim is credible. The natural rate of unemployment surely exists. Whether it is knowable is another matter.

LATER IN THIS SERIES: Overlapping generations ■



自然失业率

央行行长们的圣杯

“重大经济思想”系列之五——政策制定者花费半个世纪探寻自然失业率

失业现象为何存在？如果宏观经济学有一个核心问题的话，那就是它了。想要工作却无奈失业，那些蹉跎赋闲的时日最是浪费。失业会毁掉生活，破坏预算，倾覆政权。但政策制定者并没有对失业全面开战。大多只会像美国央行美联储那样，以实现能保持通胀稳定的“自然”失业率为目标。

这一概念的重要性毋庸置疑。例如，美联储最近加息的理据正是为防止失业率过分低于自然失业率。但从许多方面来看，自然失业率是一种信仰，人们一直在求索却从未得见。这概念到底从何而来？

失业就是无法根除，这有多方面原因。人们换工作需要时间，这会导致所谓的“摩擦性”失业。而当人们因为技能过时而找不到工作时，就可能陷入“结构性”失业——试想一下织布机面世后手工织匠的境遇。

但大多数央行人士最关注的是失业和通胀之间的权衡取舍。英国伟大的经济学家凯恩斯提出“非自愿性”失业的说法，向自然失业率假说迈出了第一步。大萧条后，凯恩斯在1936年出版了《就业、利息和货币通论》。他在书中指出，许多人无法以现行工资水平找到工作，即便他们的技能与在职者相当。古典经济学将之归咎于人为的高工资——也许是由工会造成的。但凯恩斯则指出是因为经济整体支出低迷。他推断说，即使工资下降，伴随着劳动者可支配收入减少，需求不足也将恶化。他认为出路是由政府管理总需求，以保持“充分”就业。

如今被冠以“凯恩斯主义”的理论并非完全源自凯恩斯。例如，他对失业的分析基本未涉及通胀问题。但到20世纪60年代后期，凯恩斯主义已与一种想法相关联——在管理总需求时，政策制定者不单是在选择失业率水平，同时也是在选择物价上涨的速度。

欧文·费雪（Irving Fisher）于1926年最早研究了通胀和失业之间的关系。但人们所知的“菲利普斯曲线”（Phillips curve）则得名于伦敦政治经济学院的威廉·菲利普斯（William Phillips）于1958年进行的一项研究。在研究中，他追踪了英国近一个世纪以来失业和工资增长之间的关系。他发现，在1861年至1957年间，这种关系相当稳定：失业率越低，工资增长越快。鉴于这一时期工人权利的极大变化，这种稳定性很惊人。1861年大部分工人没有选举权；到了1957年，战后工党政府已在英国经济的很多领域实施了国有化。

之后另外两位经济学大师保罗·萨缪尔森（Paul Samuelson）和罗伯特·索洛（Robert Solow）对这一关系在美国的情况作了研究，称不存在上述稳定关系。菲利普斯曲线变化不定。但萨缪尔森和索洛写道，在任何时代，“每当劳动力市场紧张时，工资水平的确倾向上涨，越是紧张涨得越快。”他们把这种关系比作一份“菜单”，这推动了一种认知，认为凯恩斯主义政策制定者的任务是在菲利普斯曲线上选取与其偏好最相符的一个点。换言之，失业率可降至什么程度完全取决于可容忍的通胀水平（因为工资上涨肯定也会推高价格）。

政策制定者是否真把通胀和失业之间的关系视为一份菜单，这不得而知。但这一观点直到20世纪60年代末仍备受瞩目，引来强烈的苛责。其两大批评者是埃德蒙·菲尔普斯（Edmund Phelps）和米尔顿·弗里德曼（Milton Friedman），两人后来都获得了诺贝尔奖。

菲尔普斯在1966年开始构思突破性的劳动力市场模型。一年后，弗里德曼在美国经济学会发表演说，对旧有思维模式做出了经典的批评。他在演说中表示，根本不存在什么菜单供政策制定者挑选，最终占主导的就是一种失业率——自然失业率。

弗里德曼分析道，假设央行试图通过印发货币来把失业率压低至自然失业率以下。这时货币供应的增加会推高支出。而由于产品需求上升，企业将扩大生产并提高价格——比方提高5%。这一通胀会令工人措手不及。其工资价值将低于当初协商劳动合同时争取到的工资水平。在一段时间内，劳

动力价值被人为压低了，这促进了雇用。失业率将降至低于自然失业率的水平。央行从而达成其目标。

然而，到下一次谈判工资时，工人会要求5%的薪酬升幅以恢复之前的生活水平。自上次定下实际工资以来，无论是企业还是工人的议价能力都没有改变，因此随着企业裁减员工来应对工资上涨，失业率将重新回到自然失业率的水平。为使失业率再次下降，央行可以再实施一轮宽松政策。但工人们不会再受愚弄。他们会预期通胀率为5%并提前要求相应地提高工资，而非总是慢央行一步，苦追不及。没有了意料之外的通胀，也就没有了意料之外的低廉劳动力。所以失业率不会下降。

这意味着什么？要让失业率低于自然失业率，央行必须不断加大力度，实现一次又一次的意外通胀。因此，弗里德曼认为，凯恩斯主义者把一个低失业率与一个特定的高通胀率挂钩是错误的。要保持失业率低于自然失业率，即便只是低一点，通胀也要每年都加速上升才行。弗里德曼和菲尔普斯主张的自然失业率后来被称为“非加速通胀失业率”（NAIRU）。

没有哪个社会能经受通胀无休止上升或下降。菲利普斯从数据中观察到一种关联性，但长远而言并不能为政策制定者所用。“通胀和失业之间总存在暂时性的取舍，”弗里德曼说，“不存在永久性的取舍关系。”近50年来，这一直是发达国家央行运作的前提。官员们谈及菲利普斯曲线时，所说的就是弗里德曼指出的暂时性取舍。他们相信，长期来看，失业率将会回归自然失业率的水平。

该理念影响力重大，部分原因是弗里德曼和菲尔普斯的理论实在恰逢其时。在1968年之前，美国有两年时间失业率低于4%而通胀率低于3%。但在弗里德曼发表演说时，市场价格确实加速上升：通胀在1968年升至4.2%，1969年更升至5.4%，而失业率基本不变。之后，70年代的“滞胀”打破了“稳定的菲利普斯曲线”之说。1973年至1979年间油价持续攀升，令通胀和失业率双双飙升。1975年，两者均超过8%；到1980年，失业率仍超过7%，通胀则升至13.5%。“非加速通胀失业率”的说法看起来也有些动摇：失业率过高，通胀本该是下降的。但弗里德曼的追随者可以辩称，是供给

方面的不当政策加上油价的冲击推高了“非加速通胀失业率”。

然而，大约同一时间，“非加速通胀失业率”的概念受到了理论家们的攻击。这一概念一定程度上基于通胀预期有“适应性”的观点：企业和工人会根据当前价值来预测通胀。但“理性预期”的原则却认定企业和消费者会最大程度地预见到政策制定者的行为。每当公众怀疑央行官员会试图将就业率压至低于自然失业率时，通胀会立即上升。另一方面，假如政策制定者做出可信的承诺，称不会追求不可持续的就业繁荣，那应该就能“锚定”人们的心理预期从而控制住通胀。

保罗·沃尔克（Paul Volcker）在1979年担任美联储主席后，将上述理论付诸检验。沃尔克决心抗击通胀。事实证明，他需要展示自己的胆量。他的紧缩货币政策（联邦基金利率在1981年升至近20%）造成经济二次探底，将失业率推高至10%以上。目标达成：通胀下滑了。自沃尔克执掌美联储以来，通胀率一般不超过5%。

直到今天，一些经济学家仍以沃尔克时期的衰退来证明通胀预期具有适应性。公众不相信只因美联储称通胀会下降，通胀就真的会下降。美国不得不以高失业率换取低通胀。最终，政策制定者还是得像弗里德曼和菲尔普斯所说的那样，必须解决短期菲利普斯曲线的问题。

然而，上世纪80年代的情形不会再现。在那之后的数十年里，各国央行纷纷致力于达到通胀目标。随着央行公信力提高，通胀率与失业率之间的取舍关系减弱。经济学家们创建了包含理性预期的“新凯恩斯主义”模型。到2005年前后，其中一些模型显现出“神迹般的巧合”：在经济震荡后，争取理想通胀率的最佳途径也是取得理想失业率的最佳途径。

但少有经济学家认为这种惊人的巧合真的会出现在现实中。新凯恩斯主义经济模式通常难以解释现实情况，除非经过改进，例如至少把具有适应性预期的一些人纳入考虑。对有关数据的粗略研究显示，通胀预期会遵循通胀的实际走势，例如，2014年下半年油价下跌后，通胀预期下降。

| 怪哉

过去十年，通胀走势表现怪异。2007年至2008年金融危机后的经济衰退使美国失业率上升至10%。但基础通胀仅短暂降至1%以下，完全没像模型预测的那样下跌。经济学者们估算自然失业率的唯一途径是观察通胀和失业率的实际变化，因此他们认为自然失业率已经上升，美国西北大学的罗伯特·戈登（Robert Gordon）在2013年的估计数字为6.5%。但目前劳动力市场虽然已经收紧——7月的失业率为4.3%，通胀却变化不大。对自然失业率的估计因此又被下调。

估算自然失业率时的这种波动限制了它对政策制定者的用处。有人认为，估算所使用的数据有误，因为失业率不包括那些已经停止找工作的人。也有人说，随着通胀预期变得越来越被牢固锚定，短期菲利普斯曲线已扁平化。问题是：这种态势会保持多久？只要低失业率不能造成足够的通胀，央行就会面临压力，需要不断推出刺激措施。央行官员们担心，假如通胀突然飙升，自己苦苦累积起的公信力可能就此崩塌，最终就要像1980年那样，不得不制造经济衰退，好再次压低通胀。

这一近期经历导致一些人怀疑自然失业率是否真的存在。但要完全否定自然失业率，你需要相信以下两者之一：即使在短期，央行也无法影响失业率；央行可以按自己的意愿压低失业率（甚至低至零）而不会引发通胀。但这两者都不可信。自然失业率必然存在。是否可知就是另一回事了。

本系列后续文章：《代际交叠》 ■



American history

Onward and upward

Technology and capitalism shaped America in unexpected ways after the civil war

“THE Oxford History of the United States” is one of the great achievements of modern historical scholarship. The series, which began appearing in 1982 and has since won three Pulitzer prizes, includes some exceptional individual volumes, such as James McPherson’s “Battle Cry of Freedom”, about the civil war, and David Kennedy’s “Freedom From Fear”, which covered the Depression and the second world war. It maintains a consistently high standard of excellence throughout and is notably better, on average, than the “Oxford History of England”. David Kennedy, the current series editor, deserves the highest praise.

Fans of the series have been waiting for the latest volume with particular eagerness. The era from 1865 to 1896 is obviously interesting in its own right: it takes America from the end of the civil war, when the South lay shattered, to the height of the gilded age, when America was taking over from Britain as the world’s mightiest economy. It is also interesting because of the parallels with our own times. This era saw the rise of great entrepreneurs who refashioned the material basis of civilisation with the discovery of efficient methods of producing steel and oil. It also saw a growing tension between the country’s egalitarian and individualistic traditions on the one hand, and its emerging business empires on the other. This tension gave rise to radical new political movements, such as populism and progressivism, and wild pendulum swings of political fortunes.

Richard White is well qualified to cover this tumultuous era. As the author of a fine book on America’s railways (“Railroaded: The Transcontinentals and the Making of Modern America”), he knows as much as anybody about

the most important technology of the era. As a professor at Stanford University, he can see the era from the perspective of the west coast as well as the east. Three great themes run through this sprawling narrative, which moves back and forth between politics, economics and political thought.

The first is that capitalism was never as triumphant in this era as its apostles claim. Contemporaries such as Ida Tarbell did a good job of demonising John D. Rockefeller and other tycoons as “robber barons”. Mr White applies the same technique to companies that those barons created. Alfred Chandler, the doyen of American business historians, and his followers argued that the great story of this era was the establishment of giant corporations, with their mastery of the logic of scale and scope, at the heart of the American economy. Mr White argues that these groups were deeply flawed. They were run by insiders who milked them for excess profits. They gained advantage by bribing politicians as well as producing new products.

The march of capitalism left a great deal of destruction in its wake. The settlers massacred both the Native Americans and the buffalo that had made their homes on the great American plains. The robber barons built their factories and railways without regard to the quality of the air or workers’ safety: in just one year, 1893, 1,567 railway workers were killed and 18,877 injured. The “creative” side of creative destruction did not necessarily compensate: Americans who were born during the gilded age were shorter and had a briefer lifespan than those born half a century earlier.

The second theme is the conflict between America’s conception of itself as a land of equal and self-reliant citizens and the reality of post-civil-war America. The North took up arms against the South in order to universalise the ideal of a republic based on free labour. It passed a succession of measures such as free land for settlers (provided they worked the soil for

five years) and public support for education in order to give the ideal flesh. But reality pulled in a different direction. The Confederacy all but re-enslaved the blacks in the iron cage of Jim Crow and prejudice. Giant organisations crushed small independent workshops. Some of the best passages in this book look at how Americans struggled with the contradictions between what they believed about the world and what stared them in the face.

The third theme is the unification of the country, as Americans gave up saying the United States “are” and began to say the United States “is”. The country became both bigger and smaller. Bigger because eastern settlers pushed ever westward, from the prairies to the Great Plains over the Rockies to the west coast, as epitomised by “American Progress”, which John Gast painted in 1872 (pictured). Smaller because the railway and the telegraph shrank distances. In 1865 it took months to travel from east to west. In 1895 you could make the same journey in days. At the same time the country turned on its axis. In the first half of the 19th century the flow of American trade was north-to-south via the coasts and river systems. In the second half of the 19th century, thanks to the arrival of the railways, it was increasingly from east to west.

At times, Mr White is so keen on exposing the destructive side of capitalism that he downplays the creative side. During this period America replaced Britain as the world’s most important economy. Great companies seized on new technologies and innovative management techniques to reduce the price of basic commodities, sometimes by as much as 90%, as in the case of steel and oil. And millions of people, many of whom came from Europe in boats, were given the chance of achieving the republican dream of a house of their own.

“The Republic for Which It Stands” should be read alongside more positive accounts such as Robert Gordon’s “The Rise and Fall of American Growth”,

which argues that productivity gains in this period laid the foundation of America's mass prosperity. But most of all Mr White's book should be read—not just because it has so much to say about the latter part of the 19th century, but also because it casts light on America's current problems with giant companies and roiling populism. ■



美国历史

攀登高峰

内战之后，技术和资本主义以意想不到的方式塑造了美国

《牛津美国史》（Oxford History of the United States）是现代历史学的一项伟大成就。该丛书自1982年起陆续出版，已获得三次普利策奖。其中有几册精彩绝伦，例如詹姆斯·麦克弗森（James McPherson）有关内战的《为自由而战的呐喊》（Battle Cry of Freedom），以及大卫·肯尼迪（David Kennedy）讲述大萧条和二战的《摆脱恐惧》（Freedom From Fear）。整套丛书始终保持卓越的水准，平均来看明显优于《牛津英国史》（Oxford History of England）。该丛书现任编辑大卫·肯尼迪理应得到至高赞誉。

很久以来，这套丛书的粉丝尤其期盼这最新一册的问世。很显然，1865年到1896年这一时期本身就引人入胜：从美国内战末期南方的一片残败开始，一直到镀金时代的高潮，美国超越英国成为世界上最强大的经济体。这一时期之所以有趣，还在于它与我们自己所处的时代颇有相似之处。伟大的企业家在那个时期登上历史舞台，发现了生产钢铁和开采石油的有效方法，从而重塑了文明的物质基础。在那时的美国，平等主义和个人主义传统与新兴商业帝国之间的矛盾也日益加剧。这种对立引发了民粹主义和进步主义等激进的新政治运动，以及政治命运剧烈的动荡交替。

要讲述这个动荡的时代，怀特完全可以胜任。他写过一本关于美国铁路的好书——《铺设铁轨：横贯美国的铁路和现代美国的形成》（Railroaded: The Transcontinentals and the Making of Modern America）。对于那个时代最重要的技术，他了如指掌。身为斯坦福大学的教授，他看待这段历史的视角得以超越东海岸而抵达西海岸。庞大的历史叙事在政治、经济和政治思想之间游走，三个宏大的主题贯穿其中。

首先是资本主义在这个时代取得的成就从未像其信徒宣称的那般巨大。与怀特同时期的艾达·塔贝尔（Ida Tarbell）等人成功地把约翰·洛克菲勒

和其他巨头妖魔化为“强盗大亨”，怀特对这些大亨创建的公司的描述如出一辙。美国商业历史学泰斗阿尔弗雷德·钱德勒（Alfred Chandler）和他的追随者则认为，这个时代的伟大成就是巨头公司的建立，它们掌握了经营规模和经营范围之道，成为美国经济的核心。怀特却认为这些公司有很大的缺陷，它们由内部人士经营，这些人从公司榨取超额利润。在生产新产品之外，巨头公司还靠贿赂政客获得优势。

资本主义大踏步前进，沿途造成巨大破坏。开拓者大肆屠杀世代以美国大平原为家的原住民和水牛。强盗大亨们修建了工厂和铁路，完全不顾空气质量或工人安全，仅在1893年一年里就有1567名铁路工人丧生，18,877人受伤。创造性破坏“创造性”的一面并不能完全提供补偿：镀金时代出生的美国人比半个世纪以前出生的人个子更小，寿命更短。

第二个主题是，美国自认为是平等和自力更生的公民的家园，但这与美国内战后的现实存在着冲突。为了全面实现基于自由劳动力的共和理想，北方拿起武器对抗南方。北方政府通过了一系列措施，如定居者可无偿拥有土地（只要在土地上耕作五年）、政府对教育给予支持，赋予该理想以实质内容。但现实却滑向了不同的方向。南方各州用《吉姆·克劳法》

（Jim Crow laws）和歧视铸成的牢笼几乎重新奴役了黑人。巨头公司压垮了个体小作坊。美国人对世界的看法与自身面临的现实相抵牾，为此他们纠结挣扎——这方面的描述是本书最精彩的部分之一。

第三个主题是国家的统一。美国人已经不再把他们的国家看作各州的集合，而将其视为一个统一的国家。国家变大了，也变小了。变大是因为东部定居者向西部推进，从大草原到大平原，再翻过落基山脉一直到西海岸，约翰·加斯特（John Gast）1872年的画作《美国的进步》（American Progress，见图）展现了这一进程。变小是因为铁路和电报缩短了距离。1865年，从东海岸去西海岸需要数月之久，到了1895年只需要几天。同时，美国发展的轴线也发生了变化。十九世纪上半叶，美国的贸易沿海岸和河流由北向南进行，到十九世纪下半叶，由于铁路的到来，逐渐变成从东向西展开。

有时，怀特一心要揭露资本主义的破坏性，而淡化了其创造性的一面。这一时期，美国取代英国成为世界上最重要的经济体。优秀大公司利用新技术和创新的管理方式降低了基本商品的价格，降幅有时高达90%，钢铁和石油就是如此。数百万移民（其中许多是从欧洲乘船来到美国）获得了实现共和梦想的机会——拥有一栋自己的房子。

《共和的象征》应该和罗伯特·戈登（Robert Gordon）的《美国增长的起落》（*The Rise and Fall of American Growth*）一起读——后者对那一时期有更积极的描述，认为那时的生产率增长为美国的大规模繁荣奠定了基础。但最重要的是，要读这本书。这不仅是因为它对十九世纪后半叶的历史阐述得如此详尽，还因为它为美国当前巨头公司垄断和民粹主义甚嚣尘上的问题带来了启示。■



Garment-making

Stitches in time

Sewing still needs human hands. But robot tailors are on their way

IN 1970 William J. Bank, president of the Blue Jeans Corporation, predicted that there would be a man on Mars before the production of apparel was automated. Almost half a century later, he has not yet been proved wrong. Viewed through the lens of history, this is astonishing. Spinning was one of the first processes to succumb to industrialisation. Weaving followed shortly afterwards. Cutting the resultant cloth into pieces from which an item is then assembled is easy now that patterns can be reduced to software. But, though effective sewing machines have been around since the 1840s, their activities still have to be guided by hand. The idea of putting a bolt of fabric into one end of an automated production line and getting completed garments out of the other thus remains as impossible as it was in Bank's day. Two American companies, however, think that they have cracked the problem, and that a system which can turn cloth into clothing without the need for tailors is just around the corner.

One of these aspiring firms, SoftWear Automation in Atlanta, Georgia, already makes machines, Sewbots, that can turn out towels, pillows, rugs, mats and other such essentially rectangular goods. SoftWear's boss, Palaniswamy Rajan, thinks Sewbots are almost ready to take the plunge with actual garments—in particular, with T-shirts. The other aspirant, Sewbo, which is based in Seattle, has made a T-shirt already, as a proof of principle, though it does not yet have a commercial production system.

The problem both firms are trying to overcome is that cloth is floppy and behaves unpredictably when pushed around. It is thus hard to align two pieces of it in a way that allows them to be sewn together accurately. The putative solutions the firms have come up with are, though, completely

different from one another. SoftWear Automation's approach has been to improve its sewing robots' ability to handle cloth—in essence, to make those robots more like human tailors. Sewbo's has been to make cloth itself easier for robots to handle.

SoftWear's Sewbots rely on two things: high-speed, high-resolution cameras able to monitor the movement of individual threads in a piece of cloth, and software that takes those movements and generalises them to describe the distortion and orientation of the fabric which the threads in question are part of. That permits a Sewbot to adjust the fabric appropriately as it is fed to the machine's needles. This feeding is done by a vacuum-powered robotic grip, which can be programmed to work with a variety of fabric sizes.

Sewbo's approach is to simplify the feeding process by stiffening the fabric. This is done by coating it with a thin layer of a plastic called polyvinyl alcohol before it gets anywhere near the needles. From then on, according to Jonathan Zornow, Sewbo's founder, it can be handled as sheets of metal might be in a car plant. Aligning such sheets so that they can be sewn together is easy. And, once a garment is completed, the plastic can be removed by soaking in warm water. This is a routine procedure, for polyvinyl alcohol is already used elsewhere in textile production to strengthen yarn during weaving.

That both Mr Rajan and Mr Zornow have their eyes on the T-shirt market is no coincidence. T-shirts are structurally simple and demand for them is huge. Both of these things make them ideal for automated mass production. Mr Rajan thinks SoftWear's Sewbot T-shirt assembly lines will be able to turn out 3,300 items a day. He hopes to start shipping them within two years. Twenty-one of them will go to a factory in Arkansas that belongs to Tianyuan Garments—a firm which is the largest producer of apparel for Adidas, a German sportswear firm.

Sewbo's plans—those that have been publicly announced, at least—are less specific. The company's demonstration T-shirt was made last year. Now, Mr Zornow says, they are refining their methods for various types of fabrics and industrial settings. Though the first use of fully automated tailoring will be for mass production, he foresees the technology becoming more specialised quite quickly. Removing the need for cheap human hands to assemble garments will permit factories to set up shop near customers in rich countries. That will allow rapid delivery to shops, and let retailers try things out in the knowledge that they can resupply successful lines almost instantly. In the longer run, the automation of garment-making may also usher in an era of “mass bespoke”, in which customers choose a style and have it made to fit their bodies in a way only haute couture or Savile Row can manage today. Whether that will happen before a human being walks on Mars remains to be seen. ■



服装制造

时光针脚

缝纫仍有赖于人的双手，不过机器人裁缝已经上路

一九七零年，蓝色牛仔裤公司（Blue Jeans Corporation）的总裁威廉·班克（William J. Bank）预言，人类登上火星要早于服装生产实现自动化。近半个世纪过去了，还不能证明他的预言是错的。从历史的角度来看，这十分惊人。纺纱是最早屈服于工业化的工艺流程之一，织布紧随其后。如今样式已经能简化为软件，把纺织好的布料剪裁成一片一片然后缝制成衣也就变得容易了。但是，尽管高效的缝纫机在19世纪40年代就已出现，它们仍需要人工操作。所以，把一匹布放到自动生产线的一端，在另一端得到成衣，这种想法依然无法实现，一如班克年轻时。然而，两家美国企业认为它们已经攻克了这个问题，它们相信很快就会诞生一个系统，无需裁缝就能把布料变成衣服。

这两家雄心勃勃的公司中的一家位于乔治亚州的亚特兰大市。SoftWear Automation制造的机器Sewbot（“缝纫机器人”）能够生产出毛巾、枕头、小毯子、地垫等大体上为长方形的物品。公司老板帕兰尼斯瓦米·拉詹（Palaniswamy Rajan）认为Sewbot差不多已准备好尝试生产真正的服装了，特别是T恤。另一家公司是位于西雅图的Sewbo，它已经做出了一件T恤来验证其原理，尽管还没有创建一个商业化的生产体系。

这两家公司都在试图克服一个问题：布是软的，当它被推来推去时状况无法预知。因此很难把两块布对齐以便准确缝合。不过两家公司提出的假定解决方案完全不同。SoftWear Automation的方法是提高缝纫机器人处理布料的能力——本质上就是让机器人更像人类裁缝。Sewbo则是让布料变得更容易由机器人处理。

SoftWear公司的Sewbot依靠两样东西：高速、高分辨率摄像头——能够监测一块布料上每根线的移动；软件——摄取相关动作并进行综合分析，指明这些线所构成的布料的变形情况和方向。这就让Sewbot在给缝纫机针送

布料时能够适当调整。这种送料动作由真空动力式机械手完成，可通过编程让这些手臂处理各种不同尺寸的布料。

Sewbo则通过硬化布料来简化送料流程。方法是在布料靠近机针前往上面涂上薄薄一层叫作聚乙烯醇的塑料。据Sewbo创始人乔纳森·佐诺（Jonathan Zornow）说，这之后，就可以像汽车厂加工金属板那样去处理布料了。对齐这些硬化过的布料并缝合就很容易了。而且，一旦缝制完成，可以用温水浸泡来去除这层塑料。这是一种常规工艺，纺织品生产的其他领域已经在使用聚乙烯醇在纺织中加强纱线的韧性。

拉詹和佐诺都着眼T恤市场，这并非巧合。T恤结构简单，需求巨大，这使它成为自动化批量生产的理想产品。拉詹认为，SoftWear的Sewbot生产线每天将能生产3300件T恤。他希望两年内将这些T恤逐步推向市场。其中的21条生产线将被安装在苏州天源服装公司位于阿肯色州的一家工厂内，该公司是德国运动服装品牌阿迪达斯的最大生产供应商。

Sewbo的计划（至少是那些已经公开宣布的）则没有那么明确。该公司的展示用T恤是去年制作的。佐诺说，现在他们正在为不同类型的面料和工业环境改进方法。虽然全自动裁剪将首先应用于大规模生产，但他预测这项技术将很快变得更加专门化。由于不再需要廉价劳动力来缝制服装，工厂就能在靠近富裕国家顾客的地方开展业务。这样就能实现快速送货到店，而零售商可以对各种货品少量进货以测试销量，因为他们知道那些热销品几乎能马上完成补货。从更长远来看，服装制造的自动化可能还会开启“大众定制”时代。到那时，服装风格将由客户选择，还有人为他们量体裁衣，而如今，这只有高级定制时装或萨维尔街（Savile Row）才能做到。至于这能否在人类登上火星之前实现，还有待观察。■



Digital labour

The human cumulus

Artificial intelligence will give rise to new forms of work

WHEN the first printed books with illustrations started to appear in the 1470s in the German city of Augsburg, wood engravers rose up in protest. Worried about their jobs, they literally stopped the presses. In fact, their skills turned out to be in higher demand than before: somebody had to illustrate the growing number of books.

Fears about the impact of technology on jobs have resurfaced periodically ever since. The latest bout of anxiety concerns the arrival of artificial intelligence (AI). Once again, however, technology is creating demand for work. To take one example, more and more people are supplying digital services online via what is sometimes dubbed the “human cloud”. Counter-intuitively, many are doing so in response to AI.

According to the World Bank, more than 5m people already offer to work remotely on online marketplaces such as Freelancer.com and UpWork. Jobs range from designing websites to writing legal briefs, and typically bring in at least a few dollars an hour. In 2016 such firms earned about \$6bn in revenue, according to Staffing Industry Analysts, a market researcher. Those who prefer work in smaller bites can use “micro-work” sites such as Mechanical Turk, a service operated by Amazon. About 500,000 “Turkers” perform tasks such as transcribing bits of audio, often earning no more than a few cents for each “human-intelligence task”.

Many big tech companies employ, mostly through outsourcing firms, thousands of people who police the firms’ own services and control quality. Google is said to have an army of 10,000 “raters” who, among other things, look at YouTube videos or test new services. Microsoft operates something

called a Universal Human Relevance System, which handles millions of micro-tasks each month, such as checking the results of its search algorithms.

These numbers are likely to rise. One reason is increasing demand for “content moderation”. A new law in Germany will require social media to remove any content that is illegal in the country, such as Holocaust denial, within 24 hours or face hefty fines. Facebook has announced that it will increase the number of its moderators globally, from 4,500 to 7,500.

AI will eliminate some forms of this digital labour—software, for instance, has got better at transcribing audio. Yet AI will also create demand for other types of digital work. The technology may use a lot of computing power and fancy mathematics, but it also relies on data distilled by humans. For autonomous cars to recognise road signs and pedestrians, algorithms must be trained by feeding them lots of video showing both. That footage needs to be manually “tagged”, meaning that road signs and pedestrians have to be marked as such. This labelling already keeps thousands busy. Once an algorithm is put to work, humans must check whether it does a good job and give feedback to improve it.

A service offered by CrowdFlower, a micro-task startup, is an example of what is called “human in the loop”. Digital workers classify e-mail queries from consumers, for instance, by content, sentiment and other criteria. These data are fed through an algorithm, which can handle most of the queries. But questions with no simple answer are again routed through humans.

You might expect humans to be taken out of the loop as algorithms improve. But this is unlikely to happen soon, if ever, says Mary Gray, who works for Microsoft’s research arm. Algorithms may eventually become clever enough to handle some tasks on their own and to learn by

themselves. But consumers and companies will also expect ever-smarter AI services: digital assistants such as Amazon's Alexa and Microsoft's Cortana will have to answer more complex questions. Humans will still be needed to train algorithms and handle exceptions.

Accordingly, Ms Gray and Siddharth Suri, her collaborator at Microsoft Research, see services such as UpWork and Mechanical Turk as early signs of things to come. They expect much human labour to be split up into distinct tasks which can be delivered online and combined with AI offerings. A travel agency, for instance, might use AI to deal with routine tasks (such as booking a flight), but direct the more complicated ones (a request to create a customised city tour, say) to humans.

Michael Bernstein of Stanford University sees things going even further. He anticipates the rise of temporary "firms" whose staff are hired online and configured with the help of AI. To test the idea, Mr Bernstein and his team developed a program to assemble such virtual companies for specific projects—for instance, recruiting workers and assigning them tasks in order to design a smartphone app to report injuries from an ambulance racing to a hospital.

Working in such "flash organisations" could well be fun. But many fear that the human cloud will create a global digital proletariat. Sarah Roberts of the University of California, Los Angeles, found that content moderators often suffer from burnout after checking dodgy social-media content for extended periods. Mark Graham of the University of Oxford concludes that platforms for online work do indeed offer new sources of income for many, particularly in poor countries, but that these services also drive down wages. So governments need to be careful when designing big digital-labour programmes—as Kenya has done, hoping to train more than 1m people for online jobs.

Technology is rarely an unalloyed bane or blessing. The printing press created new work for the wood engravers in Augsburg, but they quickly discovered that it had become much more repetitive. Similar trade-offs are likely in future. ■



数字劳动

人力积云

人工智能将催生新的工种

十五世纪70年代，世界上首批带插图的印刷书籍开始在德国奥格斯堡（Augsburg）出现，木刻工们群起抗议。他们担心自己饭碗不保，直接关停了印刷机。但实际上，对他们手工艺的需求比以往更大了：书越来越多，总得有人给它们加上插图。

自那时起，人们对技术影响就业的担忧隔一阵就发作一次，最近一波焦虑是因人工智能（AI）的到来而起。然而，技术又一次创造了对工作的需求。举个例子，越来越多人正通过一种有时被称作“人力云”的方式在网上提供数字服务。与人们的直觉相反，许多人正是因为人工智能而获得这些职位的。

根据世界银行的统计，已有五百多万人在Freelancer.com和UpWork这样的在线市场上提供远程服务。从设计网站到撰写诉讼简报，工作多种多样，服务提供者通常每小时至少能赚几美元。市场调查公司Staffing Industry Analysts的数据显示，2016年这类公司的年收入约达60亿美元。喜欢做零碎工作的人可以使用“微工作”网站，例如亚马逊运营的一项名为“土耳其机器人”（Mechanical Turk）的服务。约有50万“土耳其人”在做小段音频转文字之类的任务，他们从每项“人力智能任务”获得的收入一般不超过几美分。

许多大型科技公司雇用了成千上万的人来监督公司自身的服务、控制服务质量，主要是通过外包的公司。据说谷歌有一支由一万名“评分者”组成的队伍，他们观看YouTube视频、测试新服务，也做其他任务。微软运行的“通用人力关联系统”（Universal Human Relevance System）每月处理数百万个微任务，比如检查其搜索算法的结果。

这些数字很可能会上升。原因之一是“内容审核”需求的增加。德国的一项

新法律将要求社交媒体在24小时内删除所有该国视为非法的内容，如否认纳粹大屠杀，否则将面临巨额罚款。Facebook宣布会在全球范围内将其网页管理员的数量从4500人增加到7500人。

人工智能将淘汰某些形式的数字化劳动，比如软件在音频转录方面的能力已经提升。但人工智能也会创造出对其他类型的数字工作的需求。这项技术也许会用到大量的计算能力和复杂的数学运算，但也依赖由人提炼的数据。为了让自动驾驶汽车能识别出道路标志和行人，必须提供大量包含这两类元素的视频来训练算法。这样的视频需要手动加标记，也就是说必须把道路标志和行人分别标识出来。已有成千上万的人在为加标签这项工作而忙碌。一旦某种算法投入使用，必须要由人来检查它的效果，并给出反馈以便改进。

微任务创业公司CrowdFlower提供的一项服务就是所谓的“人机闭环”的一个例子。例如，数字工作者根据内容、情绪和其他标准对问询电子邮件进行分类。这些数据先被提供给一种算法，该算法可以处理大多数问询邮件，但那些没有简单答案的问题还是会再交给人类来解决。

你可能会认为，随着算法的改进，人类会从这种闭环中被剔除。但微软研究院的玛丽·格雷（Mary Gray）表示，这种情况即便真的会发生，也不会太快。算法最终也许会变得很聪明，足以独立处理一些任务并自主学习。但消费者和公司也将期待人工智能服务变得越来越智能：亚马逊的Alexa和微软小娜这样的数字助手要回答的问题会变得更复杂。人类仍需在训练算法和处理异常情况方面发挥作用。

因此，格雷和她在微软研究院的搭档西达尔特·苏瑞（Siddharth Suri）将UpWork和土耳其机器人等服务视作未来趋势的先兆。他们预计许多人类劳动将被拆分成不同的任务，这些任务可以在网上完成，并与人工智能服务结合起来。例如，旅行社可能会用人工智能来处理常规事务（比如预订航班），但会将更复杂的任务指派给人类（比如为客户量身定制一个城市的游览计划）。

斯坦福大学的迈克尔·伯恩斯坦（Michael Bernstein）认为变化还会更剧烈。他预计临时“公司”会兴起，它们将在人工智能的帮助下，在网上招聘员工及完成人力配置。为了验证这一想法，伯恩斯坦和他的团队制定出一个计划，为具体的项目组建这样的虚拟公司，比如招募员工并给他们分配任务，目标是设计一款智能手机应用，能在往医院飞驰的救护车里报告伤情。

在这样的“快闪机构”中工作可能会很有趣。但许多人担心人力云会创造出一个全球数字无产阶级。加州大学洛杉矶分校的莎拉·罗伯茨（Sarah Roberts）发现，内容审查员在长时间检查可疑的社交媒体内容后，经常会感到精疲力竭。牛津大学的马克·格雷厄姆（Mark Graham）认为，在线工作平台确实为许多人提供了新的收入来源，特别是在贫穷国家，但这些服务也会拉低工资。所以政府在策划大型数字劳工项目时需小心谨慎，如肯尼亚所做的那样，该国希望为在线岗位培训一百多万人。

科技极少会是纯粹的祸害或纯粹的幸事。印刷机为奥格斯堡的木刻工创造了新的工作，但他们很快发现工作的重复性大大增加了。未来可能会出现类似的得与失。■



Economic and financial indicators

South Africa's economy

GDP growth has plummeted over the past six years

GDP growth has plummeted over the past six years. Despite significant social transfers, which accounted for 16% of government spending in 2016, inequality is rife. The top income quintile earns almost 40 times more than the bottom. A proposed increase in the minimum wage should reduce poverty among low-skilled workers. But the impact it will have on employment is unclear. ■



经济和金融指数

南非经济

过去六年来GDP增速急剧下降

过去六年来GDP增速急剧下降。尽管发放了大量社会救助福利——占到2016年政府支出的16%，不平等现象仍十分普遍。收入排在前五分之一的人的所得是末尾五分之一的近40倍。提高最低工资的提案应该会缓解低技术工人的贫困状况，但对就业的影响尚不清楚。 ■



Drug firms

Pharma frenemies

A rush for immunotherapy drugs means new bedfellows

THE modern pharmaceutical firm lives or dies on the strength of its drug portfolio. As patents expire on lucrative medicines, they must replace the income that has been lost by inventing new drugs, or buying them in from outside. Both paths are expensive. But the costs of failure are greater, and this is how it was possible for a large and successful firm—such as British-based AstraZeneca—to shed 15% of its market value in a single day in late July. Around £10bn (\$13.2bn) was lost on news of disappointing results in one of its clinical trials (its shares have since rebounded by 4%).

The trial was to find out if a pair of drugs would treat a form of lung cancer. The drug, Imfinzi, and the experimental drug tremelimumab, belong to a new category of immunotherapy medicines called “checkpoint inhibitors”. Similar drugs are made by Bristol Myers Squibb (BMS), by Merck in America and Roche, a Swiss firm. In an interim finding, it was reported that Astra’s combination did not offer an improvement over therapies already on the market. John Rountree, a partner with Novasecta, a consultancy, says the results suggest it is still early days for immuno-oncology R&D, not that there is something wrong with the technology. Last year, BMS lost 16% of its market value after a failed trial of Opdivo, another checkpoint inhibitor, in lung cancer.

The promise of these drugs means the market has become crowded. It is harder for later entrants such as AstraZeneca, whose drug Imfinzi is the fifth checkpoint inhibitor that came to market, but it has a wide portfolio of good immuno-oncology drugs, which means it can offer these in combinations—something that is expected to offer a therapeutic benefit to patients.

Yet as the number of checkpoint inhibitors and immunotherapy drugs rises, the number of such potential combinations of treatments is growing (see chart), which could mean many expensive clinical trials for pharma companies. They must decide how to obtain the best sets of drugs. Mergers and acquisitions to get the right treatments look expensive (research from Novasecta found that last year the median price of a pharma firm was 39 times its revenue, compared with 19 times in 2015 and 8 times in 2014).

Instead, pharma firms that have competed fiercely for decades have decided that sometimes it is better to co-operate. In late July, Merck bought half the rights to AstraZeneca's Lynparza in a deal worth \$8.5bn. The firms will co-develop and sell a drug known as a "PARP inhibitor". It will be developed in combination with checkpoint inhibitors made by both firms. In January this year Merck also expanded its existing collaboration with Eli Lilly to study how the drug Lartruvo, a targeted cancer drug, acts with Merck's Keytruda. On July 25th Eli Lilly said it will out-license or co-develop one-third of its oncology pipeline. There are many more examples.

The industry is convinced that collaboration is needed in immuno-oncology, reckons McKinsey, a consulting firm. Working together is an effective way to mix laboratory talent and to bring medicines to patients, adds Mr Rountree. It is evidence of this drive to find combinations of drugs that most of the hundreds of trials of the top two checkpoint inhibitors on the market are led by firms or institutions other than the company that actually owns the drug, says McKinsey.

If the collaborations turn out to work, the industry will have advanced in two important ways. First, it would mean that pharma has found a way to create value for its shareholders aside from the expensive and unpredictable route of M&A. Second, the deals could drive efficiency in an industry that is struggling with productivity. Studies show that pharma productivity (measured by the number of new molecular entities created

per billion dollars of investment) has been declining for most of the industry's history. There is no denying that the deals are complex to arrange, legally speaking, but being awkward frenemies could be worth it. ■



制药企业

药企亦敌亦友

药企对免疫疗法药物趋之若鹜，新的伙伴关系随之出现

现代制药企业的生死系于其旗下药品的“阵容”之上。当利润丰厚的药品专利到期，企业就必须发明新药或从外部买进专利，以弥补失去的收入。这两种途径都代价不菲。然而一旦新药发明失败，代价就更大，这就是为什么像总部位于英国的阿斯利康（AstraZeneca）这样的大型成功企业会在7月底的一天之内市值蒸发15%——由于一次临床试验失败的消息传出，公司损失了大约100亿英镑（132亿美元），不过之后其股价已反弹了4%。

那次试验是要弄清两种配对组合的药物是否能够治疗一种肺癌。药物Imfinzi和实验性药物tremelimumab同属一类叫作“免疫检查点抑制剂”的新型免疫疗法药物。百时美施贵宝（Bristol Myers Squibb）、美国的默沙东（Merck）以及瑞士罗氏（Roche）等企业也在生产类似的药物。据一份中期报告称，阿斯利康的药物组合相比现有疗法并没有更好的疗效。咨询公司Novasecta的合伙人约翰·朗特里（John Rountree）表示，该试验结果表明肿瘤免疫学的研发仍处于起步阶段，而不是存在技术问题。去年，百时美施贵宝的另一种治疗肺癌的免疫检查点抑制剂Opdivo试验失败，导致公司市值损失16%。

这类药物的广阔前景已令这一市场变得拥挤。像阿斯利康这样的后来者处于劣势——该公司的Imfinzi是第五个获批上市的免疫检查点抑制剂。但是阿斯利康有相当丰富的肿瘤免疫良药，也就是说它可以将这些药物加以组合——人们预期这种方式会为患者带来疗效。

然而，随着免疫检查点抑制剂和其他免疫疗法药物的增加，可能的组合疗法数量也呈上升趋势（见图表），这也许意味着药企要进行很多次昂贵的临床试验。它们必须决定如何获得最佳药物组合。为得到有效治疗方案而展开并购似乎代价高昂（Novasecta的研究发现，去年收购一家药企的中位价是其收入的39倍，而在2015年为19倍，2014年为8倍）。

激烈竞争了几十年的制药企业已经意识到，有时合作才是上策。7月底，在一笔价值85亿美元的交易中，默沙东买下了阿斯利康的药物Lynparza一半的所有权。两家公司会合作研发和销售一种“PARP抑制剂”药物——它们会基于该药物与各自己有的免疫检查点抑制剂的联合疗效来研发这种药。今年1月，默沙东还扩大了它与礼来（Eli Lilly）的合作，以研究靶向抗癌药Lartruvo与默沙东的Keytruda联合使用的效果。7月25日，礼来表示将把三分之一的在研肿瘤药物对外授权或共同研发。类似的例子不胜枚举。

咨询公司麦肯锡认为，制药行业已确信在免疫肿瘤学方面合作是必要的。朗特里也表示，合作是汇集研究人才并为患者带来良药的有效途径。麦肯锡指出，就市面最好的两种免疫检查点抑制剂进行的数百次试验中，绝大多数都由其他企业或者研究机构牵头，而非由实际拥有该药物的公司负责，足见人们对探求药物的热衷。

如果这种合作见效，制药行业将在两个重要方面有所改进：第一，在代价高昂而又充满变数的并购之外，药企已找到另一个途径为股东创造价值；第二，对陷于生产率困境的制药行业，这些合作可以提高效率。研究表明，从行业历史来看，药企的生产率（以每十亿美元投资所创造的新分子实体的数量来衡量）大多时候都呈下降之势。不可否认，从法律上说，达成合作很复杂，但建立这种别扭的、亦敌亦友的关系还是值得的。■



Nuclear energy

Putting to sea

Atomic power stations that float on the ocean or are anchored beneath it may have advantages over those built on land

AFTER the events of March 11th 2011, when an earthquake and tsunami led to a meltdown of three nuclear reactors at the Fukushima Dai-ichi power plant in Japan, you might be forgiven for concluding that atomic power and seawater don't mix. Many engineers, though, do not agree. They would like to see more seawater involved, not less. In fact, they have plans to site nuclear power plants in the ocean rather than on land—either floating on the surface or moored beneath it.

At first, this sounds a mad idea. It is not. Land-based power stations are bespoke structures, built by the techniques of civil engineering, in which each is slightly different and teams of specialists come and go according to the phase of the project. Marine stations, by contrast, could be mass-produced in factories using, if not the techniques of the assembly line, then at least those of the shipyard, with crews constantly employed.

That would make power stations at sea cheaper than those on land. Jacopo Buongiorno, a nuclear engineer at the Massachusetts Institute of Technology, reckons that, when all is done and dusted, electricity from a marine station would cost at least a third less than that from a terrestrial equivalent. It would also make them safer. A reactor anchored on the seabed would never lack emergency cooling, the problem that caused the Fukushima meltdown. Nor would it need to be protected against the risk of terrorists flying an aircraft into it. It would be tsunami-proof, too. Though tsunamis become great and destructive waves when they arrive in shallow water, in the open ocean they are mere ripples. Indeed, were it deep enough (100 metres or so), such a submarine reactor would not even be affected by

passing storms.

| *Water power*

All these reasons, observes Jacques Chénais, an engineer at France's atomic-energy commission, CEA, make underwater nuclear power stations an idea worth investigating. Dr Chénais is head of small reactors at CEA, and has had experience with one well-established type of underwater reactor—that which powers submarines. He and his team are now assisting Naval Group, a French military contractor, to design reactors that will stay put instead of moving around on a boat. The plan is to encase a reactor and an electricity-generating steam turbine in a steel cylinder the length of a football pitch and with a weight of around 12,000 tonnes.

The whole system, dubbed Flexblue, would be anchored to the seabed between five and 15km from the coast—far enough for safety in case of an emergency, but near enough to be serviced easily. The electricity generated (up to 250 megawatts, enough for 1m people) would be transmitted ashore by an undersea cable. For refuelling and maintenance unmanageable from a submarine, the cylinder would be floated to the surface with air injected into its ballast tanks. And, when a station came to the end of its useful life, it could be towed to a specialist facility to be dismantled safely, rather than requiring yet another lot of civil engineers to demolish it.

Naval Group has not, as yet, attracted any customers for its designs. But a slightly less ambitious approach to marine reactors—anchoring them on the surface rather than below it—is about to come to fruition in Russia. The first such, *Akademik Lomonosov*, is under construction at the Baltic Shipyard, in St Petersburg (see picture). According to Andrey Bukhovtsev of Rosatom, the agency that runs Russia's civil nuclear programme, it is 96% complete. It will be launched later this year, towed to Murmansk, and thence transported to Pevek, a port in Russia's Far East, where it will begin generating power in 2019.

Akademik Lomonosov consists of two 35MW reactors mounted on a barge. The reactors are modified versions of those used to power *Taymyr*-class icebreakers. As such, they are designed to be able to take quite a battering, so the storms of the Arctic Ocean should not trouble them. To add to their safety, the barge bearing them will be moored, about 200 metres from shore, behind a storm-and-tsunami-resistant breakwater.

Altogether, *Akademik Lomonosov* will cost \$480m to build and install—far less than would have to be spent constructing an equivalent power station on land in such a remote and hostile environment. And, on the presumption that the whole thing will work, plans for a second, similar plant are being laid.

Nor is Russia alone in planning floating reactors. China has similar ambitions—though the destinations of the devices concerned are more controversial than those of Russia's. Specifically, the Chinese government intends, during the 2020s, to build up to 20 floating nuclear plants, with reactors as powerful as 200MW, to supply artificial islands it is building as part of its plan to enforce the country's claim to much of the South China Sea—a claim disputed by every other country in the area.

The firms involved in this project intend to tsunami-proof some of their reactors in the same way as the French, by stationing them in water too deep for massive tsunami waves to form. Because they are at the surface, though, that will not save them from storms—and locating them far from shore means the Russian approach of building sheltering breakwaters will not work either. That matters. Typhoons in the South China Sea can whip up waves with an amplitude exceeding 20 metres.

To withstand such storms, the barges will have anchors that are attached to swivelling “mooring turrets” under their bows. These will cause a barge to behave like a weather vane, always pointing into the wind. Since that is the

direction waves come from, it will remain bow-on to those waves, giving it the best chance of riding out any storm that nature cares to throw at it. The barges' bows will also be built high, in order to cut through waves. This way, claims Mark Tipping of Lloyd's Register, a British firm that is advising on the plants' design, they will be able to survive a "10,000-year storm".

The South China Sea is also a busy area for shipping, so any floating power stations there will need to be able to withstand a direct hit by a heavy-laden cargo vessel travelling at a speed of, say, 20 knots—whether that collision be accidental or the result of hostile action. One way to do this, says Chen Haibo, a naval architect working on the problem at Lloyd's Register's Beijing office, is to fit the barges with crumple zones packed with materials such as corrugated steel and wood.

Not everyone is delighted with the idea of marine nuclear power. Rashid Alimov, head of energy projects at Greenpeace Russia, an environmental charity, argues that offshore plants could be boarded by pirates or terrorists, be struck by an iceberg or might evade safety rules that are hard to enforce at sea. On July 21st Greenpeace scored a victory when Rosatom said that *Akademik Lomonosov's* nuclear fuel would be loaded in an unpopulated area away from St Petersburg.

That, though, is a pinprick. The future of marine nuclear power stations is more likely to depend on the future of nuclear power itself than on the actions of pressure groups such as Greenpeace. If, as many who worry about the climate-changing potential of fossil-fuel power stations think, uranium has an important part to play in generating electricity over coming decades, then many new nuclear plants will be needed. And if that does turn out to be the case, siting such plants out at sea may well prove a good idea. ■



核能

出海

浮在海面或拴在海底的核电站可能会比陆地上的同类更具优势

2011年3月11日，一场地震和海啸导致日本福岛第一核电站的三座核反应堆熔毁。假如你由此得出结论，称核能和海水不能搅和在一起，那也是情有可原。但许多工程师并不这么想。他们希望掺和进来的海水更多些，而不是更少。实际上，他们已经有各种计划，在海上而非陆地上建造核电站。这些核电站或是漂浮在海面上，或是停泊在海面下。

乍一听，这太疯狂了。实则不然。陆上发电站是倚赖土木工程技术建造的定制结构，每座都略有不同，在工程的不同阶段会有各种专家团队来来往往。海上发电站则不同，它们可以在工厂里批量建造，使用的即便不是流水线作业技术，也至少是造船厂的那类技术，而员工是固定的。

这会让海上发电站比陆上发电站的造价更便宜。麻省理工学院的核电工程师雅各布·布翁焦尔诺（Jacopo Buongiorno）认为，建成后，海上发电站提供的电力价格将比陆上发电站便宜至少三分之一。前者也更安全。一座被锚定在海床上的反应堆永远不缺紧急冷却，而冷却系统失灵正是福岛核电站反应堆熔毁的原因。它也无需防范恐怖分子会驾着飞机撞过来。它还能防海啸——虽然海啸在抵达浅水区时会变成破坏性的巨浪，但在广阔的海域它们只是些微的涟漪。实际上，假如在海面下足够深的地方（100米左右），这样的水下反应堆甚至不会受到过路风暴的影响。

| 借助海水

法国原子能和替代能源委员会（CEA）的工程师雅克·舍奈（Jacques Chénais）认为，所有这些好处使得水下核电站成为一个值得探索的创意。舍奈博士在该委员会主管小型核反应堆部门，在为潜水艇供电这类技术成熟的水下反应堆方面颇有经验。他和团队目前正辅助法国军事承包商海军集团（Naval Group）设计一些反应堆，它们会静止不动，而不是被装在船上四处移动。方法是把一个反应堆和一台发电的蒸汽轮机装在一

个钢筒里，这个钢筒有一个足球场那么长，重约1.2万吨。

这整套名为Flexblue的系统会被固定在距海岸5至15公里处的海底。它离陆地足够远，可以确保紧急事故时的安全性，但又足够近而方便维护。它产生的电力（可多达250兆瓦，够一百万人使用）会通过一根海底电缆传到岸上。遇到在潜艇内无法完成的更换燃料或维修任务，可以往钢筒的压载舱注入空气，让钢筒浮到海面上。而当一座发电站寿终正寝时，可以将它拖到一个专门的设施里安全拆解，而不需要再找一批土木工程师来拆除它。

海军集团的这一设计目前尚未吸引到客户。但一个略微保守些的海上反应堆设计方式即将在俄罗斯见到成效——将它们固定在水面之上而非之下。首个此类反应堆“罗蒙诺索夫院士号”（Akademik Lomonosov）正在圣彼得堡的波罗的海造船厂（Baltic Shipyard）内建造（见图）。据运营俄罗斯民用核能项目的俄罗斯国家原子能公司（Rosatom）的安德雷·布霍夫采夫（Andrey Bukhovtsev）称，该反应堆已经完成了96%。它将在今年稍晚些时候下水，被拖至摩尔曼斯克，从那里再被运到俄罗斯远东区的佩韦克港口，自2019年起开始发电。

“罗蒙诺索夫院士号”由装载在一艘驳船上的两座35兆瓦反应堆组成。它们是那些用来为泰梅尔（Taymyr）级破冰船供电的反应堆的改版，其设计令它们能够承受住相当大的撞击，因而北冰洋上的风暴应该不是问题。为增加安全性，承载它们的驳船会被锚定在一座可抗风暴和海啸的防波堤的后方，距海岸约200米远。

建造并安装“罗蒙诺索夫院士号”总共将花费4.8亿美元，远少于在偏远陆地上建造一座能抵抗同等恶劣环境、规模相当的核电站的费用。人们认为整个项目能够行得通，已经在规划第二座类似的核电站。

俄罗斯也不是唯一一个筹建浮动反应堆的国家。中国也有类似的抱负——不过相关设备的目的地比俄罗斯的更具争议。具体来说，中国政府计划在本世纪20年代建造多达20座浮动核电站，反应堆功率可达200兆瓦，为该

国正在南海上建造的人工岛屿供电。这些岛屿是中国计划对南海大部分海域行使主权主张的一部分，虽然这一主张遭到区域内所有其他国家的反对。

参与这一项目的公司计划也用法国人那种方式来让部分反应堆防范海啸，即把它们固定在海水深到无法形成巨大海啸波的地方。但因为它们是漂浮在水面上，这并不能帮助它们防范风暴。而且把它们建在远离海岸的地点，还意味着无法使用像俄罗斯那样建造庇护用的防波堤。这并非无关紧要。南海的台风掀起的海浪可超过20米。

为扛住这样的风暴，驳船上会有锚系在船头下方可旋转的“系泊转塔”上。这会使得驳船像风向标一般，永远朝向风吹来的方向。因为这是海浪扑来的方向，所以船会一直正面迎击海浪，让它能有最大可能征服大自然掀起的任何风暴。驳船的船头也会建得很高，有助于它乘风破浪。如此一来，这些核电站将能扛过“万年一遇的风暴”，英国劳氏船级社（Lloyd's Register）的马克·蒂平（Mark Tipping）说。该组织为这些核电站的设计提供咨询。

南海也是一个繁忙的航运海域，因此任何漂浮在那里的发电站都需要能承受高负载货船（比如以20海里的速度行驶）的直接撞击，无论是因为纯粹的事故还是由敌对行为所引发。在劳氏北京办事处研究相关问题的造船工程师陈海波说，一个解决办法是在驳船上设置填充波形钢板和木头这类材料的防撞缓冲区。

不是所有人都对海上核电站这个主意感到欣喜。环保慈善组织“绿色和平”俄罗斯分部能源项目主管拉希德·阿利莫夫（Rashid Alimov）表示，海上核电站可能会遭遇海盗或恐怖份子登船，可能被冰山撞击，也可能违反难以在海洋上执行的安全条例。7月21日，“绿色和平”取得了一项胜利——俄罗斯国家原子能公司称，将在远离圣彼得堡的一个无人区域为“罗蒙诺索夫院士号”装载核燃料。

不过这只是个小波澜。海上核电站的未来将更多地系于核电站自身的前

景，而不是靠“绿色和平”等组织施压。假如，就像许多担心化石燃料发电站会改变气候的人所预期的那样，未来几十年铀将在发电中发挥重要作用，那么就需要兴建大量的核电站。果真如此，那么把这类发电站投放到茫茫大海中很可能是个好主意。 ■



Maritime construction

Building under water

Marine contractors offer lessons to builders on dry land

THE *Innovation*, a 147-metre ship docked in Rotterdam, looks like a cross between an oil rig and a robot from a “Transformers” film. Her crane has been loading on giant pipes throughout the night. Soon the ship will travel to sea, where an automated hammer will drive the pipes into the ocean floor to support wind turbines. “Everything in our industry has become larger,” says Koen Vanderbeke of DEME, a Belgian dredging firm that owns the ship. “But we’ve become smarter, too.”

Unlike their counterparts on dry land, marine contractors have made big leaps in productivity in recent years. From dredging and land reclamation to offshore construction of oil platforms, costs have dropped even as the speed and quality of work have increased. In Belgium, home to two of the world’s five biggest dredgers, efficiency gains have been so large that they have skewed productivity figures for the entire building sector.

The improvements can be traced to industry consolidation and investment—things that have eluded most onshore builders. These trends have been spurred by large, demanding customers (usually governments and energy firms), as well as by the greater need for precision at sea, where a tiny slit in an oil pipe can prompt a catastrophe. As important, maritime projects have become so large and complex that firms often have no choice but to use machines rather than labour.

About 25 years ago the sector was fragmented. That changed as the ambitions of customers increased. Mergers and natural expansion resulted in five leaders: DEME and Jan De Nul in Belgium, Boskalis and Van Oord in the Netherlands and CHEC in China. The cost of a big ship, around €200m

(\$234m), and a persistent need to invest ensure that only the giants survive.

Mechanical improvements such as pumps and suction devices mean dredging ships can now break through harder material. Much manual work has been automated, from the placement of piles to the steadying of ships—GPS-guided bow thrusters have replaced anchors. As ships work in deeper, colder waters, underwater robots have supplanted divers.

Monitoring may be the biggest change. “We now measure everything,” says DEME’s Mr Vanderbeke, gesturing to the antennas on *Innovation’s* mast. Sensors track how fast the hammer is pounding, what the crane is up to, activity on the seabed and how these things interact. Such surveillance, complemented by computer simulations, helps avoid mistakes.

Another productivity-enhancer has been modular building which, both on land and at sea, can speed up construction. DEME is building an 8.6km-long quay in Singapore, using watertight concrete chambers made in a factory on land. “With the old method, you’d hammer each sheet pile,” says Alain Bernard, the firm’s boss.

Offshore productivity gains are now so big that they have changed the economic calculus for land itself. Cheaper dredging makes land reclamation more attractive. “In Amsterdam you pay around €1,000 for a square metre of land; we can now make new land in shallow water for just €300 per square metre,” says Pieter van Oord of Van Oord. In seaside cities such as Jakarta and Singapore, where land prices are up to ten times higher, the business case is even stronger. “You do the math.” ■



海上建筑工程

水下建设

海上承包商为陆上建筑者提供经验

停靠在鹿特丹的创新号（Innovation）船长147米，看上去像是钻井平台和《变形金刚》电影里机器人的混合体。船上的起重机通宵达旦地把巨大的钢管装载上船。这艘船不久就将出海，在海上，自动锤会把钢管打进海床，用来支撑风力涡轮机。创新号属于比利时疏浚企业德米集团（DEME），该公司的柯恩·凡德贝克（Koen Vanderbeke）表示：“我们行业中的一切都变大了，但我们也变得更智能了。”

与陆地上的同行不同，近年来海上承包商的生产率实现了重大飞跃。从疏浚和填海造地到海上钻井平台的建设，成本都在下降，而施工速度和质量却在提高。世界五大疏浚企业中有两家位于比利时，该国的海上建设效率提升幅度极大，乃至影响了整个建筑行业的生产率数据。

这些提升可以归因于行业整合与投资，而这些正是大多数陆上建筑商所欠缺的。这些趋势的驱动力来自苛刻的大客户（通常是政府和能源公司），以及海上项目对精确性的更高要求——在海上，油管上一个小裂缝都会引发大灾难。同样重要的因素是，海上项目变得非常庞大和复杂，公司经常别无选择，只能使用机器而非人力。

大约25年前，这个行业支离破碎。随着客户的抱负变得日益宏大，情况发生了变化。并购与自然扩张造就了五大巨头：比利时的德米集团和杨德努（Jan De Nul）、荷兰的波斯卡利斯（Boskalis）和范奥德（Van Oord），以及中国港湾工程有限责任公司。一艘大船的成本约为2亿欧元（2.34亿美元），此外还需要持续投资，因而只有巨头才能生存。

由于泵和抽吸设备等机械的改进，如今疏浚船舶能突破更坚硬的物质。从打桩到保持船的稳定（GPS导航的艏侧推已经取代了锚），许多体力劳动已经自动化。船舶在更深、更冷的水域作业时，水下机器人取代了潜水

员。

监测工作可能变化最大。“我们现在什么都测量。”德米集团的凡德贝克对着创新号桅杆上的天线比划道。传感器追踪打桩锤的击打速度、起重机在做什么、海底的动静以及这些因素的相互作用。这样的监控辅以计算机模拟，可以帮助避免错误。

另一个提高生产率的因素是模块化建筑。无论陆上还是海上，模块化建筑都能加快施工速度。德米集团正在新加坡修建一个长8.6公里的码头，工程采用了陆上工厂生产的水密混凝土室。“用老办法的话，你得一个一个地锤打板桩。”公司老板阿兰·贝尔纳（Alain Bernard）说。

现在，海上施工的生产率提升如此之大，甚至改变了对土地本身的成本计算。疏浚成本降低增加了填海造地的吸引力。范奥德的彼得·范奥德（Pieter van Oord）说：“在阿姆斯特丹，每平方米土地需要支付大约1000欧元，现在我们在浅水中造地，每平方米只要300欧元。”在地价还要高出近十倍的雅加达和新加坡等海滨城市，这在商业上就更有说服力了。“你自己算算看。”■



The business of airports

Losing altitude

Boring shops, tighter security and ride-hailing are hurting airports' profits

WHEN Heathrow airport opened, in 1946, the only retail facilities were a bar with chintz armchairs and a small newsagent's. The first terminal was a tent, a far cry from the four halls, resembling vast shopping malls, at the London airport today. Retail spending per passenger is the highest of any airport. This summer's consumer crazes include Harry Potter wands and cactus-shaped lilos.

Heathrow's journey from waiting room to retail paradise is the story of many airports. Before the 1980s, most income came from airlines' landing and passenger-handling charges. Then "non-aeronautical" revenue—from shops, airport parking, car rental and so on—rose to around two-fifths of their revenues, of \$152bn worldwide in 2015. But amid signs that non-aeronautical income is peaking, especially in mature aviation markets such as North America and Europe, the industry fears for its business model.

When airports were state-owned, and run not for profit but for the benefit of the local flag-carrier, such ancillary income was less important. Airports in Asia, Africa and the Middle East still operate like this. Globally, two-thirds lose money; the share is 75% in China and 90% in India. But most airports in Europe and the Americas have to pay their own way.

Britain led the way with privatisation in the 1980s. Canada leased its major airports to private-sector entities in 1994, and is now considering whether to sell them completely. Squeezed state budgets in America mean that most publicly owned airports are managed by arms-length organisations that must break even. And a wave of privatisation is sweeping Europe, where nearly half of terminal capacity is now owned by the private sector. France's

main airports in Paris are still partly in state hands, but Emmanuel Macron, the president, aims to sell the rest. Latin American countries are following closely behind.

Their timing may be off. Although passenger numbers are still booming—growing worldwide by 6.3% last year, according to IATA, an airline-industry group—non-aeronautical revenues per person are falling across North America and Europe, a trend that is offsetting some of the rise in aeronautical revenues from higher passenger numbers.

On the retail side, some temporary factors are at work, such as a crackdown on corruption by Xi Jinping, China's president, which has crimped sales of luxury items to high-spending Chinese. Extra security checks introduced after a run of terror attacks have cut passengers' shopping time, and that may change in future.

Yet there are structural causes too. Tyler Brûlé, an airport-design guru and editor-in-chief of *Monocle*, a British magazine, notes that the duplication of nearly identical duty-free and luxury-goods outlets at airports across the world has left many passengers unexcited by the range of items on offer. The demographics of regular flyers, which have shifted towards people with less money to spare, have not helped. At the start of the year, Aéroports de Paris, Frankfurt airport and Schiphol airport, in Amsterdam, announced drops in spending per passenger in 2016 of around 4-8%.

Under even greater threat, especially in North America, is income from car parks, which makes up two-fifths of non-aeronautical revenues across the continent, and car-rental concessions, which brings in a further one-fifth. At European airports the shares are 20% and 3% respectively (see chart). These businesses are being disrupted by ride-hailing apps, mainly Uber and Lyft, which make travel by taxi more affordable compared with renting or parking a car at the airport. In the past year, revenues from parking have

fallen short of forecast budgets by up to a tenth, airport managers say, and next year they expect worse results. Many airports at first tried to ban Uber's and Lyft's cars from their taxi ranks, but drivers found a way round it, in some cases picking up rides from nearby houses. Now more are allowing Uber and Lyft to use their facilities.

The likely direction of new technology and environmental regulation will continue to sap revenue from parking and car hire, reckons Francois-Xavier Delenclos of BCG, a consultancy. Because airports must meet local air-pollution targets, they will discourage passengers from using cars with internal combustion engines. Heathrow, for instance, wants the share of passengers using public transport to reach the airport to increase from 41% to 55% by 2040; many American airports have similar targets. Even the adoption of electric self-driving cars will offer little respite. After dropping off passengers, they will be able to take themselves home.

Revenues are stagnating just when airports in America and Europe need more cash to expand, to cope with demand for flights. Without expansion beyond current plans, by 2035, 19 of Europe's biggest airports will be as congested as Heathrow today, which operates at full capacity, according to Olivier Jankovec, director-general of ACI Europe, a trade group in Brussels. In America the Federal Aviation Administration, a regulator, estimates that congestion and delays at the country's airports cost the economy \$22bn in 2012. This will rise to \$34bn in 2020 and \$63bn by 2040 if capacity is not increased. Meanwhile, the cost of airport construction is rising more than twice as fast as general inflation, mainly due to rising costs of specialised labour.

For those tramping through airports, this is bad news. Without space for extra airlines, established carriers can raise their fares without fear of new competitors moving in. Neither are incumbent airlines keen to foot the bill for expansion. IAG, an Anglo-Spanish group, is fighting plans to levy higher

landing fees on its airlines, including British Airways, to pay for new runways at Heathrow and in Dublin. Expect to see more battles like this, for lilos and duty-free Smirnoff vodka cannot pay for all the terminals and runways that America and Europe need. ■



机场生意

失去高度

千篇一律的商店、更加严格的安保和网约车服务都在侵蚀机场的利润

希思罗机场在1946年开放时，仅有的零售设施是一个有着印花棉布扶手椅的酒吧和一个小报亭。第一个航站楼就是一个帐篷，相比今天这个伦敦机场里好似大型购物中心的四个航站楼，简直是天壤之别。该机场目前的乘客人均零售支出是所有机场中最高的，这个夏天的热销品包括哈利波特魔杖和仙人掌形的充气垫。

希思罗机场从候机厅到零售天堂的转变是许多机场的共同经历。20世纪80年代以前，机场大部分收入来自航空公司的起降费和地勤费。后来，来自商店、机场停车场、汽车租赁等方面的“非航空业务”收入上升到机场收入的五分之二左右，2015年在全球范围内达到1520亿美元。但是，随着种种迹象表明非航空业务收入即将见顶，特别是在北美和欧洲这样成熟的航空市场，业界开始忧心自身的商业模式。

如果机场是国有的，运营不是为了盈利，而是为了国家航空公司的利益，那么这种辅助收入就没那么重要了。亚洲、非洲和中东的机场都还属于这种情况。全球有三分之二的机场在亏损：中国有75%的机场亏损，印度有90%。但欧洲和美洲的机场多数都要自负盈亏。

上世纪80年代，英国率先实行私有化。1994年，加拿大将其主要机场租赁给私营实体，现在正在考虑是否将它们彻底出售。美国各州预算吃紧，令大多数公有机场都交由必须保持收支平衡的独立机构来管理。私有化浪潮正席卷欧洲，现在近一半的机场容量都归私营企业所有。法国在巴黎的主要机场仍然部分控制在国家手中，但总统马克龙的目标是全部卖掉。拉美国家紧随其后。

它们可能错过了私有化的好时机。虽然全球旅客人数仍在迅速增长——航空业组织国际航空运输协会（IATA）的数据显示去年的增幅为6.3%，但北

美和欧洲机场的人均非航空业务营收却在下滑，部分抵消了旅客人数增加带来的航空收入增长。

在零售方面，一些暂时性因素正在发挥作用，例如中国国家主席习近平发起反腐风暴，抑制了高消费的中国人购买奢侈品。一系列恐怖袭击事件发生后，额外增加的安检减少了旅客的购物时间，这可能会在将来发生变化。

但也有结构性的原因。机场设计大师、英国杂志《Monocle》总编泰勒·布鲁雷（Tyler Brûlé）指出，世界各地机场的免税店和奢侈品奥特莱斯店几乎一模一样，让许多旅客对陈列的商品无甚兴致。而且经常搭乘飞机的旅客主体已经转变为消费能力较弱的人群，无助于商店的销售。年初，巴黎机场公司（Aéroports de Paris）、法兰克福机场和阿姆斯特丹的史基浦机场（Schiphol）宣称2016年旅客人均消费约下降了4%至8%。

另外两项收入受到的威胁更大，尤其在北美，即停车场收入（占北美机场非航空业务收入的五分之二）和汽车租赁业务（占五分之一）。在欧洲机场，这两个比例分别是20%和3%（见图表）。这些业务正受到网约车应用的威胁，主要是优步和Lyft。这类应用让打车变得比租车或在机场停车更实惠。各个机场管理部门表示，去年停车收入未能达到预算案预期，缺口最多达十分之一，而且预计明年收入会更低。许多机场先是试图阻止优步和Lyft的汽车进入出租车候客区，但是司机有规避限制的方法，比如在邻近的建筑里载客。现在更多的机场还是允许优步和Lyft的车辆在机场候客。

波士顿咨询公司的弗朗索瓦-哈维尔·德伦克勒斯（Francois-Xavier Delenclos）认为，新技术可能的发展方向和环境监管将继续削减机场停车和租车的收入。由于机场必须达到当地的空气污染指标，因此会设法劝阻乘客使用燃油汽车。例如，希思罗机场希望到2040年，乘坐公共交通工具到机场的乘客比例能从41%增加到55%。许多美国机场也有类似的目标。即使采用电动无人驾驶汽车，它们也不会多做停留。乘客下车后，它们将能够自行返回。

正当美国和欧洲的机场需要更多的现金来扩张，以满足对航班的需求之时，机场收入却停滞不前。根据位于布鲁塞尔的行业组织国际机场理事会欧洲地区分会（ACI Europe）的总干事奥利维尔·扬科维奇（Olivier Jankovec）的说法，如果不能做超出当前计划的扩张，到2035年，欧洲最大的19个机场将和现在已满负荷运转的希思罗机场一样拥挤。在美国，监管机构联邦航空管理局（FAA）估计，2012年美国机场的拥挤和延误造成了220亿美元的经济损失；如果容量不增加，到2020年损失将达340亿美元，到2040年将达630亿美元。同时，机场建设成本的增长速度比总体通货膨胀的速度快出两倍还多，这主要是由于专业劳动力成本的上升。

对于那些搭乘飞机的人来说，这是个坏消息。如果机场没有多余的空间提供给其他航空公司，现有航空公司就可以提高票价，而不用担心新的竞争对手进入。现有的航空公司也不想为机场扩建买单。希思罗机场和都柏林机场为支付新跑道的建设费用而计划增收起落费，英西合资的国际航空集团（IAG）为旗下英国航空等公司提出抵制。未来还会有更多这样的角力，因为靠卖充气垫和免税皇冠伏特加（Smirnoff vodka）并不能支付美国和欧洲所需的所有航站楼和跑道的建设费用。■



Schumpeter

Ants in your pants

Meet the financial firm that makes bank bosses break into cold sweats

IN WESTERN countries it is common to talk about American technology being dominant. From an Asian perspective that seems off. Fresh from visiting the region, where buskers and kerbside fishmongers can be paid by presenting a phone, Schumpeter has found it a shock being back in New York. There, buying most things involves signing bits of paper and PIN numbers are viewed as dangerously transgressive. Only 2% of credit- and debit-card transactions in America are authenticated with PIN numbers; 19bn cheques are written in the country every year.

Asian firms have leapfrogged ahead, offering a new model of financial technology. Exhibit A is Ant Financial, a payments company affiliated with Alibaba, one of China's two giant internet firms (the other is Tencent, whose WeChat messaging app is ubiquitous and supports payments). Ant is popular in China and has ambitions outside it. Already the world's most valuable "fintech" firm, worth \$60bn, it has 520m payments customers at home and its affiliates abroad have 112m, mainly in Asia. In May it signed a deal to install its payments system in millions of American retail outlets. Ant is in the process of buying MoneyGram, a Texas-based money-transfer firm active in over 200 countries.

One admired boss in the conventional banking industry says Ant keeps him awake at night. For protectionists, the firm is evidence of a Chinese plot to control the world's financial plumbing. For consumers, it could boost competition in a cosy industry.

Ant was spun out of Alibaba in 2014. Its core business is enabling payments by a vast army of customers to the 10m or so merchants who use Alibaba's

e-commerce sites. This accounts for over a quarter of its revenues, according to CLSA, a brokerage. And it gives Ant huge scale at home. China's internet-payments market is the world's biggest, reckons Goldman Sachs, with \$11trn in transactions last year, twice the size of America's credit- and debit-card industry. Ant controls 51% of it. The firm is 16 times larger than PayPal, an American counterpart, on this measure.

China's lead is about more than size, though. People make payments mainly by using phones. Whereas Western products such as PayPal and Apple Pay often piggyback off credit-card firms' networks to access clients' funds, China's firms can access bank accounts directly, cutting out the middlemen.

Ant has developed a menu of services: its home screen lets you buy train tickets, pay utility bills and invest in mutual funds. Yu'e Bao, a money-market fund run by Ant, has \$166bn of assets. Ant lends to its clients, but so far its balance sheet is modest: outstanding loans to small firms were \$5bn in 2016. Fees are low, but Ant's profits still reached a chunky \$820m last year, up by 14% since 2014. (It does not publish its books, but some figures can be inferred from Alibaba's accounts.)

Jack Ma, the tycoon who controls Alibaba and Ant, has a grand vision to turn a Chinese empire into a global one. For Ant there are two opportunities. One is a business known as "merchants acceptance", machines for paying for goods in shops and hotels. At the moment Chinese travellers abroad, whose ranks reached 120m in 2016, often use UnionPay, a card provider. Ant is muscling in, letting people use Alipay when they have weekends in Dubai or make family trips to Disneyland.

Longer term, the goal is to create a huge online network of local consumers and merchants in other countries, replicating Ant's model in China. But building relationships with local banks and firms takes time. And in poorer

countries few people have bank accounts to connect to their mobile accounts. Instead they hand over cash in shops and kiosks to fill up mobile wallets.

As a result Ant is expanding through local subsidiaries or affiliates. Along with Alibaba it owns about half of Paytm, an Indian digital-payments star. And it has bought stakes in fintech firms in Thailand, Singapore, Indonesia, the Philippines and South Korea. Buying MoneyGram would not bring cutting-edge technology—its core activity is cash remittances—but would give Ant licences abroad and clients who could be prodded to use digital services.

Ant's scale, innovation and drive mean it is well placed. But it faces three hurdles. First, rising competition is dampening margins. At home WeChat has helped boost Tencent's market share in digital payments from 15% in 2014 to 33% last year. Abroad, Ant is not the first mover. In South-East Asia several e-commerce and ride-hailing firms are bolting payments onto their apps to attract and keep more customers. DBS, a regional lender, is a leader in digital banking. In America, Apple Pay is accepted in 4.5m locations and could get more popular.

As Ant grows it must manage a second problem, its tangled links with Alibaba. The original spin-off was controversial. Today Mr Ma controls a majority of the firm's voting interests. State-backed funds and entities collectively own about 15%. Alibaba doesn't own shares in Ant but is entitled to 37.5% of its profits. If Ant does an initial public offering this agreement can change and Alibaba would get 33% of its shares. The two firms share joint ventures and executives. They pay fees to—and receive them from—each other. There is a risk of conflict and muddle.

| *Paying its dues*

Ant's final hurdle is that foreign governments may not like Chinese firms

having a big role in their financial systems. America's national-security review panel, known as CFIUS, is looking at the MoneyGram deal. On economic grounds they should welcome Ant, so that it can disrupt the bloated credit-card industry. Visa and MasterCard extract over 0.10 cents of net income for every dollar of payments. Ant takes a smaller cut, of less than 0.03 cents.

China's financial system is isolated from the rest of the world. Ant has evolved in a distinct—and more efficient—way. The task now is to persuade other countries that its approach is safe, transparent and free from government interference. It had better hurry up. Sooner or later Silicon Valley's giants will catch up. ■



熊彼特

蚂蚁在背

来认识下这家让银行老板们冷汗直冒的金融公司

在西方国家，人们常常会谈到美国的科技占据主导地位。但从亚洲的角度来看，这种说法似乎站不住脚。在亚洲，用手机就可向街头艺人和路边的鱼贩付钱。本专栏作者刚从那里回到纽约就感受到了冲击。在纽约，大多数情况下买东西时都要在各种单据上签名，而PIN码则被视为不可靠，难以被人们接受。在美国，只有2%的信用卡及借记卡交易是以PIN码验证，整个国家一年要开出190亿张支票。

亚洲公司已超越西方，提供了一种新的金融科技模式。一个显然的案例就是蚂蚁金服。这是一家支付公司，与中国互联网公司两大巨头之一的阿里巴巴有关联（另一家是腾讯，其无所不在的通讯应用微信中也有支付功能）。蚂蚁金服在中国广受欢迎，同时也有进军海外的野心。它已是世界最具价值的“金融科技”公司，估值600亿美元，在国内有5.2亿支付用户，在海外的合作企业（主要分布在亚洲）也有1.12亿用户。5月，它签署了一项协议，在美国数百万家零售店中安装其支付系统。蚂蚁金服目前正在收购经营汇款业务的速汇金（MoneyGram）。这家公司总部位于德克萨斯州，在两百多个国家开展业务。

一位在传统银行业备受尊敬的高管说，因为蚂蚁金服，他晚上都睡不着觉。在贸易保护主义者看来，中国公司意图控制世界金融体系，这家公司便是证据。对消费者来说，蚂蚁金服或许可以在这个安逸的行业里促进竞争。

蚂蚁金服于2014年从阿里巴巴分拆出来，其核心业务是帮助庞大的消费群体向阿里巴巴电商网站上约1000万商家付款。根据经纪公司里昂证券（CLSA）的数字，这项业务占蚂蚁金服营收的四分之一以上。这让蚂蚁在中国取得了巨大的规模。高盛估算，中国的互联网支付市场为世界最大，去年的交易额高达11万亿美元，是美国信用卡及借记卡行业规模的两倍。

蚂蚁金服占据了其中51%的市场份额。以此标准衡量，蚂蚁金服的规模是美国同类公司PayPal的16倍。

不过，中国并不仅仅在规模上领先。在中国，人们主要通过手机完成支付。PayPal、Apple Pay之类的西方产品通常是利用信用卡公司的网络来接触用户的资金，而中国公司无需中间商，直接就能访问银行账户。

蚂蚁金服已开发出一系列服务。在其应用主页上，你可以买火车票、付水电煤气费、投资共同基金。蚂蚁金服运营的货币市场基金余额宝管理着1660亿美元的资产。它也向客户提供贷款，不过到目前为止其资产负债表的表现不好不坏：2016年面向小微企业的未偿贷款为50亿美元。虽然收取费用较低，蚂蚁金服去年仍取得了8.2亿美元的丰厚利润，较2014年提升了14%。（蚂蚁金服并未公布其账目，不过从阿里巴巴的财报中可推断出一些数字。）

掌管阿里巴巴和蚂蚁金服的大佬马云有着宏伟的设想，他希望这个中国的企业帝国能成为全球巨头。蚂蚁金服有两个机会，其一是“商户受理”业务，即在商店及酒店中安装用于付款的机器。中国出境游客的数量在2016年达1.2亿人次，目前他们通常都是使用银联卡。蚂蚁金服正奋力挤入该市场，让人们在迪拜度周末或全家去迪士尼乐园游玩时使用支付宝。

蚂蚁金服的长远目标是将自己在中国的模式推行至其他国家，打造出一个连接当地消费者与商户的大型在线网络。不过与当地银行及公司建立关系需要时间。在经济较为落后的国家，只有少数人有银行账户、能将之与自己的移动账户关联。他们得去商店或售货亭用现金为移动钱包充值。

因此，蚂蚁金服正通过当地的子公司或合作伙伴来拓展业务。它和阿里巴巴一道，持有印度明星企业、数字支付平台Paytm约一半的股份。它还购入了泰国、新加坡、印尼、菲律宾及韩国的金融科技公司的股份。速汇金的核心业务是现金汇款，买下它并不会收获什么尖端科技，但蚂蚁金服能由此获得经营海外业务的许可以及大量客户，有望引导他们使用其数字服务。

蚂蚁金服规模庞大、富于创新且冲劲十足，因而处于有利地位。不过它面临三重障碍。首先，日益激烈的竞争正在压缩利润。在国内，微信推动腾讯在数字支付市场的份额从2014年的15%提升至去年的33%。在海外，蚂蚁金服并未取得先行优势。东南亚的一些电商及网约车公司正在自己的应用中添加支付功能，以吸引并留住更多用户。该地区的贷款机构星展银行（DBS）是数字银行业务的领先者。在美国，Apple Pay已可在450万个场所使用，覆盖范围或许还会进一步扩大。

随着蚂蚁金服日渐壮大，它必须处理第二个问题：它和阿里巴巴之间的复杂关系。当初分拆的时候就引发了争议。如今，马云手握该公司的多数投票权，有政府背景的基金和实体总计持有大约15%的投票权。阿里巴巴并不持有蚂蚁金服的股份，但却有权分享其37.5%的利润。如果蚂蚁金服上市，两者间的协议可以变更，从而令阿里巴巴持有蚂蚁金服33%的股份。这两家公司有一些共同的合资企业和高管，还向对方支付并收取费用。这就存在着利益冲突和出现混乱的风险。

| 赢得认可

蚂蚁金服的最后一个障碍是，外国政府也许并不欢迎中国企业在其金融体系中扮演重要角色。美国的国家安全审查小组美国外资投资委员会（CFIUS）正在审视收购速汇金的交易。出于经济层面的考虑，外国政府应该欢迎蚂蚁金服，这样，臃肿不堪的信用卡行业就能迎来变革。Visa和万事达从支付的每一美元中获得超过0.10美分的净收入，蚂蚁金服从中收取的费用相对较少，不到0.03美分。

中国的金融体系与世界其他国家相隔绝。蚂蚁金服是以一种独特且更高效的方式发展起来的。现在它的任务是说服其他国家相信它的做法安全、透明且不受政府干预。蚂蚁最好加快脚步，硅谷的巨兽迟早会迎头赶上。■



Cobots

Your plastic pal who's fun to be with

If robots are to work with people, they must understand how people work

TUTHILL PLASTICS GROUP, an injection-moulding company in Clearwater, Florida, recently welcomed a new team member to its factory floor. From his first day on the job he performed the repetitive tasks required of him with dexterity, working comfortably alongside longtime employees.

Sawyer, the operative concerned, is one of the fleet of robots now labouring in the world's factories. Instead of replacing people, however, as some earlier industrial robots have, Sawyer is built to work alongside them. For Sawyer is a collaborative robot, also known as a "cobot".

Direct interaction between robots and humans at work is changing the face—or rather the arms—of manufacturing. Such interaction also means that roboticists need to design effective team mates as well as efficient workers. Cobots operate in a realm where human thoughts, human modes of communication and human safety are paramount. Rethink Robotics, a firm in Boston, had this in mind when it developed Sawyer, a one-armed cobot, and his two-armed colleague, Baxter (both pictured here). These robots are not the isolated moving arms of an assembly-line 'bot. They incorporate cameras and touch sensors. And their most noticeable feature is a screen that displays almost cartoonlike human facial elements.

Such faces are not meant to endear robots to workers (though they do). They are, rather, intended to promote communication between person and machine. For example, when a human reaches for a coffee cup, he or she usually glances towards the cup before doing so. This is a cue indicating the action about to be performed. Sawyer emulates this by "glancing" in the direction he is about to reach, in advance of the motion. That permits people to anticipate the cobot's movements.

Researchers at the Massachusetts Institute of Technology (MIT) are now pushing this non-verbal conveyance of intention between Baxter and his human colleagues a step further. They are giving cobots the ability to read minds—or, more specifically, to read brain signals. Daniela Rus and her team at MIT have equipped an experimental version of Baxter with an electroencephalography (EEG) decoding system. This takes signals from a set of electrodes attached to a human colleague's scalp and recognises within them characteristic patterns known as error-related potentials. These are generated by a brain when it is making a mistake, and also when it is observing a mistake being made by another. For example, when Baxter recognises an error-related potential from a human team mate who has sorted an item into an incorrect bin, he is able to log the error and fix the mistake, sparing the human the trouble. In the future, Dr Rus hopes, the robot will also be able to recognise such a signal when it, itself, has been seen by a human to make a mistake.

Asking the flesh-and-blood members of a human-cobot team to wear EEG caps at work is probably a stretch (though Dr Rus hopes that, by proving the idea behind them works, she will stimulate the invention of something less intrusive). But there are other ways to bridge the gap between human and 'bot. Both speech and the recognition of facial expressions—in either direction—are options. And several groups are working on these.

Once a channel of communication has been established, regardless of what it is, it needs to be used appropriately. It is important—as anyone who has had to deal with the socially inept will know—that robots understand the right moments to convey messages, and also how much information to convey. Julie Shah, another researcher at MIT, has been analysing the costs and benefits of robot over- and under-communication, and is using that information to design algorithms which can decide when and what communication is appropriate. When attempting to convey a message, a

robot must estimate its interlocutor's intentions and what his response is likely to be. If an algorithm calculates that communication will be beneficial, it must then convert the concept to be conveyed into something understandable, whether that be a raised eyebrow or a stream of synthesised speech. Too much information may result in people ignoring messages completely. One feature of Dr Shah's algorithms, therefore, is that they try to take into account what information a human team mate already possesses.

Cobots are not entirely new. BMW, a German car company, brought its first into use in its plant in Spartanburg, South Carolina in 2013. Cobot numbers are, however, growing rapidly. That original BMW cobot, nicknamed Miss Charlotte by her human colleagues, is still mounting sound insulation into car doors. Now, however, she has more than 40 non-human colleagues—and that number is expected to exceed 60 by the end of the year.

Sales of cobots and their software to the vehicle industry are expected to rise by more than 40% a year over the next five years, according to Research and Markets, an international research company. That rapid population growth brings problems of its own—particularly issues of safety. In the past, factory robots have been separated from human workers, sometimes by cages, to stop dangerous interactions with people. But using cobots requires those barriers to be torn down. That risks injury, or even death, unless firm measures are taken to avoid such outcomes.

Most collaborative robots are designed to limit the power and force they can apply. That is a basic precaution. If the robot detects force exceeding a safe level, it stops moving instantly, to ensure there is no risk of injury to anyone. Too much of this stop-start can, however, lower productivity. Dr Shah and her team have found, by tracking in detail human movements such as the relationship between shoulder and elbow, or the swing of the

torso, that they can predict where a robot should avoid being next, if it is to avoid human contact.

Dr Rus's team are also looking at safety—in their case by creating robots with softer exteriors. Softer materials not only provide greater dexterity for the 'bot when gripping, but also lessen the risk of injury when incidental contact is made between human and robot. How long, if ever, it will be before such robots truly match the marketing slogan of the Sirius Cybernetics Corporation, a fictional firm in Douglas Adams's creation, "The Hitchhiker's Guide to the Galaxy", remains to be seen. But even if not actually fun to be with, your plastic pal will become increasingly effective. ■



合作机器人

塑料好伙伴，相处有乐趣

如果机器人要与人类合作，它们必须了解人类的工作方式

注塑公司泰希尔塑料集团（Tuthill Plastics Group）位于佛罗里达州清水市（Clearwater），其工厂车间最近迎来了一名新的团队成员。从就职第一天起，它就利索地执行着派给它的重复性任务，与老员工们合作无间。这名技工就是索伊（Sawyer），是如今世界各地工厂中的机器人大军中的一员。然而，与一些早期的工业机器人不同，索伊的出现不是为替代人，而是要与人合作。这是因为索伊是一部人机合作机器人，也被称作“cobot”。

机器人与人类在工作中的直接互动正改变着制造业的面貌——更确切地说是在改变制造业的武装。这种互动也意味着机器人专家需要设计出既能高效工作又能有效合作的机器人。在这种机器人的操作范畴里，人的思想、交流方式和安全是首要的。位于波士顿的公司Rethink Robotics在开发单臂机器人索伊和它的双臂同事巴克斯特（Baxter，两者见图）时便谨记这一点。这些机器人不像装配流水线上的机器人那样只是孤立操作的移动手臂，它们有内置的摄像头和触摸传感器。它们的屏幕最引人注目，能显示近乎卡通般的人脸图案。

这样的面孔本意并非要讨工人的喜欢（尽管实际上有这样的效果），而是为了促进人机沟通。例如，一个人伸手去拿咖啡杯时，通常在动手之前会扫一眼杯子，这就是个提示，表明某个行为即将实施。索伊模仿了这个特质，在执行动作之前会朝手臂即将伸出的方向“扫视”一下，这样人类就可以预料它的动作。

| 微笑，招手

麻省理工学院的研究人员要把巴克斯特与人类同事之间这种非语言的意图传达再推进一步。他们正在让合作机器人学会“读心术”，或者更具体地说，是读取大脑信号。该校的丹妮拉·鲁斯（Daniela Rus）及其团队为实

实验版的巴克斯特配备了脑电图（EEG）解码系统。该系统从装在人类同事头皮上的一组电极收集信号，并在其中识别出被称作误差相关电位信号的特有模式，这些信号在大脑犯错以及大脑注意到别人正在犯错时产生。例如，当巴克斯特识别到人类工友错将一个物品分类放置到不正确的箱子时产生的误差相关电位信号，它就能记录这一错误并修正它，省去了人的麻烦。鲁斯希望，将来机器人在自己犯错被人类看到时，也能够识别出因此产生的这类信号。

要求人机合作团队中的血肉之躯在工作中佩戴脑电图帽可能有困难（不过鲁斯希望，通过证实这背后的原理可行，她将推动发明一些不那么干扰工作的方式）。但还有其他的方法来弥合人机隔阂。双向的语言交流和面部表情识别都是备选方案。有几个科研团队正在这些领域展开研究。

一旦建立了沟通渠道，无论什么形式，都要使用得当。机器人必须要了解传递信息的正确时机，以及传递的信息量——任何不得和社交白痴打交道的人都会明白其中的重要性。麻省理工学院另一位研究人员朱莉·沙阿（Julie Shah）一直在分析机器人沟通过度和沟通不足的成本与收益，并利用这样的信息来设计可以决定合适的信息传递时间及内容的算法。机器人尝试传递信息时，必须估计其对话者的意图以及可能的反应。如果算法计算出传递此信息是有益的，则必须将要传达的想法转换成可理解的东西，无论是挑起眉毛还是一串合成的语音。信息太多可能会导致人类完全忽略传递的内容。因此，沙阿的算法有一个特点，那就是它们试图把人类工友已知晓的信息考虑在内。

人机合作机器人并非全新发明。德国汽车公司宝马于2013年在南卡罗来纳州斯巴达堡（Spartanburg）的工厂首次投入使用合作机器人。但合作机器人的数量正在迅速增长。宝马的首台合作机器人被其人类同事昵称为夏洛特小姐，如今仍在往汽车车门里安装隔音材料。不过，她现在有了40多个非人类同事，到今年年底，这一数字有望超过60。

国际调研公司Research and Markets表示，在未来五年内，面向汽车业的人机合作机器人及其软件的销售额年增速有望超过40%。合作机器人数量

的快速增长带来了自身的问题——特别是安全问题。过去，工厂里的机器人与人类工人是分开工作的，有时还用笼子隔离起来，防止它们对人类造成危险。但使用合作机器人就需要拆掉这些隔离设施。除非采取强有力的保障措施以避免发生危险，否则可能导致伤害甚至死亡。

大多数人机合作机器人的设计都限制了它们可以运用的力量。这是基本的预防措施。如果机器人检测到超过安全水平的力量，就会立即停止动作，以确保不会对任何人造成伤害。然而，频繁的停机再启动可能会降低生产率。沙阿和她的团队仔细监测了人体动作，例如肩肘之间的关系或躯干的扭动，他们发现，可以由此预测出机器人接下来应该避免出现在哪个位置——加入它要避免与人接触的话。

鲁斯的团队也在考虑安全问题，他们的解决方案是打造外部构造较为柔软的机器人。较软的材料不仅能让机器人在抓握物体时更灵活，还能降低人机偶然接触时人类受伤的风险。道格拉斯·亚当斯（Douglas Adams）创作的小说《银河系漫游指南》（The Hitchhiker's Guide to the Galaxy）中有个虚构的天狼星机器人公司（Sirius Cybernetics），合作机器人还有多久（假如真有这么一天的话）能像这家公司的宣传口号所描述的那样拥有真实的人类性格，还有待观察。但即使在一起工作没什么乐趣，你的塑料伙伴也会变得越来越高效。 ■



Externalities

The lives of others

Arthur Pigou thought that taxes could solve a common market failure. The fourth brief in our series on big economic ideas

LOUD conversation in a train carriage that makes concentration impossible for fellow-passengers. A farmer spraying weedkiller that destroys his neighbour's crop. Motorists whose idling cars spew fumes into the air, polluting the atmosphere for everyone. Such behaviour might be considered thoughtless, anti-social or even immoral. For economists these spillovers are a problem to be solved.

Markets are supposed to organise activity in a way that leaves everyone better off. But the interests of those directly involved, and of wider society, do not always coincide. Left to their own devices, boors may ignore travellers' desire for peace and quiet; farmers the impact of weedkiller on the crops of others; motorists the effect of their emissions. In all of these cases, the active parties are doing well, but bystanders are not. Market prices—of rail tickets, weedkiller or petrol—do not take these wider costs, or “externalities”, into account.

The examples so far are the negative sort of externality. Others are positive. Melodious music could improve everyone's commute, for example; a new road may benefit communities by more than a private investor would take into account. Still others are more properly known as “internalities”. These are the overlooked costs people inflict on their future selves, such as when they smoke, or scoff so many sugary snacks that their health suffers.

The first to lay out the idea of externalities was Alfred Marshall, a British economist. But it was one of his students at Cambridge University who became famous for his work on the problem. Born in 1877 on the Isle of

Wight, Arthur Pigou cut a scruffy figure on campus. He was uncomfortable with strangers, but intellectually brilliant. Marshall championed him and with the older man's support, Pigou succeeded him to become head of the economics faculty when he was just 30 years old.

In 1920 Pigou published "The Economics of Welfare", a dense book that outlined his vision of economics as a toolkit for improving the lives of the poor. Externalities, where "self-interest will not...tend to make the national dividend a maximum", were central to his theme.

Although Pigou sprinkled his analysis with examples that would have appealed to posh students, such as his concern for those whose land might be overrun by rabbits from a neighbouring field, others reflected graver problems. He claimed that chimney smoke in London meant that there was only 12% as much sunlight as was astronomically possible. Such pollution imposed huge "uncharged" costs on communities, in the form of dirty clothes and vegetables, and the need for expensive artificial light. If markets worked properly, people would invest more in smoke-prevention devices, he thought.

Pigou was open to different ways of tackling externalities. Some things should be regulated—he scoffed at the idea that the invisible hand could guide property speculators towards creating a well-planned town. Other activities ought simply to be banned. No amount of "deceptive activity"—adulterating food, for example—could generate economic benefits, he reckoned.

But he saw the most obvious forms of intervention as "bounties and taxes". These measures would use prices to restore market perfection and avoid strangling people with red tape. Seeing that producers and sellers of "intoxicants" did not have to pay for the prisons and policemen associated with the rowdiness they caused, for example, he recommended a tax on

booze. Pricier kegs should deter some drinkers; the others will pay towards the social costs they inflict.

This type of intervention is now known as a Pigouvian tax. The idea is not just ubiquitous in economics courses; it is also a favourite of policymakers. The world is littered with apparently externality-busting taxes. The French government imposes a noise tax on aircraft at its nine busiest airports. Levies on drivers to counterbalance the externalities of congestion and pollution are common in the Western world. Taxes to fix internalities, like those on tobacco, are pervasive, too. Britain will join other governments in imposing a levy on unhealthy sugary drinks starting next year.

Pigouvian taxes are also a big part of the policy debate over global warming. Finland and Denmark have had a carbon tax since the early 1990s; British Columbia, a Canadian province, since 2008; and Chile and Mexico since 2014. By using prices as signals, a tax should encourage people and companies to lower their carbon emissions more efficiently than a regulator could by diktat. If everyone faces the same tax, those who find it easiest to lower their emissions ought to lower them the most.

Such measures do change behaviour. A tax on plastic bags in Ireland, for example, cut their use by over 90% (with some unfortunate side-effects of its own, as thefts of baskets and trolleys rose). Three years after a charge was introduced on driving in central London, congestion inside the zone had fallen by a quarter. British Columbia's carbon tax reduced fuel consumption and greenhouse-gas emissions by an estimated 5-15%. And experience with tobacco taxes suggests that they discourage smoking, as long as they are high and smuggled substitutes are hard to find.

Champions of Pigouvian taxes say that they generate a "double dividend". As well as creating social benefits by pricing in harm, they raise revenues that can be used to lower taxes elsewhere. The Finnish carbon tax was part

of a move away from taxes on labour, for example; if taxes must discourage something, better that it be pollution than work. In Denmark the tax partly funds pension contributions.

| *Pigou flies*

Even as policymakers have embraced Pigou's idea, however, its flaws, both theoretical and practical, have been scrutinised. Economists have picked holes in the theory. One major objection is the incompleteness of the framework, since it holds everything else in the economy fixed. The impact of a Pigouvian tax will depend on the level of competition in the market it is affecting, for example. If a monopoly is already using its power to reduce supply of its products, a new tax may not do any extra good. And if a dominant drinks firm absorbs the cost of an alcohol tax rather than passes it on, then it may not influence the rowdy. (A similar criticism applies to the idea of the double dividend: taxes on labour could cause people to work less than they otherwise might, but if an environmental tax raises the cost of things people spend their income on it might also have the effect of deterring work.)

Another assault on Pigou's idea came from Ronald Coase, an economist at the University of Chicago (whose theory of the firm was the subject of the first brief in this series). Coase considered externalities as a problem of ill-defined property rights. If it were feasible to assign such rights properly, people could be left to bargain their way to a good solution without the need for a heavy-handed tax. Coase used the example of a confectioner, disturbing a quiet doctor working next door with his noisy machinery. Solving the conflict with a tax would make less sense than the two neighbours bargaining their way to a solution. The law could assign the right to be noisy to the sweet-maker, and if worthwhile, the doctor could pay him to be quiet.

In most cases, the sheer hassle of haggling would render this unrealistic, a

problem that Coase was the first to admit. But his deeper point stands. Before charging in with a corrective tax, first think about which institutions and laws currently in place could fix things. Coase pointed out that laws against nuisance could help fix the problem of rabbits ravaging the land; quiet carriages today assign passengers to places according to their noise preferences.

Others reject Pigou's approach on moral grounds. Michael Sandel, a political philosopher at Harvard University, has worried that relying on prices and markets to fix the world's problems can end up legitimising bad behaviour. When in 1998 one school in Haifa tried to encourage parents to pick their children up on time by fining them, tardy pickups increased. It turned out that parental guilt was a more effective deterrent than cash; making payments seems to have assuaged the guilt.

Besides these more theoretical qualms about Pigouvian taxes, policymakers encounter all manner of practical ones. Pigou himself admitted that his prescriptions were vague; in "The Economics of Welfare", though he believed taxes on damaging industries could benefit society, he did not say which ones. Nor did he spell out in much detail how to set the level of the tax.

Prices in the real world are no help; their failure to incorporate social costs is the problem that needs to be solved. Getting people to reveal the precise cost to them of something like clogged roads is asking a lot. In areas like these, policymakers have had to settle on a mixture of pragmatism and public acceptability. London's initial £5 (\$8) fee for driving into its city centre was suspiciously round for a sum meant to reflect the social cost of a trip.

Inevitably, a desire to raise revenue also plays a role. It would be nice to believe that politicians set Pigouvian taxes merely in order to price in an

externality, but the evidence, and common sense, suggests otherwise. Research may have guided the initial level of a British landfill tax, at £7 a tonne in 1996. But other considerations may have boosted it to £40 a tonne in 2009, and thence to £80 a tonne in 2014.

Things become even harder when it comes to divining the social cost of carbon emissions. Economists have diligently poked gigantic models of the global economy to calculate the relationship between temperature and GDP. But such exercises inevitably rely on heroic assumptions. And putting a dollar number on environmental Armageddon is an ethical question, as well as a technical one, relying as it does on such judgments as how to value unborn generations. The span of estimates of the economic loss to humanity from carbon emissions is unhelpfully wide as a result, ranging from around \$30 to \$400 a tonne.

| *It's the politics, stupid*

The question of where Pigouvian taxes fall is also tricky. A common gripe is that they are regressive, punishing poorer people, who, for example, smoke more and are less able to cope with rises in heating costs. An economist might shrug: the whole point is to raise the price for whoever is generating the externality. A politician cannot afford to be so hard-hearted. When Australia introduced a version of a carbon tax in 2012, more than half of the money ended up being given back to pensioners and poorer households to help with energy costs. The tax still sharpened incentives, the handouts softened the pain.

A tax is also hard to direct very precisely at the worst offenders. Binge-drinking accounts for 77% of the costs of excessive alcohol use, as measured by lost workplace productivity and extra health-care costs, for example, but less than a fifth of Americans report drinking to excess in any one month. Economists might like to charge someone's 12th pint of beer at a higher rate than their first, but implementing that would be a nightmare.

Globalisation piles on complications. A domestic carbon tax could encourage people to switch towards imports, or hurt the competitiveness of companies' exports, possibly even encouraging them to relocate. One solution would be to apply a tax on the carbon content of imports and refund the tax to companies on their exports, as the European Union is doing for cement. But this would be fiendishly complicated to implement across the economy. A global harmonised tax on carbon is the stuff of economists' dreams, and set to remain so.

So, Pigou handed economists a problem and a solution, elegant in theory but tricky in practice. Politics and policymaking are both harder than the blackboard scribbles of theoreticians. He was sure, however, that the effort was worthwhile. Economics, he said, was an instrument "for the bettering of human life."

LATER IN THIS SERIES: The natural rate of unemployment; Overlapping generations ■



外部性

他人的生活

“重大经济思想”系列之四——亚瑟·庇古认为征税可解决一个常见的市场失灵问题

有人在火车车厢内大声交谈，令其他乘客无法专注。农民喷洒除草剂，殃及邻家的作物。司机停车不熄火，排放的废气污染环境，危害众人。这类行为可被视为不体恤他人、反社会，甚至不道德。对经济学家来说，这些溢出效应是一个有待解决的问题。

市场组织经济活动，理应惠及社会众人。但直接参与者的利益与普罗大众的利益并不总是一致。若听之任之，聒噪粗鄙的乘车人可能会无视其他旅客对宁静空间的需求，农民会任由除草剂影响别家的作物，驾车人会忽视废气排放造成的污染。所有这些情形中，都是行为人受益，旁人遭殃。

（火车票、除草剂或汽油的）市场价格并未计入这类更广泛的成本，即“外部性”。

以上所举均为“负外部性”的例子。还有“正外部性”。例如，旋律优美的音乐可使所有乘客心情愉悦；新修的道路令社区受惠，程度可能超过私人投资者的预想。还有一些例子称之为“内部性”更恰当，就是人们在当下率性而为，不顾将来的自己要承担何种代价，例如吸烟或过量摄入甜食而损害健康。

率先提出“外部性”这一理念的是英国经济学家阿尔弗雷德·马歇尔

（Alfred Marshall）。而以此著书立说而成名的则是他在剑桥大学的一名学生。1877年出生于英国怀特岛（Isle of Wight）的亚瑟·庇古（Arthur Pigou）在校园里不修边幅，形容邋遢。他不善与生人打交道，却智力超群。马歇尔很器重他，在这位老学者的扶持下，庇古在年仅30岁时便继承其衣钵，成为剑桥大学经济系主任。

1920年，庇古出版了《福利经济学》（The Economics of Welfare），在这本艰深的论著中，他概述了以经济学为工具，改善穷人生活的构想。论题

的核心正是“外部性”，认为“利己之心不见得会.....使国民收益最大化”。

庇古在分析中穿插了上流阶层的学生感兴趣的事例，比如他担心有些人的土地会被相邻田野里泛滥的兔子侵扰，但其他例子则反映出更严肃重大的问题。他声称，在伦敦，烟囱里冒出的烟导致白天的光照强度只达到理论日光强度的12%。这种污染给民众造成巨大的“未计入”成本，体现为衣服变脏、蔬菜被污染，以及人们需采用昂贵的人造照明。他认为，假如市场运作正常，人们本该在防烟雾装置上增加投资。

庇古认为可采取不同方式应对外部性。有些方面需要立法监管。对于无形的手能引导房地产投机者创造出规划合理的城镇的观点，庇古嗤之以鼻。其他一些行为干脆就该禁止。他认为没有任何“欺骗性活动”（例如食品掺假）能产生经济效益。

但在他看来，最显而易见的干预方式是“奖金与征税”。这些措施能利用价格让市场恢复完美运转，也能让人们免受繁琐规程之累。例如，“致醉物”的生产者和销售者会引起人们醉酒闹事，却不必支付监狱和警察的成本，有鉴于此，他建议对酒类征税。酒价上升应该能使部分酒鬼打退堂鼓；其余酒鬼将为自己造成的社会成本买单。

这类干预如今被称为庇古税。这不仅是经济学课程中的基本概念，还是政策制定者的最爱。全世界随处可见显然是为抵消外部性而设的税收。法国政府在国内九个最繁忙的机场对飞机征收噪音税。在西方国家，向驾驶者征税来抵消拥堵和污染的外部性是常见做法。旨在解决“内部性”的征税也很普遍，如烟草税。明年开始，英国将效仿其他国家，对不健康的含糖饮料征税。

庇古税也是应对全球变暖的政策辩论的重要部分。芬兰和丹麦自20世纪90年代初以来一直征收碳排放税；加拿大不列颠哥伦比亚省（British Columbia）于2008年开征碳排放税；智利和墨西哥则从2014年开征。征税以价格为信号，应该能推动个人和企业减少碳排放，效果胜于监管机构的强令限制。如果大家都面对同样的税收，那些觉得减排最容易的人应该

会减排最多。

这些措施的确会改变人们的行为。例如在爱尔兰，塑料袋税令塑料袋的使用量减少了超过90%（伴随一些不良副作用——购物篮和手推车盗窃增多）。伦敦对驶入市中心的车辆征收“拥堵费”三年后，该区域交通堵塞程度已减轻四分之一。据估计，不列颠哥伦比亚省的碳排放税使燃料消耗量和温室气体排放量减少了5%至15%。另外，经验显示，烟草税能劝阻吸烟，只要税率高而且走私烟难寻。

庇古税的支持者们表示这些税项能产生“双重红利”。除了因在定价中纳入伤害成本而创造出社会效益外，它们还提高了国家收入，可用于在其他方面推行减税优惠。例如，芬兰的碳排放税正是下调劳动所得税的一环——假如征税必定要阻遏某种行为，所针对的最好还是污染，而非劳动。在丹麦，碳排放税的部分所得补贴了养老金缴款。

| 庇古空想

然而在庇古的理念为政策制定者采纳之时，人们也仔细审视起它在理论及实践上的缺陷。经济学家们纷纷给庇古的理论挑毛病。一大反对观点是认为其框架不完整，因为它把经济体内的其他一切都固化了。举例来说，庇古税的影响取决于所涉市场的竞争程度，如果垄断组织已利用自身势力减少了其产品的供应，再开征新税项也许不会带来任何额外好处。而且，如果一家饮料业霸主公司承受了酒精税的成本，而不转嫁于消费者，那么庇古税也许就不能改善酗酒闹事的情况。（“双重红利”的说法也受到类似的批评：对劳动收益征税会使人们不愿多干活，但假如环境税导致人们的消费成本上升，同样可能降低他们的工作意愿。）

对庇古理论的另一攻击来自芝加哥大学的经济学家罗纳德·科斯（Ronald Coase，本系列首篇文章介绍了他关于公司本质的理论）。科斯认为“外部性”可归因为产权不明确。假如能恰当分配这些权利，人们会自行商讨完美的解决方案，而无需粗暴地征税。科斯举例说，假如一家甜食店的机器噪音干扰了隔壁医生安静工作，与其用征税来解决这一矛盾，还不如让这两位邻居自己协商解决来得合理。法律可以赋予甜食店发出噪音的权利，

而医生如果认为有必要，可以向甜食店付钱来换取安静。

在大多数情况下，繁琐的协商过程会令这一做法不切实际，科斯自己最先承认了这个问题。但他的深层观点是成立的。在匆忙动用矫正性税收前，先想想哪些现有机构和法律可以解决问题。科斯指出，反滋扰法规可对付兔子破坏土地的问题；如今的火车会设置静音车厢，按乘客的噪音偏好给他们分配空间。

其他人则从道德立场上反对庇古的做法。哈佛大学政治哲学家迈克尔·桑德尔（Michael Sandel）担心，依赖价格和市场来解决世界的问题可能导致不良行为被正当化。1998年，以色列海法的一所学校试图以罚款督促家长按时接小孩，结果迟到的家长有增无减。原来，相比罚金，为人父母的内疚感更能防止迟到，支付罚金似乎反而减轻了内疚感。

关于庇古税，除了这些偏理论的疑虑外，政策制定者还遇到各种实际应用上的问题。庇古也承认自己提出的解决方法不够明确。在《福利经济学》中，虽然他认为对有破坏性的行业征税有利于社会，但他并没指明是哪些行业。他也没有详细说明如何确定税收水平。

现实世界中的定价也是个难题。价格未能纳入社会成本正是需要解决的问题。让人们说出道路拥堵等情况给他们造成的确切成本，这无疑是苛求。在这些方面，政策制定者只能结合实用主义和公众接受度行事。伦敦市中心的交通拥堵费最初定为五英镑（八美金），要反映在市中心驾车的社会成本，这个太过规整的数字着实令人生疑。

增加国库收入的愿望免不了也要掺一脚。若政客们设立庇古税只为纳入外部成本，自然是好的，但实证和常识都显示并非如此。英国的垃圾填埋税在1996年的初始水平为每吨七英镑，也许是有研究结果作为指引。但2009年提高至每吨40英镑，2014年又升至每吨80英镑，可能就是有其他考虑了。

要估算碳排放的社会成本就更加困难了。经济学家们孜孜不倦地摆弄全球经济的各种庞大模型，来推算气温和GDP之间的关系。但这类做法难免依

赖大胆假设。给环境末日标价不止是技术问题，还是一个道德伦理问题，因为这要依赖各种判断，比如该为子孙后代做出怎样的考虑。结果，对人类因碳排放而遭受经济损失的估计从每吨约30美元到400美元不等，跨度之大，无助解决问题。

| 要紧的是政治，傻瓜

庇古税落到谁的头上也是个棘手问题。一种常听到的批评是，这些征税是倒退的，惩罚的是穷人，比如烟瘾更重和更无力承受取暖费涨价的人。经济学家也许会不以为然：目的就是要对造成外部性的人提价，不管那人是谁。但政客就不能如此铁石心肠。2012年澳大利亚推出一种碳排放税，所得的税款过半数最终归还到退休人士和较贫穷的家庭手中，帮他们支付能源费用。该税收强化了激励，派发的福利又舒缓了痛楚。

要精准地向最恶劣的施恶者征税也很难。例如，按职场工作效率损失和额外医疗费用计算，酗酒占了过量酒精摄入所致成本的77%，但在任何一个月里，承认自己曾饮酒过量的美国人不到五分之一。经济学家们可能会主张，顾客买第12杯啤酒的价钱要高于第一杯，但这实施起来将是一场噩梦。

全球化更是增加了麻烦。在国内征收碳排放税也许会促使人们转向进口产品，或者损害企业的出口竞争力，甚至可能促使企业迁往别处。一个解决方案是对进口产品的碳含量征税，并对企业出口产品退税，就像欧盟针对水泥的做法。但这在整个经济体中实施起来将极度复杂。全球协调一致的碳排放税是经济学家梦寐以求的，但也只能是梦想而已。

所以说，庇古给经济学家们提出了一个问题和一个解决方案，理论上精妙绝伦，但实践起来困难重重。政治角力和政策制定都比理论家在黑板上挥笔疾书来得困难。然而，庇古确信，这样的努力是值得的。他说，经济学是“改善人类生活”的一件工具。

本系列后续文章：《自然失业率》、《代际交叠》 ■



Overcapacity and undercapacity

Glutology

The third brief in our series on big economic ideas looks at Say's law

IN 1804 Jean-Baptiste Say enrolled in the National Conservatory of Arts and Crafts in Paris to learn the principles of spinning cotton. The new student was 37 years old, points out his biographer, Evert Schoorl, with a pregnant wife, four children and a successful career in politics and letters trailing behind him. To resume his studies, he had turned down two lucrative offers from France's most powerful man, Napoleon Bonaparte. The ruler would have paid him handsomely to write in support of his policies. But rather than "deliver orations in favour of the usurper", Say decided instead to build a cotton mill, spinning yarn not policy.

Napoleon was right to value (and fear) Say's pen. As a pamphleteer, editor, scholar and adviser, he was a passionate advocate for free speech, trade and markets. He had imbibed liberal principles from his heavily annotated copy of Adam Smith's "The Wealth Of Nations" and bolstered his patriotic credentials in battle against Prussian invaders. (During breaks in the fighting, he discussed literature and political economy with other learned volunteers "almost within cannonballs' reach".)

His greatest work was "A Treatise on Political Economy", a graceful exposition (and extension) of Smith's economic ideas. In Say's time, as nowadays, the world economy combined strong technological progress with fitful demand, spurts of innovation with bouts of austerity. In France output of yarn grew by 125% from 1806 to 1808, when Say was starting his factory. In Britain the Luddites broke stocking frames to stop machines taking their jobs.

On the other hand, global demand was damaged by failed ventures in South

America and debilitated by the eventual downfall of Napoleon. In Britain government spending was cut by 40% after the Battle of Waterloo in 1815. Some 300,000 discharged soldiers and sailors were forced to seek alternative employment.

The result was a tide of overcapacity, what Say's contemporaries called a "general glut". Britain was accused of inundating foreign markets, from Italy to Brazil, much as China is blamed for dumping products today. In 1818 a visitor to America found "not a city, nor a town, in which the quantity of goods offered for sale is not infinitely greater than the means of the buyers". It was this "general overstock of all the markets of the universe" that came to preoccupy Say and his critics.

In trying to explain it, Say at first denied that a "general" glut could exist. Some goods can be oversupplied, he conceded. But goods in general cannot. His reasoning became known as Say's law: "it is production which opens a demand for products", or, in a later, snappier formulation: supply creates its own demand.

This proposition, he admitted, has a "paradoxical complexion, which creates a prejudice against it". To the modern ear, it sounds like the foolhardy belief that "if you build it, they will come". Rick Perry, America's energy secretary, was ridiculed after a recent visit to a West Virginia coal plant for saying, "You put the supply out there and the demand will follow."

To grasp Say's point requires two intellectual jumps. The first is to see past money, which can obscure what is really going on in an economy. The second is to jump from micro to macro, from a worm's eye view of individual plants and specific customers to a panoramic view of the economy as a whole.

Firms, like coal plants and cotton mills, sell their products for money. But

in order to obtain that money, their customers must themselves have previously sold something of value. Thus, before they can become a source of demand, customers must themselves have been a source of supply.

What most people sell is their labour, one of several “productive services” on offer to entrepreneurs. By marshalling these productive forces, entrepreneurs can create a new item of value, for which other equally valuable items can then be exchanged. It is in this sense that production creates a market for other products.

In the course of making his merchandise, a producer will pay wages to his workers, rent to his landlord, interest to his creditors, the bills of his suppliers and any residual profits to himself. These payments will at least equal the amount the entrepreneur can get for selling his product. The payments will therefore add as much to spendable income as the recipients’ joint enterprise has added to supply.

That supply creates demand in this way may be easy enough to grasp. But in what sense does supply create its “own” demand? The epigram seems to suggest that a coal plant could buy its own coal—like a subsistence farmer eating the food he grows. In fact, of course, most producers sell to, and buy from, someone else.

But what is true at the micro level is not true at the macro level. At the macro level, there is no someone else. The economy is an integrated whole. What it purchases and distributes among its members are the self-same goods and services those members have jointly produced. At this level of aggregation, the economy is in fact not that different from the subsistence farmer. What it produces, what it earns, and what it buys is all the same, a “harvest” of goods and services, better known as gross domestic product.

| *From head to foot*

How then did Say explain the woes of his age, the stuffed warehouses, clogged ports and choked markets? He understood that an economy might oversupply some commodities, if not all. That could cause severe, if temporary, distress to anyone involved in the hypertrophied industries. But he argued that for every good that is too abundant, there must be another that is too scarce. The labour, capital and other resources devoted to oversupplying one market must have been denied to another more valuable channel of industry, leaving it under-resourced.

Subsequent economists have tried to make sense of Say's law in the following way. Imagine an economy that consists only of shoes and hats. The cobblers intend to sell \$100-worth of shoes in order to buy the equivalent amount of hats. The hatters intend to sell wares worth \$80 so as to spend the same sum at the cobbler's. Each plan is internally consistent (planned spending matches revenue). Added together, they imply \$180 of sales and an equal amount of purchases.

Sadly, the two plans are mutually inconsistent. In the shoe market the producers plan to sell more than the consumers will buy. In the hat market the opposite is the case. A journalist, attentive to the woes of the shoe industry, might bemoan the economy's egregious overcapacity and look askance at its \$180 GDP target. Cobblers, he would conclude, must grasp the nettle and cut production to \$80.

The journalist might not notice that the hat market is also out of whack, in an equal and opposite way. Hat-buyers plan to purchase \$100 from producers who plan to sell only \$80. Unfortunately, this excess demand for hats cannot easily express itself. If cobblers can only sell \$80 of shoes, they will only be able to buy the equivalent amount of hats. No one will see how many hats they would have bought had their more ambitious sales plans been fulfilled. The economy will settle at a GDP of \$160, \$20 below its

potential.

Say believed a happier outcome was possible. In a free market, he thought, shoe prices would quickly fall and hat prices rise. This would encourage shoe consumption and hat production, even as it discouraged the consumption of hats and production of shoes. As a result, both cobblers and hatters might sell \$90 of their good, allowing the economy to reach its \$180 potential. In short: what the economy required was a change in the mix of GDP, not a reduction in its level. Or as one intellectual ally put it, “production is not excessive, but merely ill-assorted”.

Supply gives people the ability to buy the economy’s output. But what ensures their willingness to do so? According to the logic of Say and his allies, people would not bother to produce anything unless they intended to do something with the proceeds. Why suffer the inconvenience of providing \$100-worth of labour, unless something of equal value was sought in return? Even if people chose to save not consume the proceeds, Say was sure this saving would translate faithfully into investment in new capital, like his own cotton factory. And that kind of investment, Say knew all too well, was a voracious source of demand for men and materials.

But what if the sought-after thing was \$100 itself? What if people produced goods to obtain money, not merely as a transactional device to be swiftly exchanged for other things, but as a store of value, to be held indefinitely? A widespread propensity to hoard money posed a problem for Say’s vision. It interrupted the exchange of goods for goods on which his theory relied. Unlike the purchase of newly created products, the accumulation of money provides no stimulus to production (except perhaps the mining of precious metals under a gold or silver standard). And if, as he had argued, an oversupply of some commodities is offset by an undersupply of others, then by the same logic, an undersupply of money might indeed entail an oversupply of everything else.

Say recognised this as a theoretical danger, but not a practical one. He did not believe that anyone would hold money for long. Say's own father had been bankrupted by the collapse of *assignats*, paper money issued after the French Revolution. Far from hoarding this depreciating asset, people were in such a rush to spend it, that "one might have supposed it burnt the fingers it passed through."

In principle, if people want to hold more money, a simple solution suggests itself: print more. In today's world, unlike Say's, central banks can create more money (or ease the terms on which it is obtainable) at their own discretion. This should allow them to accommodate the desire to hoard money, while leaving enough left over to buy whatever goods and services the economy is capable of producing. But in practice, even this solution appears to have limits, judging by the disappointing results of monetary expansions since the financial crisis of 2007-08.

| *Say it ain't so*

Today, many people scoff at Say's law even before they have fully appreciated it. That is a pity. He was wrong to say that economy-wide shortfalls of demand do not happen. But he was right to suggest that they should not happen. Contrary to popular belief, they serve no salutary economic purpose. There is instead something perverse about an economy impoverished by lack of spending. It is like a subsistence farmer leaving his field untilled and his belly unfilled, farming less than he'd like even as he eats less than he'd choose. When Say's law fails to hold, workers lack jobs because firms lack customers, and firms lack customers because workers lack jobs.

Say himself faced both a ruinous shortage of demand for his cotton and excess demand for his treatise. The first edition sold out quickly; Napoleon blocked the publication of a second. Eventually, Say was able to adapt, remixing his activities as his own theory would prescribe. He quit his

cotton mill in 1812, notes Mr Schoorl. And within weeks of Napoleon's exile in 1814, he printed a second edition of his treatise (there would be six in all). In 1820 he began work once again at the Conservatory in Paris—not this time as a student of spinning, but as France's first professor of economics, instructing students in the production, distribution and consumption of wealth. He considered it a “new and beautiful science”. And, in his hands, it was.

LATER IN THIS SERIES: Pigouvian taxes; The natural rate of unemployment; Overlapping generations ■



产能过剩与产能不足

生产过剩的学问

“重大经济思想”系列之三——萨伊定律

让-巴蒂斯特·萨伊（Jean-Baptiste Say）于1804年入读巴黎国立工艺学院（National Conservatory of Arts and Crafts），学习棉纺原理。传记作家埃夫特·斯古勒（Evert Schorl）指出，这名新生37岁，带着怀孕的妻子和四个孩子，此前他在政界和文坛已颇有建树。为继续自己的学业，萨伊两次拒绝了法国最有权势的人拿破仑·波拿巴（Napoleon Bonaparte）发出的条件优厚的邀请。这位统治者愿以优渥的报酬请萨伊撰文支持自己的政策。但萨伊没有“为篡权者发声”，而是决定建一家棉纺厂，纺纱线而不是编政策。

拿破仑看重（且畏惧）萨伊的文笔，这是对的。作为檄文作者、编辑、学者和顾问，萨伊积极倡导自由言论、自由贸易及自由市场。他从自己那本写满评注的亚当·斯密的《国富论》中汲取自由主义思想，在对抗普鲁士侵略的战斗中强化了自己的爱国形象。（在战斗间隙，他与其他博学的志愿者讨论文学和政治经济学，而“炮弹几乎就在脚边炸开”。）

他最伟大的著作《政治经济学概论》（A Treatise on Political Economy）精妙阐述（并发展了）亚当·斯密的经济学理念。萨伊所在的时代跟现在一样，世界经济在技术方面有长足的进步但需求时起时落，创新迸发而经济紧缩频现。1806至1808年间，法国的纱线产量上升了125%，而萨伊的纺纱厂正是在那时起步。在英国，卢德分子捣毁织袜机以阻止机器抢走自己的工作。

另一方面，因在南美扩张失利，全球需求受损，而拿破仑的最终垮台更令需求萎靡不振。1815年滑铁卢战役后，英国政府削减了40%的开支。约30万名退役士兵和水手被迫另谋出路。

结果便是一轮产能过剩，在萨伊那个年代人们称之为“全面生产过剩”。英

国货被指责充斥了从意大利到巴西的各个外国市场，就和今天中国被指向全球倾销商品一样。1818年，来到美国的一位访客发现“待售商品的数量总是大大超出购买者的财力，每一城镇莫不如此”。“全球各个市场的全面过剩”成为萨伊及其批评者的关注焦点。

试图解释该现象时，萨伊先是否认可能存在“全面”过剩。他承认有些商品可能供应过剩。但商品不会全面过剩。他的理论如今被称为萨伊定律：“生产自行开启了对产品的需求”，或套用后期更简明的表述：供给自行创造需求。

他承认，这一理念“有一种矛盾的特性，令人产生偏见”。在现代人听来，这个定律有点像“做出了东西，就自然会有人要”这种愚勇的信念。最近美国能源部长里克·佩里（Rick Perry）在访问西弗吉尼亚一家火力发电厂时发表的言论备受嘲讽。他说，“你供应了，需求自然就来了。”

要理解萨伊的观点，需要做两次思维跳跃。第一，要超越金钱看问题，因为金钱会掩盖经济体内的实际情况。第二是从微观跳跃至宏观，从细观个别工厂和某些顾客转向俯瞰经济全景。

就像火电厂和棉纱厂那样，各类公司为赚钱而销售产品。而它们的顾客要获得购买产品的资金，就必须先卖出一些具有价值的东西。因此，在成为需求的源头之前，顾客自己必须先成为供应的源头。

大多数人出卖的是自己的劳动力——向企业家提供的几种“生产性服务”之一。通过组织这些生产力，企业家可以创造出具有价值的新产品，可用来换取相同价值的其他产品。从这个意义上讲，生产为其他产品创造了市场。

在制造商品的过程中，生产者会付工资给员工，付租金给房东，付利息给债权人，支付供应商账单，支付利润给自己。这些支出金额至少会等于企业家销售产品所能获得的收入。因此，这些支出令可支配收入增加，增加的程度等同于收款人此前合力提供的供给。

供给以此方式创造了需求，这也许不难明白。但从什么意义上能说供给创造了“自己”的需求？这一妙语似乎在说，煤矿可以买回自己产的煤炭，就像自给自足的农民吃自己种的粮食那样。但实际上，不消说，大多数生产商都是从别处购入材料，产品也都是卖给别人的。

然而，那是微观层面的情况，在宏观层面并非如此。宏观层面上不存在“别人”。经济是统一的整体。经济体在成员中购入和分配的正是这些成员合力生产的同样那些商品和服务。如此聚合来看，经济体与自给自足的农民差别不大。其生产的、赚取的、购入的，根本是一回事，就是商品和服务的“收成”——更为人熟知的说法是“国内生产总值”。

| 从头到脚

那么萨伊如何解释他那个时代的困境——仓库积压、港口拥堵、市场窒息？他明白，一个经济体内纵然不会全部商品都供过于求，但仍可能出现部分商品过剩。在过度扩张的产业内，这可能对每个人都造成严重（尽管是暂时的）困扰。但他认为，有一种商品过剩，就必然会有另一种商品稀缺。投入一个过剩市场的劳动力、资本及其他资源必然是另一更具价值的产业部门所缺的，造成其资源不足。

后来的经济学家们试图通过以下方式来理解萨伊定律。想象一个仅有鞋子和帽子这两种商品的经济体。鞋匠们打算卖出总值100美元的鞋子，以购买金额相当的帽子。帽匠们想卖出总值80美元的帽子，然后在鞋匠那里花费相同金额购买鞋子。两者的计划都具有内在一致性（计划的支出与收入相等）。加起来，这意味着180美元的销售额和同样金额的采购额。

可惜的是，这两个计划是相互矛盾的。在鞋子市场，生产者的计划销售额大于顾客意欲购买的总额。在帽子市场，情况则相反。一位关注鞋业困境的记者可能会叹息经济存在产能严重过剩的问题，并对180美元的GDP目标表示怀疑。他会得出结论，认为鞋匠们必须忍痛减产至80美元。

这位记者可能没有注意到，帽子市场同样存在失衡，只是情况相反而已。帽子的买家计划购入100美元的帽子，而帽子生产者只打算卖出80美元的

产品。不幸的是，对于帽子的超额需求无法轻易显现出来。假如鞋匠们只能卖出总值80美元的鞋子，他们就只能购买相等金额的帽子。没有人知道，假如鞋匠当时雄心勃勃的销售计划得以实现，他们最终会买入多少帽子。这个经济体的GDP将只能达到160美元，比实际潜力低20美元。

萨伊相信能达到更皆大欢喜的结果。他认为，在自由市场上，鞋价会迅速下跌，帽子价格则会上升。这将推动鞋子的消费和帽子的生产，同时压抑帽子的消费和鞋子的生产。结果是，鞋匠和帽匠们可能会各卖出90美元的产品，使经济体实现其180美元GDP的潜力。简言之：经济体所需的是GDP构成比例上的调整，并非整体水平的下降。或如一位认同此观点的学者所说的，“生产并没有过剩，只是调配不当而已”。

供给使人们能够购买经济体的产出。但怎样确保人们愿意这样做？根据萨伊及其追随者的逻辑，如果不是想要获得收益来做点什么，人们是不愿意去生产任何东西的。为什么要劳心费力提供总值100美元的劳动？自然是追求等值回报。即便人们选择把收益存起来而不去消费，萨伊还是确信，这笔存款会完全转化为新资本投资，就像他自己那家棉纱厂。萨伊深知，这样的投资会形成对人力和资源的巨大需求。

但如果人们追求的是那100美元本身呢？假如人们生产货物获取金钱，但这些钱不是仅作为迅速交换其他货物的交易手段，而是作为价值存储工具被无限期持有，情况又会怎样？人们普遍喜欢囤积货币，这对萨伊的观点构成了挑战。囤积货币的倾向扰乱了萨伊理论中“以物易物”的前提。不同于购入新制造的产品，积累金钱并不刺激生产（也许金本位或银本位下的贵金属开采除外）。而且，如果像他认为的那样，某些商品的供过于求会被另一些商品的供不应求抵消，那么按同样的道理，货币供应不足也许真会导致其他一切商品的供应过剩。

萨伊承认这在理论上是一种风险，但不太可能发生。他不相信有人会长期持有货币。萨伊的父亲就因法国大革命后发行的纸币“指券”（assignat）的崩溃而破产。人们绝不会囤积这种贬值的资产，而是急于把它花掉，就好像“它很烫手一样”。

原则上，如果人们要持有更多货币，显然有一个简单的解决方案：加印货币。今时今日已有别于萨伊的时代，中央银行可自行决定加印更多货币（或放宽获取货币的条件）。这应该就能照顾到人们囤积货币的需求，同时留下足够的货币让人们购买经济体能生产的商品和服务。但实际上，自2007至2008年金融危机以来推行的宽松货币政策效果令人失望，由此看来，上述解决方案似乎也有局限性。

| 萨伊非议

今天，许多人甚至在对萨伊定律一知半解时就对它加以嘲笑。这很可惜。萨伊认为经济体内不存在整体的需求不足，这是错误的。但他提出这种不足不应该发生，这是对的。与普遍的认知相反，整体需求不足对于经济并不发挥什么有益的功能。假如一个经济体因为支出不足而变得贫困，这其中倒是有些反常之处。这就好比一个自给自足的农民任田地闲置，腹中饥饿；他吃的比自己能吃的少，虽然想多干点活却又只能少干点。当萨伊定律不成立时，工人就会就业不足，因为公司缺乏顾客；而公司也会缺乏顾客，因为工人就业不足。

萨伊自己生产的棉纱严重需求不足，但他撰写的专著却供不应求。第一版推出后迅速售罄；拿破仑禁止出版第二版。最终，萨伊做出了调整，照自己的理论指示的那样，重新安排了自己的活动分配。斯古勒提到，萨伊在1812年关掉了棉纱厂。1814年拿破仑被流放后的数周内，萨伊出版了自己专著的第二版（共出了六版）。1820年，他再次进入巴黎国立工艺学院——这次不是学纺纱的学生，而是成了法国首位经济学教授，给学生传授有关财富生产、分配及消费的知识。他视经济学为一门“美妙的科学”。在他手中，确实如此。

本系列后续文章：《庇古税》、《自然失业率》、《代际交叠》 ■



Human capital

The people's champion

Gary Becker made humans the central focus of economics. The second in our series on big economic ideas

WHY do families in rich countries have fewer children? Why do companies in poor countries often provide meals for their workers? Why has each new generation spent more time in school than the one that came before? Why have earnings of highly skilled workers risen even as their numbers have also increased? Why should universities charge tuition fees?

This is an incredibly diverse array of questions. The answers to some might seem intuitive; others are more perplexing. For Gary Becker, an American economist who died in 2014, a common thread ran through them all: human capital.

Simply put, human capital refers to the abilities and qualities of people that make them productive. Knowledge is the most important of these, but other factors, from a sense of punctuality to the state of someone's health, also matter. Investment in human capital thus mainly refers to education but it also includes other things—the inculcation of values by parents, say, or a healthy diet. Just as investing in physical capital—whether building a new factory or upgrading computers—can pay off for a company, so investments in human capital also pay off for people. The earnings of well-educated individuals are generally higher than those of the wider population.

All this might sound obvious. As far back as Adam Smith in the 18th century, economists had noted that production depended not just on equipment or land but also on peoples' abilities. But before the 1950s, when Becker first examined links between education and incomes, little thought

was given to how such abilities fit with economic theory or public policy.

Instead, economists' general practice was to treat labour as an undifferentiated mass of workers, lumping the skilled and unskilled together. To the extent that topics such as training were thought about, the view was pessimistic. Arthur Pigou, a British economist who is credited with coining the term "human capital", believed there would be an under-supply of trained workers because companies would not want to teach skills to employees only to see them poached by rivals.

After the second world war, when America's GI bill helped millions complete high school and university, education started to receive more attention from economists, Becker among them. The son of parents who had never got beyond the eighth grade but who filled his childhood home with discussions about politics, he wanted to investigate the structure of society. Lectures by Milton Friedman at the University of Chicago, where Becker completed his graduate studies in 1955, showed him the analytical power of economic theory. Doctoral degree in hand, Becker, then in his mid-20s, was hired by the National Bureau of Economic Research to work on a project calculating returns on schooling. What seemed a simple question led him to realise that no one had yet fleshed out the concept of human capital. In subsequent years he developed it into a full-fledged theory that could be applied to any number of questions and, soon enough, to issues previously seen as outside the realm of economics, from marriage to fertility.

One of Becker's earliest contributions was to distinguish between specific and general human capital. Specific capital arises when workers acquire knowledge directly tied to their firms, such as how to use proprietary software. Companies are happy to pay for this kind of training because it is not transferable. By contrast, as Pigou suggested, firms are often reluctant to stump up for general human capital: teach employees to be good

software programmers and they may well jump ship to whichever company pays them the most.

But this was just the beginning of his analysis. Becker observed that people do acquire general human capital, but they often do so at their own expense, rather than that of employers. This is true of university, when students take on debts to pay for education before entering the workforce. It is also true of workers in almost all industries: interns, trainees and junior employees share in the cost of getting them up to speed by being paid less.

Becker made the assumption that people would be hard-headed in calculating how much to invest in their own human capital. They would compare expected future earnings from different career choices and consider the cost of acquiring the education to pursue these careers, including time spent in the classroom. He knew that reality was far messier, with decisions plagued by uncertainty and complicated motivations, but he described his model as an “economic way of looking at life”. His simplified assumptions about people being purposeful and rational in their decisions laid the groundwork for an elegant theory of human capital, which he expounded in several seminal articles and a book in the early 1960s.

His theory helped explain why younger generations spent more time in schooling than older ones: longer life expectancies raised the profitability of acquiring knowledge. It also helped explain the spread of education: advances in technology made it more profitable to have skills, which in turn raised the demand for education. It showed that under-investment in human capital was a constant risk: young people can be short-sighted given the long payback period for education; and lenders are wary of supporting them because of their lack of collateral (attributes such as knowledge always stay with the borrower, whereas a borrower’s physical assets can be

seized). It suggested that there was no fixed number of good jobs but that highly paid work would increase as economies produced more skilled graduates who generated more innovation.

| *The backlash*

Human capital could also be applied to topics beyond returns to individuals from education. The idea was a powerful variable in explaining why some countries fared far better than others: to promote income growth over many years, heavy investment in schooling was necessary. It shed light on why firms in poor countries tended to be more paternalistic, providing dormitories and canteens: they reaped immediate productivity gains from rested, well-fed workers. It informed big increases in the numbers of women studying law, finance and science since the 1950s: the automation of much household work meant that women could invest more in building their careers. And it helped explain the shrinkage of families in wealthy countries: if increasing value is placed on human capital, parents must invest more in each child, making large families costly.

But any theory that attempts to explain so much is bound to encounter pushback. Many critics bristled at Becker's market-driven logic, which seemed to reduce people to cold, calculating machines. Although "human capital" is an unsightly term—in 2004 a panel of German linguists deemed *Humankapital* the most offensive word of the year—it is the task of social science to identify and refine concepts that would otherwise be fuzzy. It took Becker's framework to make the importance of education explicit, and to put people at the heart of economics.

Within the discipline, some objected that Becker had overstated the importance of learning. Education matters not because it imparts knowledge, critics said, but because of what it signals about the people who complete university, namely that they are disciplined and more likely to be productive workers. In any case, people of greater abilities are the ones who

are most likely to get higher degrees in the first place.

Yet increasingly sophisticated empirical analyses has revealed that the acquisition of knowledge is in fact a big part of what it means to be a student. Becker himself highlighted research findings that one quarter of the rise in per-person incomes from 1929 to 1982 in America was because of increases in schooling. Much of the rest, he insisted, was a result of harder-to-measure gains in human capital such as on-the-job training and better health.

He was also fond of pointing to the success of Asian economies such as South Korea and Taiwan, endowed with few natural resources other than their populations, as proof of the value of investing in human capital—and in particular of building up education systems. Becker's original analysis focused on the private benefits to students, but economists who followed in his footsteps expanded their field of study to include the broader social gains from having well-educated populations.

The importance of human capital is now taken for granted. What is more controversial is the question of how to cultivate it. For those inclined to support a bigger state, one interpretation of Becker's analysis is that the government ought to pour money into education and make it widely available at a low cost. For a conservative, the conclusion might be that the private gains from education are so big that students should bear the costs of tuition.

Although Becker's academic writings rarely strayed into policy prescriptions, his popular writings—a monthly *Businessweek* column that began in the 1980s and blog posts in later years—offer a measure of his views. For starters, he talked of “bad inequality” but also “good inequality”, an unfashionable idea today. Higher earnings for scientists, doctors and computer programmers help motivate students to tackle these difficult

subjects, in the process pushing knowledge forward; from this perspective, inequality contributes to human capital. But when inequality gets too extreme, the schooling and even the health of children from poor families suffer, with their parents unable adequately to provide for them. Inequality of this sort depresses human capital, leaving society worse off.

As for the debate about whether government-funded universities should raise tuition fees, Becker thought that only fair, given that their graduates could expect higher lifetime earnings. Rather than subsidising students who go on to become bankers or lawyers, he argued that it would be more productive for the government to fund research and development. Yet, concerned by mounting inequality in America, he thought that more should be done to invest in early childhood education and improve the state of schools.

| *The knowledge economy*

Becker applied his own prodigious reserves of human capital well beyond education. He used his “economic approach” to look at everything from the motives of criminals and drug addicts to the evolution of family structures and discrimination against minorities. In 1992 he was awarded the Nobel prize for extending economic analysis to new spheres of human behaviour. He remains one of the most cited economists of the past half-century.

Mr Becker’s way of doing economics, initially a radical challenge to convention, came under attack as it went mainstream. The rise of behavioural economics, with its emphasis on limits to rationality, undercut his depiction of people as rational agents seeking to maximise welfare. Improvements in data collection and analysis also gave rise to more detailed empirical research, instead of the wide-ranging concepts that he favoured.

Yet precisely because Mr Becker’s analysis touched on so much, it still has a

lot to offer. Consider the debate on how governments ought to respond to disruptive technological change. From the standpoint of human capital, one answer is obvious. Technological advances mean that the knowledge that people acquire in school is becoming obsolete more quickly than before. At the same time, longer life expectancies mean that the returns on mid-career training are higher than in the past. It is therefore both necessary and possible to replenish human capital by designing better systems for lifelong learning.

This is just one element of the response to technological disruption but it is a vital one. Becker never intended that his theory of human capital explain everything in economics, only that it explain a little about a lot. On this count his work remains indispensable.

LATER IN THIS SERIES: Say's law; Pigouvian taxes; The natural rate of unemployment; Overlapping generations ■



人力资本

人民斗士

“重大经济思想”系列之二——加里·贝克尔使人力因素成为经济学焦点

为什么富裕国家的家庭里孩子更少？为什么贫穷国家的公司往往向员工提供伙食？为什么每一代人都比上一代花更多的时间读书求学？为什么高技能工人人数增加的同时，其收入也在上升？为什么大学应该收取学费？

这些问题异常地多样广泛。有些问题的答案似乎很直观，另一些则更复杂难解。在美国经济学家加里·贝克尔（Gary Becker，2014年去世）看来，却有一个共同的因素贯穿其中：人力资本。

简单来说，人力资本是指赋予人们生产力的那些能力及素质。其中最重要的是知识，但其他因素也很重要，如守时观念，乃至个人健康状况等。因此，人力资本投资主要是指教育，但也包括其他方面，比如父母灌输的价值观或健康的饮食习惯等。正如投资物质资本可使公司获益——无论是建设新厂房还是升级电脑，投资人力资本也会给人带来回报。受过良好教育的人，其收入通常高于社会大众。

这些似乎都是显而易见的事。早在18世纪，经济学家亚当·斯密（Adam Smith）就已指出，生产不仅取决于设备或土地，还取决于人们的能力。但很少有人把这种能力与经济学理论或公共政策结合起来讨论，直到20世纪50年代，贝克尔率先研究了教育和收入之间的关联。

在贝克尔之前，经济学家一般视劳动力为无差异的工人群体，把熟练工人和不熟练工人混为一谈。就算真会探讨培训等议题，态度也是悲观的。首创“人力资本”一词的英国经济学家阿瑟·庇古（Arthur Pigou）认为，熟练工人将供应不足，因为公司都不愿向员工传授技能，不想眼巴巴看着他们学成后被对手挖走。

第二次世界大战后，美国退伍军人福利法案（GI bill）帮助数百万人完成

了高中和大学课程，经济学家们开始更关注教育这一议题，包括贝克尔。贝克尔的父母只念到八年级，但总在家中谈论政治，从小耳濡目染的贝克尔对探究社会结构兴趣浓厚。1955年他在芝加哥大学完成研究生课程，在那里，米尔顿·弗里德曼（Milton Friedman）的讲学令贝克尔领略到经济学理论的分析力量。拿到博士学位后，25岁的贝克尔受聘于美国国家经济研究局（National Bureau of Economic Research），参与一个研究学校教育回报的项目。一个看似简单的问题让他意识到，人力资本这一概念在当时还未得到充分的阐述。之后几年，他将之发展为可应用于众多问题的一套完整的理论。很快，该理论就被推及至探讨从婚姻到生育这类以往不列入经济学范畴的问题。

贝克尔最早的贡献之一是把特定人力资本和一般人力资本区分开来。工人获得与所在公司直接关联的知识，如使用专有软件的技能，就形成了特定人力资本。公司乐于为这类培训付费，因为这种人力资本是不可转移的。相比之下，正如庇古提出的，公司往往不愿对一般人力资本做投入：把员工培养为一流软件程序员，他们很可能会跳槽去任何一家给他们开出最高薪水的公司。

但这只是其分析的切入点。贝克尔发现，人们还是能获得一般人力资本的，但往往要自掏腰包，而非由雇主出资。上大学就是这样，在进入职场前，学生需要自行举债支付教育费用。几乎所有行业的劳动者也都如此：实习生、培训生及初级员工的薪水较低，实际是在帮公司分担“进入角色”的成本。

贝克尔假设人们会冷静地计算该投资多少来增加自己的人力资本。他们会比较不同职业选项的收入前景，考虑与之对应的教育成本，包括用于课堂学习的时间。他知道现实情况远比这混乱，人们的抉择受到各种不确定因素和复杂动机的侵扰，但他形容自己的模型是“以经济学的方式看待生活”。贝克尔认为人们会有的放矢地做出理性的选择，这种简化的假设为他日后提出的精妙的人力资本理论奠定了基础。上世纪60年代初，他在多篇影响深远的文章和一本著作中阐述了这一理论。

他的理论有助解释为何年轻世代读书的时间比老一辈长：预期寿命变长，获取知识的收益率从而提高。这也有助解释教育的普及：科技进步使掌握技能更有利可图，这进而又促进了对教育的需求。该理论显示，人力资本投入不足是一种常见风险：由于教育投资的回报期长，年轻人可能会目光短浅；而由于年轻人缺乏抵押物（实体资产还可以查封，而知识这种东西却没法从借款人身上剥离），借款方对于借钱给这些人也很谨慎。该理论也表明，好工作的数量并非固定不变，随着经济体内培养出更多能进一步推动创新的高技能毕业生，高薪工作的数量也会增加。

| 反击贝克尔

人力资本理论也可应用于个人教育回报以外的议题。要解释一些国家境况为何大大优于其他国家，人力资本是个有力的变量：要促进收入持续多年增长，大幅投资发展学校教育是必要的。它也有助解释为何穷国的公司往往更有家庭式关怀，会提供宿舍和食堂：工人休息得好吃得饱，便可直接促进公司生产率的提升。该理论解释了上世纪50年代以来，学习法律、金融及科学的女性人数大增的现象：家务工作大量自动化，女性便可投入更多精力发展自己的事业。它也有助解释富裕国家家庭规模的缩小：假如人力资本愈加受重视，家长必须加大对每个小孩的教育投入，这令维持大家庭的成本变得高昂。

但任何试图解释太多问题的理论必然招致反对声。贝克尔的市场主导的逻辑似乎把人简化成了精于算计的冰冷的机器，引发许多评论家不满。虽然“人力资本”是个不太讨喜的词（2004年，德国一群语言学家把它选为年度最令人反感的词汇），但明确及修正模糊概念正是社会科学研究的责任。贝克尔的框架阐明了教育的重要性，而且把人置于经济学的核心。

在经济学界，有人反对贝克尔，认为他夸大了学习的重要性。批评者说，教育之所以重要，并不在于知识的传授，而在于它是一种信号，显现出完成大学教育的人所具备的素质——他们更自律，更有可能成为高效率的劳动者。无论如何，能力较强的人本来就是最有可能获得更高学位的人。

然而，愈加严密的实证分析显示，获取知识确实是学习的一大意义所在。

贝克尔本人的研究结果就显示，1929年至1982年间，美国人均收入增幅中有四分之一归功于学校教育的增加。至于其余部分，他坚持认为大多是来自难以测量的人力资本增长，如在职培训和更健康的体魄。

他还喜欢谈论韩国和台湾这些自然资源匮乏而人口众多的亚洲经济体，以其成功来证明投资人力资本的价值——尤其是建立教育体系。贝克尔最初的分析侧重于学生个人的获益，但追随其足迹的经济学者们拓展了研究范畴，把受过良好教育的人群带来的广泛社会效益也纳入其中。

人力资本的重要性现在已毋庸置疑。更具争议的是该如何发展人力资本。在倾向支持加大政府干预的人那里，贝克尔的理论可诠释为政府应大力注资发展教育，降低求学成本，促进教育普及。但在保守派看来，结论可能是，教育对个人的好处如此之大，学生应自行承担学费成本。

尽管贝克尔的学术著作很少涉及政策建议，其撰写的热门文章（上世纪80年代开始的《商业周刊》每月专栏，以及后期的博客文章）透露了他在这方面的一些观点。首先，他谈到“恶性不平等”，也提出“良性不平等”这一如今已过时的想法。科学家、医生及计算机程序员的高收入激励学生们钻研这些艰深学科，过程中又推动了知识向前发展。从这个角度看，不平等有助于人力资本的发展。然而当不平等过了头，贫穷家庭的家长力有不逮，子女教育甚至健康都会受到拖累。这类不平等减损人力资本，导致社会退步。

至于政府资助的大学应否提高学费，贝克尔觉得，考虑到毕业生有望获得更高的终身收入，提高学费也算公平。他认为，与其资助学生成为银行家或律师，政府还不如把资金投入到研发项目上，成效会更大。但美国不平等现象日益严重，忧心于此，他认为应加大对幼儿教育的投入并改善学校状况。

| 知识经济

贝克尔释放自己惊人的“人力资本储备”，所涉略的议题远不止教育。他运用自己的“经济学角度”来审视方方面面，从罪犯及吸毒者的动机，到家庭

结构的演变，以及对少数族裔的歧视等问题。1992年，他因把经济学分析拓展至人类行为的新领域而获得诺贝尔奖。过去半个世纪，他一直是被援引最多的经济学家之一。

贝克尔的经济学研究方法一开始是对传统的颠覆，后来便成为主流，并受到攻击。后来兴起的行为经济学强调理性的局限，削弱了贝克尔对于人作为理性主体追求利益最大化的论述。数据收集及分析能力的改善也催生了更具体的实证研究，而非贝克尔偏好的宽泛概念。

然而，恰恰因为贝克尔的分析触角广泛，至今仍能带来很多启发。例如有关政府该如何应对颠覆性技术变革的争论。从人力资本的角度来看，有一个答案显而易见。技术进步意味着人们在学校学到的知识过时的速度比以往快，而预期寿命的延长也令职业中期培训的回报高于以往。因此，通过设计更好的终身学习体系来补充人力资本既必要，也可行。

虽然这只是应对技术颠覆的一个方面，但至关重要。贝克尔从来没指望他的人力资本论能解释经济学的方方面面，只是希望能对众多问题带来一点启发。就这点来说，他的理论依然不可或缺。

本系列后续文章：《萨伊定律》、《庇古税》、《自然失业率》、《代际交叠》 ■



The theory of the firm

Coase call

If markets are so good at directing resources, why do firms exist? The first in our summer series on big economic ideas

ONE morning, an economist went to buy a shirt. The one he chose was a marvel of global production. It was made in Malaysia using German machines. The cloth was woven from Indian cotton grown from seeds developed in America. The collar lining came from Brazil; the artificial fibre from Portugal. Millions of shirts of every size and colour are sold every day, writes Paul Seabright, the shirt-buying economist, in his 2004 book, “The Company of Strangers”. No authority is in charge. The firms that make up the many links in the chain that supplied his shirt had merely obeyed market prices.

Throwing light on the magic of market co-ordination was a mainstay of the “classical” economics of the late-18th and 19th centuries. Then, in 1937, a paper published by Ronald Coase, a British economist, pointed out a glaring omission. The standard model of economics did not fit with what goes on within companies. When an employee switches from one division to another, for instance, he does not do so in response to higher wages, but because he is ordered to. The question posed by Coase was profound, if awkward for economics: why are some activities directed by market forces and others by firms?

His answer was that firms are a response to the high cost of using markets. It is often cheaper to direct tasks by fiat than to negotiate and enforce separate contracts for every transaction. Such “exchange costs” are low in markets for standardised goods, wrote Coase. A well-defined task can easily be put out to the market, where a contractor is paid a fixed sum for doing it. The firm comes into its own when simple contracts of this kind will not

suffice. Instead, an employee agrees to follow varied and changing instructions, up to agreed limits, for a fixed salary.

Coase had first set out his theory while working as a lecturer in Dundee, in 1932, having spent the prior academic year in America, visiting factories and businesses. “The nature of the firm”, his paper, did not appear for another five years, in part because he was reluctant to rush into print. Though widely cited today, it went largely unread at first. But a second paper, “The problem of social cost”, published in 1960, by which time he had moved to America, brought him to prominence. It argued that private bargaining could resolve social problems, such as pollution, as long as property rights are well defined and transaction costs are low (they rarely are). He had been asked to expound his new theory earlier that year to a sceptical audience of University of Chicago economists. By the end of the evening, he had won everyone around. Coase was invited to join the university’s faculty in 1964; and there he remained until his death in 2013 at the age of 102.

In 1991 Coase was awarded the Nobel prize for economics, largely on the strength of these two papers. But as late as 1972, he lamented that “The nature of the firm” had been “much cited and little used”. In a strange way, Coase himself was partly to blame. The idea of transaction costs was such a good catch-all explanation for tricky subjects that it was used to close down further inquiry. In fact, Coase’s paper raised as many difficult questions as it answered. If firms exist to reduce transaction costs, why have market transactions at all? Why not further extend the firm’s boundaries? In short, what decides how the economy as a whole is organised?

Almost as soon as Coase had wished for it, a body of more rigorous research on such questions began to flourish. Central to it was the idea that it is difficult to specify all that is required of a business relationship, so some contracts are necessarily “incomplete”. Important figures in this field

include Oliver Williamson, winner of the Nobel prize in economics in 2009, and Oliver Hart and Bengt Holmstrom, who shared the prize in 2016. These and other Coase apostles drew on the work of legal theorists in distinguishing between spot transactions and business relations that require longer-term or flexible contracts.

Spot markets cover most transactions. Once money is exchanged for goods, the deal is completed. The transaction is simple: one party wants, another supplies. There is little scope for dispute, so a written contract can be dispensed with. If one party is unhappy, he will take his business elsewhere next time. Spot markets are thus largely self-policing. They are well suited to simple, low-value transactions, such as buying a newspaper or taking a taxi.

Things become trickier when the parties are locked into a deal that is costly to get out of. Take a property lease, for instance. A business that is evicted from its premises might not quickly find a building with similar features. Equally, if a tenant suddenly quit, the landlord might not find a replacement straight away. Each could threaten the other in a bid for a better rent. The answer is a long-term contract that specifies the rent, the tenure and use of the property. Both parties benefit.

But for many business arrangements, it is difficult to set down all that is required of each party in all circumstances. In such cases, formal contracts are by necessity “incomplete” and sustained largely by trust. An employment contract is of this type. It has a few formal terms: job title, work hours, initial pay and so on, but many of the most important duties and obligations are not written down. It is thus like a “mini-society with a vast array of norms beyond those centred on the exchange and its immediate processes”, wrote Mr Williamson. Such a contract stays in force mostly because its breakdown would hurt both parties. And because market forces are softened in such a contract, it calls for an alternative form of

governance: the firm.

One of the first papers to elucidate these ideas was published in 1972 by Armen Alchian and Harold Demsetz. They defined the firm as the central contractor in a team-production process. When output is the result of a team effort, it is hard to put the necessary tasks out to the market. That is because it is tricky to measure the contribution of each member to the finished work and to then allocate their rewards accordingly. So the firm is needed to act as both co-ordinator and monitor of a team.

| *Chain tale*

If a team of workers requires a firm as monitor, might that also be true for teams of suppliers? In some cases, firms are indeed vertically integrated, meaning that suppliers of inputs and producers of final goods are under the same ownership. But in other cases, suppliers and their customers are separate entities. When is one set-up right and not the other?

A paper published in 1986 by Sanford Grossman and Mr Hart sharpened the thinking on this. They distinguished between two types of rights over a firm's assets (its plant, machinery, brands, client lists and so on): specific rights, which can be contracted out, and residual rights, which come with ownership. Where it becomes costly for a company to specify all that it wants from a supplier, it might make sense to acquire it in order to claim the residual rights (and the profits) from ownership. But, as Messrs Grossman and Hart noted, something is also lost through the merger. The supplier's incentive to innovate and to control costs vanishes, because he no longer owns the residual rights.

To illustrate this kind of relationship, they used the example of an insurance firm that pays a commission to an agent for selling policies. To encourage the agent to find high-quality clients, which are more likely to renew a policy, the firm defers some portion of the agent's pay and ties it to

the rate of policy renewals. The agent is thus induced to work hard to find good clients. But there is a drawback. The insurance firm now has an incentive of its own to shirk. While the agent is busting a gut to find the right sort of customers, the firm can take advantage by, say, cutting its spending on advertising its policies, raising their price or lowering their quality.

There is no set-up in which the incentives of firm and agent can be perfectly aligned. But Messrs Grossman and Hart identified a next-best solution: the party that brings the most to any venture in terms of “non-contractible” effort should own the key assets, which in this case is the client list. So the agent ought to own the list wherever policy renewals are sensitive to sales effort, as in the case of car insurance, for which people tend to shop around more. The agent would keep the residual rights and be rewarded for the effort to find the right sort of client. If the insurance firm shirks, the agent can simply sell the policies of a rival firm to his clients. But in cases where the firm brings more to the party than the sales agent—for example, when clients are “stickier” and the first sale is crucial, as with life insurance—a merger would make more sense.

This framework helps to address one of the questions raised by Coase’s original paper: when should a firm “make” and when should it “buy”? It can be applied to vertical business ties of all kinds. For instance, franchises have to abide by a few rules that can be set down in a contract, but get to keep the residual profits in exchange for a royalty fee paid to the parent firm. That is because the important efforts that the parent requires of a franchisee are not easy to put in a contract or to enforce.

The management of ties between a firm and its “stakeholders” (its customers, suppliers, employees and investors) is another variation on this theme. A firm often wants to put restraints on the parties it does business with. Luxury-goods firms or makers of fancy sound equipment may ban

retailers from discounting their goods as a way to spur them to compete with rivals on the quality of their shops, service and advice.

| *Inside the cubicle*

If one of the challenges set by Coase was to explain where the boundary between firms and markets lies, another was for economic analysis not to cease once it reached the factory gate or office lobby. A key issue is how agreements are structured. Why, for instance, do employment contracts have so few formal obligations? One insight from the literature is that a tightly specified contract can have perverse outcomes. If teachers are paid according to test results, they will “teach to the test” and pay less regard to other tasks, such as inspiring pupils to think independently. If chief executives are paid to boost the firm’s short-term share price, they will cut investment projects that may benefit shareholders in the long run.

Mr Holmstrom and Paul Milgrom established that where important tasks are hard to monitor, and where a balance of activities is needed, then a contract should shun strong incentives tied to any one task. The best approach is to pay a fixed salary and to leave the balance of tasks unspecified. A related idea developed by Mr Hart and John Moore is of a job contract as a “reference point” rather than as a detailed map. Another insight is that deferred forms of pay, such as company pension schemes and promotions based on seniority, help cement long-term ties with employees and reward them for investing in skills specific to the relationship.

Coase noted in 1937 that the degree to which the mechanism of price is superseded by the firm varies with the circumstances. Eighty years on, the boundary between the two might appear to be dissolving altogether. The share of self-employed contractors in the labour force has risen. The “gig economy” exemplified by Uber drivers is mushrooming.

Yet firms are unlikely to wither away. Prior to Uber, most taxi drivers were already self-employed. Spot-like job contracts are becoming more common, but flexibility comes at a cost. Workers have little incentive to invest in firm-specific skills, so productivity suffers. And even if Mr Seabright's shirt was delivered by a set of market-based transactions, the supply chains for complex goods, such as an iPhone or an Airbus A380 superjumbo, rely on long-term contracts that are often "incomplete". Coase was the first to spot an enduring truth. Successful economies need both the benign dictatorship of the firm and the invisible hand of the market.

LATER IN THIS SERIES: Becker and human capital Say's law Pigouvian taxes
The natural rate of unemployment Overlapping generations ■



公司理论

科斯难题

本刊夏季“重大经济思想”系列之开篇：如果市场能很好地调配资源，为何还会有公司？

一天早上，一位经济学家去买衬衫。他选中的那件是全球制造所创造的奇迹：产地是马来西亚，但生产设备来自德国；布料由印度种植的棉花织成，但棉籽是在美国培育的；领衬产自巴西；人造纤维来自葡萄牙。这位买衬衫的经济学家保罗·西布莱特（Paul Seabright）在他2004年出版的著作《陌生人的公司》（The Company of Strangers）中写道，每天有千百万件不同尺寸和颜色的衬衫售出，并没有任何权威机构在掌管。在这条生产衬衫的供应链中，各个环节上的公司只不过是按市场价格行事而已。

解析市场协调作用的魔力构成了18世纪后期至19世纪“古典”经济学的基调。之后，英国经济学家罗纳德·科斯（Ronald Coase）在1937年发表的一篇论文中指出了一个刺眼的疏漏。经济学的标准模型与公司内部的实际情况并不相符。例如，雇员从一个部门调到另一部门，并非因为那里工资更高，而是他受命这样做。科斯提出的问题虽然令经济学尴尬，却有深刻的意义：为何有些活动受市场力量主导，而另一些则由企业操控？

他的答案是，当依赖市场力量的成本高昂时，公司应运而生。相比就每宗交易进行谈判并订立不同的合同，以命令指派任务通常成本更低。科斯写道，在标准化商品的市场上，此类“交易成本”较低。清晰明确的任务很容易就可投放到市场上，合约承包方收取固定费用来完成该任务。当这类简单的合同不够用时，公司就派上了用场。与直接交易不同，公司雇员同意在约定范围内，按多样而不固定的指令完成工作，以换取固定的薪酬。

科斯在邓迪大学（University of Dundee）任讲师时开始提出这套理论。那是1932年，之前一个学年他在美国访学，参观了一些工厂和企业。他的论文《企业的性质》（The nature of the firm）则在五年后才发表，一定程度上是因为是他不想匆忙出版。这篇文章今天虽被广为引用，最初却几乎

无人问津。而科斯移居美国后于1960年发表的第二篇论文《社会成本问题》（The problem of social cost）则让他一举成名。文中指出，私人议价可解决环境污染等社会问题，只要产权明确且交易成本低（现实很少是这样）。1960年初，他受邀向芝加哥大学一群满腹狐疑的经济学家阐述自己的新理论。当晚，他赢得了众人的信服。1964年，科斯受邀到芝加哥大学任教，之后一直留在该校，直至2013年离世，享年102岁。

科斯在1991年获得了诺贝尔经济学奖，主要是缘于上述两篇论文的贡献。但直到1972年，他还在怨叹《企业的性质》被“大量引用但很少应用”。说来也怪，科斯本人也有部分责任。交易成本这一说法成了应对各式难题的万全解释，因而被用作挡箭牌，阻碍了进一步的探究。事实上，科斯的论文虽然解释了一些难解的现象，但也引发了同样多的难题。假如公司的存在是为降低交易成本，为何还需要市场交易？何不进一步拓展公司的边界？简而言之，是什么在决定着整个经济的组织运作？

几乎就在科斯期盼之际，关于这类问题的一系列更严谨的研究开始涌现。其核心观点是，因为难以将商业关系中的所有要求都明确化，所以一些合同必然是“不完整的”。该领域的重要人物包括2009年诺贝尔经济学奖得主奥利弗·威廉姆森（Oliver Williamson）以及2016年诺贝尔经济学奖联合得主奥利弗·哈特（Oliver Hart）和本特·霍姆斯特罗姆（Bengt Holmstrom）。他们及科斯的其他信徒运用了法学家的理论来区分现货交易和需要长期或灵活合同的商业关系。

现货市场涵盖大多数交易。钱货两清后，交易即告完成。这种交易很简单：一方需求，另一方供给。争议的余地很小，因而可以免除书面合同。如果一方不满，下次就会另选别家交易。由此可见，现货市场主要靠自我监管，适合简单低价的交易，例如买报纸或打车。

当解除交易对双方都代价高昂之时，情况变得更棘手了。以物业租赁为例，被迫迁出的商家可能无法立刻找到条件类似的新址。同样，租户若突然退租，业主也可能无法马上找到新租户。这种情况下，双方可以相互威胁以谋求更好的租金。解决方法是签订长期合同，明确规定租金、租期及

物业的使用权限。双方都能因此受益。

但在许多商业协议中，难以订明各方在所有情况下的全部权利义务。在这种情况下，正式合同必然是“不完整的”，而主要靠信任来支撑。雇佣合同就属于这一类。其中包含一些正式条款：职位头衔、工作时数、起薪等，但许多最重要的职责和义务并未言明。因此，这就像一个“迷你社会，除了围绕此交易及其直接流程的规范之外，还有许许多多其他的规范需要遵守。”威廉姆森写道。这样的合同能够发挥效力主要是因为它的瓦解会损害双方的利益。而由于在这种合同中市场力量被弱化，就需要另一形式的管控力量：公司。

最早阐述这些想法的论文中，有一篇是由阿门·阿尔奇安（Armen Alchian）和哈罗德·德姆塞茨（Harold Demsetz）在1972年发表的。他们把“公司”定义为团队生产过程中的核心承包商。当产出来自团队合作时，其中必要的工作便难以交给市场完成，因为市场很难衡量每个成员对成品所作的贡献并相应地分配报酬。这就需要公司来兼任团队的协调者和监督者。

| 供应链

假如一组员工需要一家公司来监督，那么各组供应商是否也该如此？在某些情况下，公司的确是垂直整合的，即原料供应商和成品制造商同属一个所有者。但在其他情况下，供应商与其客户是不同的实体。两种方式分别适用哪种情况？

桑福德·格罗斯曼（Sanford Grossman）和哈特在1986年发表的一篇文章对此做了一番探究。他们把对公司资产（厂房、机器、品牌、客户名录等）的权利区分为两类：可通过合同外包的明示权利（specific rights）和所有权附带的剩余权利（residual rights）。如果一家公司向供应商订明一切要求会导致成本高昂，那么收购该供应商、通过所有权取得剩余权利（及利润）就可能是合理的做法。但正如格罗斯曼和哈特指出的，合并也会导致某种损失。供应商会丧失创新及控制成本的动力，因为他已不再拥有剩余权利。

两位学者以保险公司向代理人支付销售保单的佣金为例，来说明这种关系。为鼓励代理人寻找续保可能性高的优质客户，保险公司会延付代理人的部分薪酬，并将之与续保率挂钩。代理人因而会努力寻找优质客户。但这有一个缺点。保险公司这时大可懈怠行事。在代理人竭尽全力挖掘目标客户之际，保险公司可能趁机减少保险广告投放、提高价格或降低服务质量。

没有任何设计能使公司和代理人的利益动机完全一致。但格罗斯曼和哈特发现了一个退而求其次的解决办法：那就是为企业带来最多的“不可缔约”成就的一方应拥有关键资产，在此案例中，这种资产就是客户名录。所以，在销售成绩影响续保率的情况下，保险代理人应拥有客户名录。车险也一样，这方面，人们更是喜欢到处比价。代理人应享有剩余权利，并因努力找到合适的客户而获得回报。假如保险公司消极怠惰，代理人完全可以向自己的客户销售对手公司的保单。然而，若公司比代理人带来的利益更大，例如客户“更具粘性”，而且首次销售至关重要——就像人寿保险那样，则两者合并更合理。

这一框架有助于解决科斯在他最初的论文里提出的一个问题：公司何时该“自产”，何时该“外购”？这适用于各种垂直业务关系。例如，特许经营店必须遵守可在合同内订明的一些规则，但通过向母公司支付特许权费，它们可以保留剩余利润。这是因为母公司要求它们承担的重要工作难以在合同内清晰订明或执行。

公司与其“利益相关方”（客户、供应商、员工及投资者）之间的关系管理则是这一主题的另一变式。公司往往会想要约束交易对手的行动。奢侈品公司或高级音响制造商可能会禁止零售商折价售卖其商品，以此促使零售商之间就店铺、服务及导购的质量展开竞争。

| 隔间之内

如果说科斯提出的难题之一是要解释公司和市场的界限何在，那么另一挑战则是要求经济学分析不能止步于工厂大门或办公楼的大堂。一个关键的问题是协议如何设计。例如，为何雇佣合同中规定的正式职责那么少？从

他的论文中得出的一个见解是，严格规定的合同可能带来不利的后果。假如教师薪酬与学生考试成绩挂钩，那么他们就会只顾“应试教学”而忽略其他职责，比如激励学生独立思考。假如首席执行官的收入系于推高公司短期股价，他们就会削减那些可能有利于股东长远利益的投资项目。

霍姆斯特罗姆和保罗·米格罗姆（Paul Milgrom）认为，在重要任务难以监控并且需要平衡各种活动的情况下，合同应避免对任何一项职责产生强烈的激励。最佳办法是支付固定薪金，而不指明如何平衡不同职责。哈特和约翰·摩尔（John Moore）提出的一个相关理念认为，劳动合同只是一个“参照点”，而非详细地图。另一个见解指出，各种形式的延付薪酬，如企业年金及基于资历的晋升，有助于巩固员工与公司之间的长期关系，也是对员工为服务公司而拓展相应技能的一种回报。

科斯在1937年指出，价格机制被公司取代的程度会随环境而变。80年过去了，两者之间的界限似乎正趋于完全消弭。劳动力大军中自雇人士的比例增加。以优步司机为代表的“零工经济”正蓬勃发展。

然而，公司不可能就此消失。在优步出现以前，大多数出租车司机就已经是自雇人士。零散型的工作合约正变得更为普遍，但这种灵活性是有代价的。这些劳动者没有动力发展专门服务于某家公司的技能，生产力因而受损。而即使西布莱特买到的衬衫是由一系列基于市场的交易制成的，iPhone或空客的A380巨无霸客机等复杂商品的供应链仍依赖内容往往“不完整”的长期合同。科斯率先发现了一个颠扑不破的真理：成功的经济既需要公司的良性专政，也需要市场的无形之手。

本系列后续文章：《贝克尔与人力资本》、《萨伊定律》、《庇古税》、《自然失业率》、《代际交叠》 ■



Private equity

Secondary education

Financiers used to changing others' business models tinker with their own

THE private-equity business presents a paradox. Its barons like to boast of revamping the companies they buy. But they themselves have been steadfast to their own business model, centred on funds with a ten-year life. Within this time span, fund managers, known as “general partners” (GPs), commit to buy, manage and sell a clutch of companies; investors commit to lock up their money for the duration. Sometimes GPs or investors chafe at the time constraint. A new segment of the secondary market, “GP-led” deals, has sprung up to help them.

Investors wanting to exit a fund early need to find a buyer for their stake in the secondary market. But sometimes none will offer an attractive price. Sometimes also, a fund nearing its expiry date may find itself still holding a large number of its investments. GP-led deals place the onus on fund managers to find buyers.

Such transactions have quickly grown from just 10% of the secondary market in 2012 to over one-third this year, according to estimates from Credit Suisse, a bank (see chart). Some such deals offer liquidity to investors during a fund’s “normal” lifetime. For instance, when many investors want to sell out of a fund early, a manager may solicit offers from buyers through a tender process, often getting investors a better price, as in a 2015 deal by Palamon Capital Partners, a British firm. A variant is a “stapled” deal where a firm ties a secondary-market sale to a primary fundraising. In June, Lexington, a secondary investor, bought out €1.2bn (\$1.4bn) from investors in a 2012 fund of BC Partners, a London-based firm, while committing €600m to that firm’s newest fund.

Perhaps the greatest novelty of GP-led deals, however, has been to ease the ten-year straitjacket. Private-equity managers often reckon they could make a better return by holding some assets for longer. But investors usually want their money back as promised, and are reluctant to stick around for much more than an additional year or two. GP-led fund restructurings and spin-outs try to close this gap.

The restructuring market had a rocky start in around 2011. Some of the earliest deals involved poorly performing managers with no plans to set up any new funds. Investors were understandably unhappy at being stuck in “zombie funds”, or even being asked to chip in more.

But as the market has grown, restructuring and spin-out deals have become a way to provide investors with the liquidity they want, while allowing assets to be managed for longer. The deals now nearly always involve new capital, usually from specialist investors in the private-equity secondary market, such as HarbourVest or Neuberger Berman. So existing investors can be offered choices ranging from cashing out to staying put to investing more.

Such deals are not necessarily just for strugglers, but have become a tool for fund managers to pursue other goals. For instance, Investindustrial, a firm focused on southern Europe, in March 2017 put some assets into a new fund, largely because it expected better returns from managing its prize asset, PortAventura, a Spanish theme park, for longer. In 2016, Bridgepoint, a British private-equity firm, sold several smaller firms from its 2005 fund to a new fund, as it wanted to focus its efforts on a few investments, such as its crown jewel, Pret A Manger, a sandwich chain, which it wished to take public.

The recent boom has been in part cyclical. In private equity’s core markets of Europe and America, where investors expect continued growth,

secondary stakes are selling on average at just a 5% discount to their net asset value, making restructurings look attractive. In South America, by contrast, where the economic outlook is cloudier, the going discount is about 30%, and negotiations over several GP-led restructurings have collapsed.

David Atterbury of HarbourVest, however, argues that GP-led deals are far from a temporary phenomenon: investors prize the liquidity they bring, and managers appreciate the newfound flexibility. Credit Suisse reckons private-equity secondary transactions may approach \$40bn this year. But according to Preqin, a data provider, private-equity assets stood at nearly \$2.6trn worldwide at the end of 2016. The new market has plenty of room to grow. ■



私募股权

二级市场革新

惯于改变他人商业模式的金融家们开始修补自己的模式

私募股权行业有个悖论。行业大腕喜欢炫耀他们对被收购公司所做的调整，但对自己的商业模式却毫不动摇，专注于设立十年期的基金。在这十年中，被称为“普通合伙人”（general partners, GP）的基金经理致力于收购、管理和出售公司，投资者则保证在此期间锁定自己的资金。有时候这一时间限制会令GP或投资者恼火。二级市场上，一种新的“GP主导”交易应运而生。

希望提早退出基金的投资者需要在二级市场上寻找买家接盘，但有时连一个开出理想价格的买家都没有。还有些时候，一个接近到期日的基金可能仍持有大量的投资。GP主导的交易将寻找买家的责任放在了基金经理的头上。

据瑞信银行的估计，这种交易增长迅速，2012年只占二级市场的10%，今年已占到三分之一以上（见图表）。部分这样的交易在基金的“正常”存续期内为投资者提供流动性。例如，如果很多投资者希望提前出售基金，基金经理可以通过招标征求买家，这通常会让投资者获得更好的价格，就像英国公司Palamon Capital Partners在2015年的一次交易那样。这种交易的一个变体是“装订”交易，即投资公司把二级市场出售的基金与一级市场上的融资挂钩。今年6月，二级市场投资公司列克星敦（Lexington）从伦敦BC Partners公司一只2012年基金的投资者手中买下了12亿欧元（14亿美元）的股权，同时向该公司最新的基金投入了6亿欧元。

然而，GP主导的交易最大的新意也许在于它能放松十年期限的束缚。私募股权基金经理往往认为，有些资产持有时间久一些可以获得更高的回报。但投资者通常希望能按最初承诺的那样收回资金，顶多延长一两年而不愿拖延更久。GP主导的基金重组和拆分设法解决这一问题。

重组市场在2011年前后开始发展时并不顺利。在最早的一些交易中，基金公司表现不佳，没有计划设立任何新的基金。投资者被困在“僵尸基金”中，甚至被要求投入更多资金，自然十分不满。

但随着市场的发展，重组和拆分交易已成为向投资者提供其所需流动性的一种方式，同时还可以延长对资产的管理时间。如今这些交易几乎总是涉及新的资本，通常来自专门投资私募股权二级市场的公司，如HarbourVest或Neuberger Berman。因此现有投资者有了更多选择，既可套现，也可按兵不动，还可以追加投资。

这些交易并不一定只有助于被套牢的投资人，而是已成为基金经理追求其他目标的工具。例如，2017年3月，专注于南欧市场的公司Investindustrial将一些资产投入了一只新基金，主要是因为预计此基金通过更长时间管理其明星资产西班牙主题乐园PortAventura能得到更好的回报。2016年，英国私募股权公司Bridgepoint将其2005年基金中的几家小公司卖给了一只新基金，因为它想把精力集中在少数投资上，例如它想推动上市的王牌企业三明治连锁公司Pret A Manger。

近期的市场繁荣在某种程度上是周期性的。在欧洲和美国这两个投资者期望会有持续增长的私募股权核心市场，二级市场股权的平均交易价格与其资产净值相比只有5%的折让，这让重组看起来很有吸引力。相比之下，在经济前景更为不明朗的南美，目前折价率约为30%，多个GP主导的重组谈判已经失败。

然而，HarbourVest的戴维·阿特伯里（David Atterbury）认为，GP主导的交易远非暂时现象：投资者青睐它们带来的流动性，而基金经理则喜欢新获得的灵活性。瑞信认为，私募股权二级交易今年可能达到400亿美元的规模。不过数据提供商Preqin称，2016年底，全球私募股权资产总额接近2.6万亿美元。这一新市场还有很大的发展空间。■



Buttonwood

Money for nothing

Comparing national and corporate balance-sheets

THE easiest way to get an economist to laugh sardonically is to compare a country's finances to those of a family. It is both simplistic and wrong, they will argue, for politicians to say that a country "must live within its means".

But in a new working paper* from the National Bureau of Economic Research, Patrick Bolton and Haizhou Huang make a different comparison; between the finances of a government and those of a company. A business can finance itself in three ways: through internal funds (its revenues); through borrowing; and through equity (the issuance of new shares). In the first two cases, it is easy to see the analogy with a nation state; governments can raise money from taxes or borrow in the form of government bonds.

But the paper's most striking idea is that the national equivalent of equity is fiat money. Governments are able to issue money that can be used to settle debts and pay taxes—the term "fiat" comes from the Latin for "let it be done". Equity gives its holders a claim on the assets and profits of a company; money gives its holders (citizens) a claim on the goods and services produced by a country.

Inflation can be explained with another analogy. If a company issues shares to new investors for less than their true value, the holding of existing shareholders is diluted. "Similarly when a nation issues more money to new holders while adding less real output than the purchasing power of money, then existing holders of money are also diluted in proportion to the transfer of value," the authors write.

The authors draw a parallel with a well-known concept in corporate

finance—the Modigliani-Miller theorem. Franco Modigliani and Merton Miller proposed that, in the absence of a range of complex factors like taxes and bankruptcy costs, the value of a company should be unaffected by how it is financed.

To spell this out: the enterprise value of a company represents the combined value of its shares and bonds. The bondholders have first claim on its cashflows. If the company suddenly issues a lot of bonds, its shares will become more risky and will fall in value, but the overall enterprise value will be unchanged.

With the help of some fancy maths, the authors say that a similar argument can be applied to national finances. Assume that a country wants to invest to improve its productive capability. It can choose to finance these investments by borrowing in foreign currency or issuing fiat money. In an economy without “frictions”, it should not matter which of these options it chooses. A version of the Modigliani-Miller theorem thus applies.

In the real world, of course, there are bound to be frictions. One of these is a side-effect of inflation. This may not be a problem in an ideal economy. Consider a stock split; some companies with high nominal share prices issue new shares on a pro-rata basis. So a company with 10m shares trading at \$500 each could issue another 10m shares; the price should fall to \$250 and the overall value of the company would be unchanged. No one loses.

If governments issuing new fiat money could distribute it equally to each citizen, the same arguments would apply. Instead, however, governments tend to use new money to buy financial assets, or goods and services. So the gains are not evenly distributed. This is the real cost of fiat-money issuance—the transfer of wealth from some citizens to others.

But borrowing also brings risks. A country with too high a debt ratio may

default on its foreign-currency obligations. The result may be a shock: much higher interest rates or lost access to the credit markets that may damage the economy. So when a rational government finances investments, it is choosing between the redistribution risks caused by inflation and the risk of default on foreign debts.

It is an intriguing way of formulating the debate, particularly in the light of the extensive use of quantitative easing by central banks since the financial crisis broke in 2008. This has caused less inflation than many feared, which has led some economists to argue that there is little constraint on the ability of rich-world governments to finance their spending, provided a central bank is willing to issue fiat money at will. But what counts is confidence. Countries can find eager takers for their debts and willing holders of their money. Until, at some point, they won't accept them any more. Predicting when that point occurs is the tricky task, for economists and non-economists alike.

* The Capital Structure of Nations, NBER working paper 23612 ■



梧桐

钱无所值

对比国家和公司的资产负债表

要让经济学家发出讥笑，最简单的方法就是拿一个国家的财政和一个家庭的财政做比较。他们会认为，政客所谓的国家“必须量入为出”的说法既过分简单又大错特错。

但在美国国家经济研究局（National Bureau of Economic Research）一篇新的工作论文中，帕特里克·博尔顿（Patrick Bolton）和黄海洲在另一组事物间做了比较：政府财政和企业财政。企业可通过三种方式融资：内部资金（企业收入）、借贷、股权（发行新股）。在前两种情况下，很容易看出企业与国家的类似之处——政府可以通过税收筹钱或以政府债券的形式借款。

但这篇论文最引人注目的观点是，在国家层面，法定货币（fiat money）就相当于企业的股权。政府能够发行可用于清偿债务和纳税的货币——“法定”（fiat）一词来自拉丁语，意为“命其如是”。股权赋予持有人对公司资产和利润的要求权；货币给予持有人（公民）对国家生产的商品和服务的要求权。

通货膨胀可以用另一个类比来解释。如果公司向新投资者发行股票的价格低于其真实价值，现有股东持有的股票就被摊薄了。论文作者写道：“同样，当一个国家向新的持有人增发货币，而增加的实际产出低于货币的购买力时，现有持有人手中货币的价值也被稀释了。”

两位作者用企业融资中一个众所周知的概念来做类比——莫迪利亚尼-米勒定理。弗兰科·莫迪利亚尼（Franco Modigliani）和默顿·米勒（Merton Miller）提出，如果不存在税收和破产成本等一系列复杂因素，公司的价值不应受其融资方式的影响。

来解释一下这是什么意思：一家公司的企业价值决定了其股票和债券的综合价值。债券持有人对公司现金流有优先要求权。如果公司突然发行大量债券，其股票的风险便会上升，价值也将下降，但整体企业价值将保持不变。

作者利用一些复杂的数学计算说明类似的论证也适用于国家财政。假设一个国家想通过投资来提高生产能力，它可以选择借贷外币或发行法定货币来为这些投资项目融资。在一个没有“摩擦”的经济体中，选择哪一种方式应该并不重要。因此莫迪利亚尼-米勒定理换种说法也是适用的。

当然，现实世界中必然会有摩擦。其中之一就是通货膨胀的副作用。在理想经济体中这可能不是个问题。考虑一下股票分割的情形：有些名义股价高的公司会按比例配发新股，所以一家拥有1000万股股票、每股价格500美元的公司可以再发行1000万股，这时股价应该会下降到250美元，而公司的总体价值不会变，谁也没损失什么。

如果发行新法定货币的政府可以把货币平均分配给每个公民，上述道理同样适用。然而，政府一般会用新的货币来购买金融资产、商品和服务，所以收益分配并不平均。这就是法定货币发行的实际成本——一些公民手中的财富转移到他人手中。

但借贷也有风险。一个债务率过高的国家可能会对外币债务违约，结果可能是冲击性的：利率大涨或无法再进入信贷市场，因而可能损害经济。所以理性的政府在为投资融资时，其实就是在通货膨胀导致的再分配风险和外债违约的风险之间做选择。

这种说明问题的思路很有意思，特别是考虑到2008年金融危机爆发以来各国央行广泛采取了量化宽松政策。量化宽松导致的通货膨胀水平比许多人担心的要低，这让一些经济学家认为只要富裕国家的中央银行愿意随意发行法定货币，其政府为支出融资的能力就不受什么限制。但最重要的是信心。政府可以找到渴望持有其债券的人，也能找到乐于持有其货币的人。但到了某个时候，他们就不愿再接受了。要预测这个时间点绝非易事，对

经济学家和非经济学家来说都是如此。

* 《国家资本结构》，美国国家经济研究局第23612号工作论文 ■



Chinese monetary policy

Dynastic equilibrium

Citing an ancient emperor, China modernises its interest-rate system

QIN SHIHUANG was the emperor who first unified China, through bloody conquest more than two millennia ago. Known for starting the Great Wall and burying scholars alive, he has a new claim to fame: the central bank has drawn on his construction of a national road system to help explain its new monetary system. In a report on August 11th, the People's Bank of China seized on an idiom derived from his road-building experience: it had "shaved off mountain peaks and filled valleys" in managing liquidity.

The modernisation of monetary policy is in its own way a monumental project for China. Over the past two decades, the central bank's conduct of policy had two defining features. It focused on the quantity, not the price, of money. And it relied on inflows of foreign cash to generate new money. Both features are now slowly changing, bringing China closer to the norm in developed markets, an essential transition for an increasingly complex economy.

Start with interest rates. These used to be of secondary importance in China. Regulators instead used quotas to dictate how much banks lent and in effect fixed their deposit and lending rates. This made sense when China was in the early stages of moving away from a planned economy. Crude targets were still needed. But as a bigger, rowdier financial system took shape, these targets became less relevant. With the emergence of a large bond market, myriad non-bank lenders and new investment options for savers, banks now face more competition for deposits and in building up their loan books.

Seeing this, the central bank in late 2015 gave banks freedom, in theory, to

set their own lending and deposit rates. It also eliminated mandatory loan-to-deposit ratios and put less stress on credit quotas. However, this opened a gap. It had relinquished its former controls without new ones in place. The answer has been to create a policy rate, much like benchmark short-term interest rates in America and Europe. The central bank has tried to create an equivalent anchor in China's financial system: the seven-day "repo" rate (the bond-repurchase rate at which it lends to banks).

To do so it has established a band around the seven-day rate, with a lower bound for lending to banks flush with cash and an upper bound for those in need. To cap rates at the upper bound, the central bank also started accepting a wider array of collateral. Since mid-2015 this has worked. The central bank has kept the seven-day rate within the corridor and nudged it up as the economy has gathered pace (see chart 1). On August 15th, in its annual review of China's economy, the IMF passed a tentative verdict: "The conduct of monetary policy increasingly resembles a standard interest-rate-based framework."

Complementing this shift has been the central bank's creation of a range of liquidity-management tools. Since 2013 it has opened a baffling plethora of new lending windows: short-term liquidity operations, standing lending facilities, medium-term lending facilities and pledged supplementary lending. All added up to the same thing: conduits to inject cash at different rates and for different durations or, by letting them expire, to withdraw cash.

Their importance has been clear over the past two years as capital outflows eroded the value of China's foreign-exchange reserves. This placed pressure on domestic liquidity, since China had relied on cash inflows to generate money growth (issuing new yuan to buy up the dollars streaming in). After initial hiccups, the central bank more than made up for the loss of dollars at home by using its various tools (see chart 2). As a result, it has been

better able to manage cash levels on a daily basis. High volatility in money-market rates, once a regular occurrence, has all but vanished, hence the central bank's conceit that, in a Qin-like manner, it has shaved off mountain peaks and filled valleys.

Nevertheless, both policy shifts are works in progress. With state-owned banks and companies still counting on government support in the event of trouble, interest rates have less signalling value than in a freer market. The central bank, for its part, continues to use administrative controls to influence lenders. And its success in managing liquidity has been greatly helped by China's tightened grip on its capital account over the past year. Without that, money growth at home might have fuelled more capital outflows. It is, in other words, a gradual approach to reform, in which sense the invocation of China's first emperor is unfortunate. His rule was transformative but violent and short-lived. Slower monetary-policy shifts, in contrast, have much to recommend them. ■



中国的货币政策

王朝均衡

中国对利率体系进行现代化改造，引证了秦始皇的手段

两千多年前，经过血腥的征战，秦始皇成了历史上第一位统一中国的皇帝。除了修建长城和焚书坑儒，他的名声如今又有了新的注脚：中国央行借由他建造全国道路系统的方式来解释中国新的货币系统。在8月11日发布的报告中，中国人民银行引用了由秦始皇修路的经验衍生出来的成语“削峰填谷”，称自己以此法管理流动性。

货币政策现代化对中国来说是一项意义深远的工程。过去20年间，中国央行在制定和执行货币政策上有两个关键特征：它注重货币的数量而非价格，并且依赖国外资金流入来创造新的货币。现在这两项特征都在缓慢发生变化，令中国更加接近发达市场的常态。对于一个日益复杂的经济体来说，这是个至关重要的转变。

先从利率说起。过去它在中国是次要的。监管机构用配额来决定银行提供多少贷款，实际上固定了银行的存款和贷款利率。在中国脱离计划经济的早期，这种做法可以理解，因为仍然需要有粗略的目标。但随着规模更大、更纷繁复杂的金融体系成形，这些目标变得不那么重要了。随着大型债券市场、无数非银行贷款机构和储户的投资新选择出现，现在银行在吸收存款和发放贷款上都面临更多竞争。

有鉴于此，2015年底央行理论上赋予了各银行自行制定贷款和存款利率的自由，同时取消了强制性的贷存比要求，放松了对信贷额度的要求。然而，这也打开了一个缺口。央行放弃了旧的管制手段，却未配以新的控制措施。解决方法是创造一个政策利率，就像美国和欧洲的基准短期利率一样。中国央行尝试在中国的金融体系中创造一个与之类似的“锚”：七天回购利率（它给银行贷款的债券回购利率）。

为做到这一点，央行设置了一个七天利率的区间，下限是向现金充裕的银

行放贷的利率，上限是向需要现金的银行放贷的利率。为了将最高利率限制在上限以内，央行还开始接受更大范围的抵押品。自2015年中以来，这种做法已经奏效。中央银行一直将七天利率保持在区间内，并且随着经济增长速度的加快将它推高（见图表1）。8月15日，在对中国经济的年度回顾中，国际货币基金组织得出了一项暂时性结论：“货币政策的制定执行越来越像标准的基于利率的框架。”

央行还创造了一系列流动性管理工具来作为这一转变的补充。自2013年以来，它推出了令人眼花缭乱的众多新借贷窗口：短期流动性调节工具（SLO）、常备借贷便利（SLF）、中期借贷便利（MLF）和抵押补充贷款（PSL）。所有这些都是为了同一个目的：通过不同利率和不同期限的贷款注入流动性，或者通过让它们到期中止来收回流动性。

过去两年，由于资本外流削弱了中国的外汇储备，这些工具的重要性清晰地显现出来。资本外流给国内流动性带来了压力，因为中国过去依赖资金流入创造货币增长（发行新的人民币以买进流入的美元）。在经历初期的小问题之后，央行通过使用各种工具出色地弥补了国内美元的流失（见图表2），由此得以更好地管理了每日现金水平。货币市场利率的高波动性曾经是常态，现在几乎已经消失，因此央行认为，正如秦朝修路时那样，它已经做到了削峰填谷。

然而，两种政策转变都在进行之中。由于国有的银行和企业遇到麻烦时仍指望政府的支持，相比自由市场，利率的风向标作用较小。央行自身仍在继续利用行政控制来影响银行。过去一年中国收紧了对资本账户的控制，为央行在流动性管理上的成功提供了极大助力。如果没有这一点，国内的货币增长可能会促发更多的资本外流。换句话说，这是一种渐进的改革方式，就这一点而言，中国的第一位皇帝并不成功。他的统治翻天覆地，但却暴力且短暂。相比之下，缓慢的货币政策转变有很多可取之处。





Boring technology

Underground adventures

The search for quicker, cheaper ways of tunnelling

A BIG hole in the car park at SpaceX's headquarters in Los Angeles is the first visible evidence of another of Elon Musk's ventures. Mr Musk who, besides leading SpaceX, a rocket company, also runs Tesla, a maker of electric cars, is going into the tunnelling business. The goal of the Boring Company, as he dubs his new enterprise, is to dig tunnels faster and more cheaply than is possible at the moment.

Apart from the pit in the car park, Mr Musk says he has also begun a series of test tunnels for a project that will, if it comes to fruition, carry cars under Los Angeles on high-speed sledges, in order to avoid the dreadful traffic jams above. More ambitiously, he claims to have official support for a 320km (200-mile) tunnel that would, in half an hour, whisk people between New York and Washington, DC, in magnetically propelled capsules, using a technology he has dubbed the hyperloop.

Loopy these ideas may sound, but Mr Musk is surely right about one thing—that tunnelling, which is currently slow and expensive, is a technology ripe for innovation. And he is not the only one who thinks so. In Europe, things are also stirring beneath the surface. In January a consortium of academic and commercial researchers began work on a project called BADGER. This is intended to develop a robot tunnelling machine (albeit one for tunnels much smaller than Mr Musk has in mind) that can detect and avoid obstacles such as pipes, cables, the foundations of buildings and even buried boulders.

Existing tunnel-boring machines are, in effect, building sites on rails. At the front, a cutting wheel with a diameter a little larger than that of the final

tunnel (to allow for the thickness of the lining) is pushed forward by pistons and chews away at soil and rock as it travels. The spoil from this excavation is then taken to the surface by conveyor belts. Once enough material has been cleared, the borer is stopped and the newly exposed section is lined with precast concrete sections.

Slow, this process certainly is. The boring machines employed to construct the tunnels for Crossrail, a new railway under London which should open next year, cut through the strata they were faced with at a rate of around a metre an hour—literally a snail's pace. As to expense, Crossrail required eight boring machines, each of which cost around \$15m in 2012, when tunnelling started. Each also needed to be supervised by a gang of up to a dozen people on board, adding to costs. The total bill for Crossrail's tunnelling was £1.5bn (\$2.4bn). This bought 42km of tunnels (21km each for the eastbound and westbound tracks); the longest individual tunnels (8.3km each) took 2½ years to dig.

The Boring Company thinks it can speed this sort of operation up, and also cut costs. To do so it plans to make boring machines more powerful, so that they can cut through material faster. It also wants to automate things, to reduce labour costs, and to line the tunnel as the machines progress, instead of stopping excavation when linings are added. One idea is to compact the spoil into bricks and use those as lining material. Reducing the diameter of tunnels would also help. That is part of the reasoning for putting cars on sledges. A two-lane road tunnel needs to be about 8.5 metres wide. Crossrail, at around seven metres, is slightly narrower. But a sledge tunnel could be a single lane, because the sledges can be packed close together and so do not need as much space. It could thus work with a diameter of four metres, cutting costs by as much as three-quarters.

No one could ever accuse Mr Musk of not thinking big. But tunnels do not necessarily need to be big to be useful. BADGER is being designed

specifically for small-diameter tasks, such as digging conduits for cables and pipes. The initial plan, according to the project's co-ordinator, Carlos Balaguer of Carlos III University, in Madrid, is for the machine to burrow at depths of up to four metres, at speeds of around two metres an hour. If that works, it should then be possible to increase both speed and scale.

BADGER's face will combine a conventional rotary cutting head with an ultrasonic drill, which will pulverise rock with high-frequency sound waves. As with existing machines, the spoil will then be sent to the surface. Unlike existing machines, however, BADGER will move forward not as a rigid unit, but like a worm. The rear section will clamp itself to the wall of the newly cut tunnel and push the front section forward. The forward section will then clamp itself and pull up the rear. And so on. As it advances, BADGER will line the tunnel behind it using a 3D printer. One idea is to print the wall with plastic, so that the result resembles a conventional pipe.

BADGER will navigate using various sensors including, crucially, ground-penetrating radar. This will enable it to operate autonomously and detect potential obstacles before it reaches them, so that it can steer around them. The great benefit of BADGER is being able to excavate tunnels below busy cities without closing roads to dig trenches—thus avoiding making the traffic jams about which Mr Musk complains even worse. Whether the tunnels are straight or loopy, though, the future of tunnelling will be anything but boring. ■



挖掘技术

地下探险

寻找更快更省的隧道挖掘法

伊隆·马斯克又有冒险之举。洛杉矶SpaceX总部停车场上的大洞就是第一个摆在人们眼前的证明。身为火箭运载公司SpaceX和电动汽车制造商特斯拉的掌门人，马斯克如今又开始进军隧道挖掘业务。他将新公司命名为“无聊”【译注：Boring Company，Boring兼有“挖掘”之义】，公司的目标是要比现有方法更快更省地挖掘隧道。

除了停车场上的深坑，马斯克表示他还为一项计划开始了一系列试验性的隧道建设。如果该计划得以实现，就能在洛杉矶地下用貌似雪橇的高速装置运送汽车，以避免地面上可怕的交通堵塞。他更是雄心勃勃地宣称已得到政府支持，要修建一条320公里的隧道。该隧道将采用一项他称之为“超级回路”（hyperloop）的技术，让人们能乘坐磁悬浮“胶囊列车”在半小时内穿梭于纽约与首都华盛顿之间。

这些想法听上去也许疯狂，但有一点马斯克无疑是正确的，那就是目前耗时又费钱的隧道挖掘技术创新的时机已经成熟。而他不是唯一有此想法的人。在欧洲，地面之下同样暗潮涌动。今年1月，一个由学术和商业研究人员组成的联盟启动了一个叫作BADGER的项目，意在研发一个隧道挖掘机器人（虽然它挖出的隧道要比马斯克设想的那种隧道小很多），让它能探测并且避开诸如管道、电缆、建筑物地基甚至地下岩石等障碍物。

现有的隧道挖掘机其实就是铁轨上的建筑工地。隧道挖掘机前端有一个切割轮，直径比建成后的隧道直径略大一点（为隧道衬砌留出空间）。它由活塞推进，一路啃噬土壤和岩石，挖掘过程产生的弃渣通过传送带运到地面。一旦足够多的土壤岩石被清除，挖掘机便停止工作，新挖掘完成的隧道段开始用预制混凝土管片衬砌。

这个过程显然太慢。预计明年通车的伦敦新地铁项目“横贯城

铁”（Crossrail）中，挖掘机以大约每小时一米的速度挖穿面前的地层，真正是蜗牛的速度。费用方面，2012年工程开始时，横贯城铁动用了8台挖掘机，每台大约1500万美元。另外，每台挖掘机还需要配备多达12人的管控小组，这也增加了成本。横贯城铁项目共挖掘隧道42公里（东西方向轨道各21公里），总共花费15亿英镑（24亿美元），其中最长的一组隧道（东西向各8.3公里）花了两年半时间才挖完。

“无聊公司”认为自己能让这种工程提速，同时削减费用。为了做到这一点，它计划加大挖掘机的功率，这样就能更快挖穿地层。它还希望通过自动化操作降低劳动力成本，并在机器掘进时同步为隧道衬砌，而不是在衬砌时停止挖掘。将弃渣压实制成衬砌用的砖块是一个办法。还有就是减小隧道的直径——这也是用雪橇装置运送汽车设想的一部分。一条双车道的隧道大约需要8.5米宽。纵贯城铁稍窄一点，大约7米。但是使用雪橇装置的隧道可以是单车道，因为雪橇装置可以紧密排列在一起，不需要那么大的空间。这样这条隧道只需要4米的直径，可减少大约四分之三的成本。

从没人会说马斯克不够大胆。不过隧道并不一定要大才有用。BADGER专为挖掘小口径隧道设计，比如为电缆和管道挖掘通道。据项目负责人、西班牙马德里卡洛斯三世大学（Carlos III University）的卡洛斯·巴拉格尔（Carlos Balaguer）说，最初的计划是让这台机器在最深四米的地方以每小时大约两米的速度挖掘。如果这行得通，之后提高速度和扩大规模都是有可能实现的。

BADGER的前部由一个常规旋转钻头和一個超声波钻机组成，后者可以用高频声波粉碎岩石。和现有机器一样，弃渣随后会被送到地面。不过，和现有机器不同的是，BADGER不像刚性装置那样向前移动，而是像蠕虫一样。它的后部能固定在新挖隧道的内壁上，推动前部前进；然后再固定前部，把后部再往前拉，如此往复。BADGER前行时，会使用一个3D打印机给身后的隧道衬砌。一个办法是用塑胶打印内壁，出来的结果就像常规的管道。

BADGER将使用多种传感器来导航，其中探地雷达尤为重要。有了传感

器，它能够自主操控，并提前探测到潜在障碍物从而绕行。BADGER的一大好处是能在繁忙的城市地下挖掘隧道，不必为挖壕沟而封闭道路——如此一来，马斯克抱怨的交通堵塞就不会雪上加霜。不过，无论隧道是直是弯，隧道挖掘的未来绝不会无聊。■



Economic and financial indicators

Economic outlook

The Economist's latest poll of forecasters, August



经济与金融指标

经济前景

《经济学人》8月对各家预测机构的最新调查



Hunter-gatherer economics

Living off the land

Modern capitalist societies may have something to learn from the ways of their ancient forebears

IN JANUARY 1488, Bartolomeu Dias, a Portuguese explorer, rounded Africa's southern cape and put to shore to take on food and water. There he found a group, smaller and lighter-skinned than the other Africans he had encountered, who, mystified by the odd men appearing out of the infinity of the sea, chased them back to their boat under a hail of arrows.

The exchange, notes James Suzman in his new book "Affluence Without Abundance", was a meeting of two distant branches of the human family tree: Europeans descended from ancient tribes that migrated out of Africa, and people commonly known as the San, who had called southern Africa home for at least 150,000 years. Just as important, the meeting represented the collision of humanity's most ancient and durable form of economic organisation with its most powerful. The latter, wielded by Europeans, has dominated the half millennium since that scrape on the beach. But modern capitalist societies may have something to learn from the ways of their ancient forebears.

Mr Suzman is an anthropologist who has spent years studying the Bushmen of the Kalahari Desert: a San people related to those who greeted Dias on the beach, some of whom maintain the hunting and gathering lifestyle that sustained them for 150 millennia. But "Affluence Without Abundance" is not simply a description of Bushman life. Mr Suzman deftly weaves his experiences and observations with lessons on human evolution, the history of human migration and the fate of African communities since the arrival of Europeans. The overarching aim of the book is more ambitious still: to challenge the reader's ideas about both hunter-gatherer

life and human nature.

Life spent hunting and gathering, while occasionally trying, was not a tale of constant toil and privation. Food could run short during droughts or annual lean periods, but reliance on a broad range of food sources typically afforded such tribes a reliable, well-balanced diet. Even around the arid Kalahari food is plentiful (at least when the tribes are not forced to share the land with farmers and ranchers)—so much so that the typical adult need work less than 20 hours per week.

The contrast with farming societies, which dominated history after the domestication of plants and animals about 10,000 years ago, is stark. Farmed land is more productive, which allowed the more populous farmers to push hunter-gatherers off all but the most remote or inhospitable land. But farming societies depend heavily on a few staples, leaving them poorly nourished and vulnerable to crop failure. That high productivity also took endless, mind-numbing work: to prepare and tend the fields, keep up the homestead and defend the surpluses needed to feed everyone from one harvest to the next.

Mr Suzman argues that the dramatic cultural shift resulting from the adoption of agriculture gave rise to impulses that people in modern rich countries, the heirs of farming societies, regard as naturally human—especially the insatiable desire to accumulate. Farming teaches people to accept inequality and to valorise work. But for the vast majority of human history there was little point in accumulating, since most of what was needed could easily be got from the surrounding environment. Nor was there anything heroic about work; spending time getting more food than one could eat was a foolish waste.

Modern San struggle to cope in a market economy, thanks to this heritage (and to anti-San bigotry). Employers struggle to keep them on the job:

offered higher wages they work fewer hours rather than more. Yet Mr Suzman also reckons, after years of studying the Bushmen, that a world in which people work and worry less is possible. Humanity spent many more thousands of years living that way than working its fingers to the bone, after all. ■



狩猎采集经济

以土地为生

现代资本主义社会或许能从它们古老祖先的生产生活方式中学到一些东西

1488年1月，葡萄牙探险家巴托洛梅乌·迪亚士（Bartolomeu Dias）绕过非洲南部的海角，靠岸补给食物和水。在那里他发现一个族群，比他之前遇到的其他非洲人个子矮、肤色浅。对方被这些从茫茫大海中突然冒出的怪人弄懵了，用一阵箭雨把他们赶回了船上。

詹姆斯·苏兹曼（James Suzman）在他的新书《不富足也幸福》（*Affluence Without Abundance*）中指出，那次交锋是人类族谱中两个遥远分支的一次相遇：一支是欧洲人，起源于从非洲走出的古老部落；另一支通常被称作桑人（San），他们把南部非洲叫做家园至少已有15万年的时间。同样重要的是，那次相遇代表了人类两种经济组织形式的碰撞：一种最古老、持久；另一种则最强大。而自从海滩的那次摩擦事件后，由欧洲人执掌的后者已经雄霸世界五百年。但是现代资本主义社会或许能从它们古老祖先的生产生活方式中学到一些东西。

人类学家苏兹曼花了多年时间研究卡拉哈里沙漠（Kalahari Desert）的布须曼人——也就是在海滩上与迪亚士不期而遇的桑人种族，他们当中一些人延续着15万年来一直赖以生存的狩猎采集的生活方式。但是《不富足也幸福》并不仅仅是对布须曼人生活的描述。苏兹曼巧妙地将他的经历、观察与人类进化中的教训、人类迁移史以及欧洲人到来后非洲群体的命运等结合在一起。统领全书的宗旨则更不容小觑——激发读者对狩猎采集生活方式以及人类本性的反思。

狩猎采集的生活偶有艰辛，但并非总是劳碌而匮乏。遇到干旱或者每年青黄不接的时候，食物也许会短缺。但是依靠广泛的食物来源，这些部落通常能获得可靠而均衡的饮食。即使是在干旱的卡拉哈里沙漠周边，食物依然充足（至少在这些部落没有被迫与农民和牧民共享土地的时候是这样）——一般成年人甚至每周只需工作不到20个小时。

一万年人类驯化了动植物，历史便由农耕社会主宰。农耕与狩猎采集相比明显不同。耕地更高产，使得人数众多的农民将狩猎采集者排挤到最偏僻或最荒凉的土地。但农耕社会严重依赖少数几种主要作物，造成人们营养不良并且易受作物歉收的影响。此外，高产量也要求无休无止、枯燥乏味的劳作：平整及照料田地、保持家庭田产、守护多余的口粮以在两次收获期之间供养每一个人。

苏兹曼认为，农业的普及带来了急剧的文化转型，导致人类一些欲念的产生。作为农耕社会的继承者，现代富裕国家的人将这些欲念视为人的本性，特别是永不满足的积攒欲。耕作教会了人们接受不平等，并赋予工作以价值。但是在人类历史的绝大部分时候，积攒并没有什么意义，因为轻易就可从周围环境中获得大部分所需。工作也没有任何崇高的意义，花时间获取吃不完的食物是愚蠢的浪费。

由于这种传统（以及对桑人的偏见），现代桑人在市场经济中举步维艰。即使支付桑人更高的工资，他们也宁愿少干而不是多干，因此雇主们对于留用桑人也左右为难。但是在对布须曼人研究多年后，苏兹曼也认为，人们少工作、少担忧的世界是可能实现的。毕竟，比起起早摸黑地工作，人类保持那种生活状态的年头要多出好几千年。■



DNA and insurance

The gene is out of the bottle

Insurers worry that genetic tests might one day ruin their business

IF A genetic test could tell whether you are at increased risk of getting cancer or Alzheimer's, would you take it? As such tests become more accessible, more and more people are saying "yes". The insurance industry faces a few headaches as a result.

Once used only for medical reasons, basic predictive genetic tests can now be ordered online for a few hundred dollars. One company, 23andMe, in California, has collected some 4,000 litres of sputum since 2007, enlightening 2m people on their ancestry, health risks and what they may pass on to offspring. In April it received regulatory approval to screen for risk factors connected to ten diseases and genetic conditions, including late-onset Alzheimer's and Parkinson's. The ruling could open the floodgates for others to sell direct to consumers.

"Information is power", argue many who take such tests. But insurers fear that without equal access to such information, they will lose out to savvy customers. Consumer groups, on the other hand, fear that if underwriters did have access to such information, people with "bad" genes might find themselves unfairly excluded from cover. Either way, the scientific advances could well disrupt insurance significantly.

Unlike diagnostic genetic tests, predictive ones are conducted on people without symptoms. The best-known example was provided by Angelina Jolie, an actress who discovered she had a gene mutation that markedly raised her risk of breast cancer. She underwent a double mastectomy.

Tests might influence financial as well as medical decisions. A person at

increased risk of dying young may want to buy life insurance. Someone likely to contract cancer may buy cancer or critical-illness cover, which pays a lump sum upon diagnosis. Because predictive tests—unlike diagnostic ones—often need not be disclosed, the customer can secure an advantage over a future insurer.

So underwriters warn that predictive genetic testing could well lead to adverse selection. The *New York Times* recently reported on a woman who bought long-term care insurance after testing positive for ApoE4, a mutation of a gene related to increased risk of Alzheimer's. The insurer had tested her memory three times before issuing the policy, but could not know about the genetic result. Robert Green, at Harvard University, found that people told they have the mutation were five times more likely to buy long-term care insurance than those without such information.

Asymmetry of information—when the customer knows more than the insurer—is the industry's nightmare. If predictive tests further improve and become more common while non-disclosure rules stay in place, some insurance products might eventually die out. Either insurers would go belly-up, or premiums would become prohibitively expensive. Hence, argue some insurers, if the customer knows something relevant about their health, so should the insurer.

But tests might also help insurers. Christoph Nabholz, from Swiss Re, a reinsurance giant, is most excited about tests that spot early signs of cancer or cardiovascular disease. For life and health insurers, who want to keep people alive and well, such information could be invaluable. Discovery, a South African health insurer, plans to offer customers a test that maps part of their genome. The focus is on “actionable data”, where medical intervention or lifestyle change could mitigate risk, explains Jonathan Broomberg from Discovery.

This might help people who are already insured. But it worries those seeking new policies, who fear that underwriters may use predictive information to discriminate. Some might lose access to insurance. This raises ethical questions about when, if ever, genetic discrimination is acceptable. Moreover, since the relative role that genes play in the development of diseases is still being studied, some people might be unfairly and wrongly penalised.

| *Unpredictability rules*

So regulations today often protect consumers from the mandatory disclosure of predictive tests. But the rules are patchy. In Britain the industry has agreed to a blanket moratorium, renewable every three years, on using predictive genetic information. The sole exception is Huntington's chorea, where a test of one gene is infallible and has to be disclosed to an insurer for life cover worth more than £500,000 (\$662,000). In America the Genetic Information Nondiscrimination Act bans health insurers (and employers) from using such results, but is silent on other types of insurance. In several countries life insurers may already ask for disclosure of predictive genetic tests for policies over a certain value.

But testing is rarely cut-and-dried. Ronnie Klein from the Geneva Association, an insurance-industry think-tank, says that, unlike Huntington's, most illnesses stem from a number of factors, including lifestyle and environment, and a combination of genes. For example, although the ApoE4 allele increases the risk of Alzheimer's, many without it still get the disease.

Some regulators, such as Germany's, have outlawed direct-to-consumer tests. But nothing stops Germans from ordering from abroad, and, just as it became normal for life insurers to ask for family history, so insurers will surely eventually have access to relevant genetic information. The question will be what they are allowed to do with it. When blood tests for AIDS first

appeared, insurers also fretted about adverse selection. Many jurisdictions ruled they could not be used for calculating health premiums, as these were a basic good, but could be used for life policies. As genetic testing spreads, society and insurers may face many similar difficult assessments. ■



DNA和保险

猛兽已出笼

保险商担心有朝一日会被基因检测毁了生计

假如一项基因检测能查出你是否有较大的风险患癌症或老年痴呆，你会不会去做这项测试？随着这类测试变得更加方便，现在有越来越多的人回答“会”。保险业因而面临一些麻烦。

基本的预测性基因检测从前只用于医疗目的，如今花几百美元就可以在網上买到。加州23andMe公司自2007年以来已经收集了约4000升痰液，为200万人提供了血统、疾病风险，以及可能将什么遗传给后代等信息。今年4月，该公司获监管部门批准，可以筛查与十种疾病和遗传病症相关联的风险因素，包括在生命晚期出现的阿尔兹海默症和帕金森症。这项裁定结果可能为这一市场打开了闸门，大量直接向消费者销售的检测将汹涌而至。

“信息就是力量。”许多做这类检测的人如此主张。但保险商担心，如果自己沒有同等机会获得此类信息，就会败给那些勤于做功课的客户。而另一边，消费者团体担心如果保险商真的获得了此类信息，那些带有“坏”基因的人可能会被不公平地排除在保险服务之外。无论何种情况，科学的发展很可能会给保险业带来深刻的颠覆。

和诊断性基因检测不同，预测性检测是在那些并未显现症状的人们身上实施。最为人熟知的例子是女演员安吉丽娜·茱莉。她在检测出自己带有显著增加患乳癌风险的基因突变后，做了双侧乳腺切除术。

基因检测不但会影响医疗决策，可能还会影响理财。一个早逝风险更高的人可能会想购买人寿险。患癌几率高的人也许会想购买癌症或重大疾病保险，一旦确诊会获得大笔赔付。因为预测性检测不像诊断性检测，通常无需公开，客户在未来买保险时就可以占保险商的便宜。

保险商为此警告称，预测性基因检测很可能导致逆向选择。《纽约时报》近日报道了一名女性在检测出ApoE4阳性后购买了长期医保。携带ApoE4这种基因突变会增加患阿尔兹海默症的风险。保险公司给她做了三次记忆力检测后才核准她参保，但他们无从知晓这一基因检测结果。哈佛大学的罗伯特·格林（Robert Green）发现，检测出携带这种基因突变的人购买长期医保的可能性是其他人的五倍。

投保人知道的比保险商多，这种信息不对称是保险业的噩梦。如果预测性检测进一步改进并变得更加普遍，但保密原则不变，那么一些保险产品最终可能要消亡。要么保险商破产，要么保费涨到难以承受。因此，一些保险商主张，假如客户知道一些和自身健康有关的重要信息，那么保险商也该知道。

但检测也可能帮到保险商。瑞士再保险巨头Swiss Re集团的克里斯托夫·奈伯霍兹（Christoph Nabholz）对于能发现癌症或心血管疾病早期症状的检测最感兴趣。人寿和医疗保险商希望人们活着且身体健康，对他们而言这类信息可能极其宝贵。南非医疗保险商Discovery计划为客户提供能够描绘出其部分基因图谱的一项检测。该公司的乔纳森·布隆伯格（Jonathan Broomberg）解释说，这种检测关注的焦点是“可行动数据”，即能通过医疗干预或改变生活方式来减少风险的部分。

这可能会帮到那些已经买了保险的人。但那些想要购买新保险的人担心，保险公司可能会利用预测性信息差别对待投保人。一些人可能因此而买不到保险。这引发了伦理议题：“基因歧视”在何时可被容许（如果真有这样的时刻的话）？此外，基因在疾病发展中起到的相对作用目前仍在研究中，一些人可能会受到不公平和错误的惩罚。

| 不可预见性主导

所以，当前的监管规定通常都保护消费者，不要求他们公开预测性检测结果。但这类规定并不整齐划一。在英国，保险业已经同意一个禁用预测性遗传信息的一揽子协议，每三年续订一次，唯一的例外是亨丁顿舞蹈症，这种病可以通过检测某个基因获得是否会患病的确切诊断，在申请偿付超

过50万英镑（66.2万美元）的人寿险时必须告知保险商。在美国，遗传信息反歧视法案（Genetic Information Nondiscrimination Act）禁止医疗保险商（及雇主）使用这类检测结果，但对其他类型的保险并无要求。在少数几个国家，人寿保险商可能已就超过某个偿付数额的保单要求投保人告知预测性遗传检测结果。

但检测结果很少意味着已成定局。保险行业智库日内瓦协会（Geneva Association）的龙尼·克莱恩（Ronnie Klein）说，和亨丁顿舞蹈症不同，大部分疾病源自一系列因素，包括生活方式、环境，以及基因组合。比如，虽然ApoE4等位基因增加了患阿尔兹海默症的风险，许多并不携带这种基因的人却也得了这种病。

一些国家的监管机构，比如德国，已经把直接向消费者销售检测列为非法。但没什么能阻止德国人从海外购买检测。而正如人寿保险商询问家族病史已经变成惯例，各类保险商终有一天也会获得相关遗传信息。问题将在于他们被允许拿这些信息来做什么。艾滋病血液检测刚出现时，保险商也曾担心逆向选择。许多地区规定不能使用这一血液检测结果来计算医疗保费（因为医保是一种基础商品），但可用于审批人寿保险。随着基因检测的推广普及，社会和保险商可能面临许多类似的、棘手的评估。■



Football finance

Shooting stars

Why the world's best footballers are cheaper than they seem

FOR football clubs, August is often the costliest month, when they make vast bids for each other's players. This year has been particularly lavish. On August 3rd Paris Saint-Germain (PSG), a French team, signed Neymar da Silva Santos Júnior, a Brazilian forward, from Barcelona for €222m (\$264m), more than double the previous record price for a footballer.

With three weeks of the transfer "window" left, teams in Europe's "big five" leagues—the top divisions in England, Spain, Germany, Italy and France—have paid €3.2bn, just short of the record of €3.4bn set last year. The €179m splurged by Manchester City, an English club, on defenders outstrips 47 countries' defence budgets. Arsène Wenger, a veteran manager of Arsenal, a London team, and an economics graduate, describes the modern transfer market as "beyond calculation and beyond rationality".

Neymar, as he is known, will cost PSG's owners, a branch of Qatar's sovereign-wealth fund, about €500m over five years. In the betting markets, his arrival has boosted PSG's implied chances of winning the Champions League, Europe's most coveted club competition—but only from around 5.5% to about 9%. And prize money and ticket sales alone struggle to generate enough revenue to recoup such an outlay.

That does not make Neymar a bad investment. The goals he scores may matter less than the gloss he lends to the club's brand and the sponsors he will lure. He earns more from endorsements than any footballer except Cristiano Ronaldo and Lionel Messi. Some 59% of PSG's revenue of €520m last year was commercial (ie, other than ticket sales and broadcasting fees), more than any other club in the big five leagues. Neymar has more

followers on Instagram, a social network, than does Nike, his main sponsor and the provider of PSG's kit, for which privilege it pays €24m a year. Neymar's popularity will help PSG when this deal is renegotiated. Nike has already agreed to pay Barcelona €155m a season from 2018.

PSG's owners are confident of breaking even, though they could afford a loss. Qatar has been spending €420m a week preparing for the 2022 World Cup, and the signing of Neymar is a message that the otherwise embattled country remains strong and rich. The danger is to PSG, since under "financial fair play" rules, teams are punished if they fail to limit their losses. In 2014 the club was fined for violating these. Another failure to balance the books could mean a ban from the Champions League.

Such spending caps irk billionaire owners, but they have helped prevent the inflation of a transfer-fee bubble. The rapid rise is a result of European football's expanding fan base. In the English Premier League, football's richest, average net spending on players per club has stayed roughly constant, hovering at around 15% of revenue since the 1990s, according to the 21st Club, a football consultancy.

As long as clubs' revenues keep growing, the transfer boom is likely to persist. Broadcasting revenue, the game's first big injection of cash in the 1990s, has become, in the internet era, the weakest link. British television audiences for live games have dipped as some fans opt for illegal streaming sites or free highlights. Zach Fuller, a media analyst, reckons that signing a sponsorship magnet like Neymar is a hedge against volatility in that market.

Audiences are more robust elsewhere: around 100m Chinese viewers tune into the biggest games. Manchester United are the most popular team on Chinese social media, despite qualifying for the Champions League only twice in the past four seasons. They have overtaken Real Madrid, who have

won the trophy three times in the same period, as the world's most prosperous club. If Neymar unlocks new markets as well as defences, then PSG may have backed a winner. ■



足球金融

摘星

为什么世界上最好的足球运动员并没有看起来那么贵

对于足球俱乐部来说，八月是最花钱的月份，这时候它们都会出高价买下其他俱乐部的球员。而今年尤其大手笔。8月3日，法国球队巴黎圣日耳曼支付了2.22亿欧元（2.64亿美元）的转会费，从巴塞罗那买进巴西前锋内马尔。这个价格是之前足球运动员身价纪录的两倍多。

离转会“窗口”关闭还有三周，欧洲的五大联赛——英国、西班牙、德国、意大利和法国的顶级联赛——已经花费了32亿欧元，离去年34亿欧元的纪录只差一点点。英国俱乐部曼城豪掷1.79亿欧元充实后防线，比47个国家的国防预算还多。伦敦球队阿森纳老资格的主帅、经济学硕士温格（Arsène Wenger）称现代转会市场“无法估量、失去理性”。

巴黎圣日耳曼的股东、也就是卡塔尔主权财富基金的一个分支，五年内将在内马尔身上总共花费约五亿欧元。在博彩市场上，他的到来增加了巴黎圣日耳曼赢得欧洲冠军联赛这一欧洲最受瞩目的俱乐部赛事的可能性，不过也只是将几率从约5.5%提升到9%左右。仅靠赛事奖金和门票销售很难产生足够的收入来弥补这一大笔支出。

这并不是说买下内马尔是个糟糕的投资。比起进球，他给俱乐部带来的品牌效应和他能吸引到的赞助商可能更重要。除了C罗和梅西，他的代言收入比其他任何球员都多。去年巴黎圣日耳曼5.2亿欧元的收入中，约59%是商业营收（即除门票和转播费以外的收入），多过五大联赛中的其他任何一家俱乐部。内马尔在社交网络Instagram上的粉丝比耐克还多，而耐克是他的主要赞助商，也是巴黎圣日耳曼队运动装备的供应商，耐克现在每年为这一特权支付2400万欧元。等再和耐克谈合同时，内马尔的声望会对巴黎圣日耳曼有利。耐克已经同意从2018年起每赛季付给巴塞罗那1.55亿欧元。

巴黎圣日耳曼的东家对收支平衡有信心，不过他们也承受得起亏损。为准备2022年世界杯，卡塔尔每周支出已达4.2亿欧元，而签下内马尔是传递一个信息，表明这个陷入困境的国家仍然强大而富有。有危险的是巴黎圣日耳曼，因为根据《财政公平法案》的要求，不能控制亏损的球队将受到惩罚。2014年该俱乐部曾因违反这些规定而被罚款。如果又一次收支失衡，那么可能会被欧冠禁赛。

这样的支出限制惹恼了拥有球队的亿万富豪们，但有助于防止转会费泡沫膨胀。转会费飙升是欧洲足球球迷群体不断扩大的结果。足球咨询公司21俱乐部（21st Club）的数据显示，自上世纪90年代以来，足球界收入最高的英超联赛中，每家俱乐部在球员身上的平均净支出基本持平，一直保持在年收入的15%左右。

只要俱乐部的收入不断增长，转会热潮很可能会持续下去。电视转播收入在上世纪90年代是这一运动的第一大资金来源，但在互联网时代，这部分收入已成为最薄弱的环节。因为一些粉丝转而访问非法的流媒体网站或收看免费的集锦节目，英国观看直播的电视观众已经减少。媒体分析人士扎克·富勒（Zach Fuller）认为，签下像内马尔这样的赞助吸铁石，是一种应对转播市场波动的对冲工具。

其他地方的观众群体则更稳固：大约有1亿中国观众会收看最盛大的足球赛事。曼联是中国社交媒体上最受欢迎的球队，尽管它在过去四个赛季里只获得过两次参加欧冠的资格。它已经超越了同一时期内三次捧杯的皇家马德里，成为世界上最富有的俱乐部。如果内马尔既能冲破其他球队的防线，又能打开新的市场，那么巴黎圣日耳曼可能下了个稳赚不赔的赌注。





The Fed's next chair

Rate race

Who will be the next head of the Federal Reserve?

LOOK only at unemployment and inflation, says Peter Conti-Brown, a historian of the Federal Reserve, and Janet Yellen is the Fed's most successful boss of all time. The second indicator may be below target, but that is a blip compared with the recessions most Fed chairmen have endured. So it is perhaps not surprising that President Donald Trump is openly considering retaining Ms Yellen, a Democrat installed by Barack Obama, after her term ends in February 2018. Nor by historical standards is it odd: the Fed's past three leaders were all reappointed by presidents from the other party. Yet Ms Yellen, whom Mr Trump criticised on the campaign trail, is not the leading candidate. PredictIt, a betting site, gives her a 28% chance of staying put. In front of her, with a 36% chance of appointment, is someone else Mr Trump is publicly weighing up: Gary Cohn (pictured on the left).

Mr Cohn was until January the chief operating officer and president of Goldman Sachs. He left that role to become the president's senior economic adviser. A domineering personality, he has amassed influence in the administration, outshining Peter Navarro, Mr Trump's trade economist. Mr Cohn is often said to lead a "globalist" faction within the White House, against protectionists like Mr Navarro and Steve Bannon, another adviser.

He would, however, make an unusual Fed chairman. He has no background in economics, even as a student. The previous chief to have been similarly unqualified was William Miller, who spent an unhappy year and a half in 1978 and 1979 presiding over low growth and soaring inflation. A happier comparison is to Marriner Eccles, chairman from 1934 to 1948. Like Mr Cohn—and unlike Miller—Eccles had been a successful financier. Also like

Mr Cohn, he was close to the president who appointed him, Franklin Roosevelt. And his lack of economics training did not stop him from backing Keynesian stimulus after the Depression, even before Keynes himself had published “The General Theory”. Eccles made such a mark that the Fed’s headquarters are named after him.

Mr Cohn might find the Eccles building staid. It lacks the day-to-day energy of the White House or Treasury, let alone the buzz of the trading floor. Inside, staff quietly digest vast quantities of economic research to prepare for less-than-monthly monetary-policy decisions. Some wonder if Mr Cohn has an appetite for the minute analysis which, unlike the practice in most organisations, is carried out even by the Fed’s leaders. The chairman can, of course, lean on his staff. But one of Miller’s problems, says Mr Conti-Brown, was that he lost the respect of his better-trained colleagues.

The Fed’s chairman has to be confirmed by the Senate, and some doubt whether it would accept Mr Cohn. Despite the Republicans’ control of the chamber, Ms Yellen, given her record, may be a surer bet. Yet the praise for her record can be overdone. She has not been tested by many economic shocks. And the inflation shortfall—underlying inflation, currently 1.5%, has not hit the Fed’s 2% target during her tenure—was not entirely unforeseen. Larry Summers, the former treasury secretary whom she beat to the job, has been relentlessly advocating looser monetary policy to stoke more inflation. Ironically, Ms Yellen’s main charm for Mr Trump seems to be that she is “a low-interest-rate person”. In truth, she relies on the unemployment rate to guide her. While it was too high, she was doveish. Now it is just 4.3%, she seems comparatively hawkish.

| *The Cohn unknowns*

The interest-rate opinions of the favourite to succeed her are less clear. Mr Cohn thinks that monetary policy is a global endeavour, and that central banks may have been playing beggar-thy-neighbour. In March 2016 he told

a conference that if every central bank suddenly raised interest rates by three percentage points, “the world would be a better place”. Yet he also said he was not sure Ms Yellen had been right to raise rates three months earlier. And he criticised the Fed’s recent forward guidance as confusing for the markets. He said it should worry more about what it does than what it says.

The Fed is not only responsible for monetary policy. It is also the biggest regulator of banks. Here Mr Cohn is more in sync with Mr Trump’s deregulatory agenda. However, that may not matter much. The president recently nominated Randal Quarles, another critic of recent regulation, to be vice-chairman for supervision, a post left empty since it was created in 2010 (though in practice the job was done by Daniel Tarullo, who left the Fed in April). Whoever heads the Fed, Mr Quarles will probably take the lead on regulation.

Other candidates are in the frame. Kevin Warsh (pictured on the right), a former banker who was a Fed policymaker from 2006 to 2011, appears to be manoeuvring for the job. Republicans in Congress may favour John Taylor (in glasses), a Stanford academic who devised a mathematical rule that describes central banks’ actions and, like many Republicans, wants the Fed to follow such an algorithm.

The two outsiders have contrasting skills. Mr Warsh is a smooth-talking politician who may lack the intellectual firepower of past Fed chairs. Nobody can doubt Mr Taylor’s braininess. But he did not leave much of a mark on Washington during previous stints there, most recently at the Treasury during George W. Bush’s first presidential term. So he may lack the political nous the job demands. In any case, Mr Warsh and Mr Taylor may well both be too hawkish for Mr Trump. After the financial crisis, both opposed the Fed’s quantitative easing (QE)—ie, purchases of securities using newly created money—warning of a surge in inflation. In fact, inflation has mostly been too low since then.

No names spring to mind, but Mr Trump still has time to find a trained economist who is a Republican and yet tends towards Ms Yellen's views on interest rates. Even such a conservative dove might shake up the Fed. Republicans have long complained about its \$1.8trn portfolio of mortgage-backed securities, a result of QE. The central bank hopes to start unwinding QE soon, but its current plans would leave some mortgage-backed securities on its balance-sheet for more than a decade. A Republican chairman might make his mark by offloading these securities faster. But given the stability of Ms Yellen's tenure, markets could be forgiven for wanting as few changes as possible. ■



美联储的下一任主席 利率竞赛

美联储下任主席花落谁家？

如果只看失业率和通货膨胀率，珍妮特·耶伦是美联储有史以来最成功的掌门人，研究美联储的历史学家彼得·康迪-布朗（Peter Conti-Brown）这样表示。第二个指标即通胀率可能低于美联储的目标，但这与大多数美联储主席经受过的经济萧条相比微不足道。因此特朗普总统公开表示正考虑留任由前总统奥巴马任命、身为民主党人的耶伦，也许就没什么好令人惊讶的了。耶伦的任期将于2018年2月结束。从历史惯例来看，耶伦留任也没什么不寻常：美联储前三任主席都是由来自另一党派的总统再次任命的。但是，曾被特朗普在竞选活动中指摘过的耶伦并非首选对象。博彩网站PredictIt预测耶伦留任的概率为28%。而以36%的任命概率位列她之前的是特朗普公开考量的另一个人——加里·科恩（Gary Cohn，图中最左者）。

今年1月科恩辞去高盛集团总裁兼首席运营官的职务，转而担任总统的高级经济顾问。专横跋扈的科恩在政府中的影响力日益彰显，风头盖过特朗普的贸易经济学家彼得·纳瓦罗（Peter Navarro）。科恩常被视为在白宫内领导着一个“全球主义”的小派系，与纳瓦罗以及另一位经济顾问史蒂夫·班农（Steve Bannon）等贸易保护主义者针锋相对。

然而，如果科恩上台，他将是一名非同寻常的美联储主席。科恩没有经济学背景，甚至学生时代也未学过经济学。之前也有一名同样资历欠缺的美联储主席威廉·米勒（William Miller）。在他1978至1979年间一年半的糟糕任期里，美国经济低迷，通胀飙升。另一个更令人鼓舞的比较对象是1934至1948年担任美联储主席的马瑞纳·伊寇斯（Marriner Eccles）。有别于米勒，伊寇斯与科恩都曾是成功的金融家，此外两人都与任命他们的总统关系密切。伊寇斯由罗斯福总统任命，他也欠缺经济学背景，但这并不妨碍他在“大萧条”之后支持凯恩斯主义的经济刺激政策，那时凯恩斯本人甚至还未出版他的《通论》。伊寇斯留下了如此浓墨重彩的一笔，以至

于美联储总部大楼都是以他的名字命名的。

科恩可能会觉得伊寇斯大楼了无生气。它缺乏白宫或财政部的日常活力，更别说像交易大厅那样的喧闹了。在大楼内，员工们悄无声息地分析处理海量的经济研究，为不到一个月就要进行一次的政策决策做准备。有人怀疑科恩是否对这样细致入微的分析有兴趣。和大多数机构的做法不同，在美联储，就连领导层也要做这项工作。主席当然可以倚仗员工来出力。不过康迪-布朗指出，米勒的问题之一就是失去了比自己更加训练有素的同事们的尊重。

美联储主席的任命必须得到参议院批准，而一些人怀疑科恩得不到参议院的认可。尽管国会由共和党控制，但从耶伦的履历看，她似乎是更可靠的选择。不过对耶伦的履历或许有过誉之嫌。她没有经历过很多经济冲击的考验。她任期内的通胀率不足（目前的基础通胀率为1.5%，未达到美联储2%的目标）并不是完全无法预料的。曾在美联储主席角逐中输给耶伦的前财政部长拉里·萨默斯（Larry Summers）一直坚持不懈地倡导更加宽松的货币政策以提升通胀。讽刺的是，对特朗普来说，耶伦最大的魅力似乎在于她是“一个主张低利率的人”。而事实上，失业率才是耶伦的行动指南。当失业率过高时，她是温和的鸽派；目前失业率仅为4.3%，她的作风似乎又更偏鹰派。

| 科恩未知数

作为接替耶伦的最热门人选，科恩对于利率的观点就不那么清晰。他认为货币政策需要全球共同的努力，而各国央行可能一直都在玩着损人利己的把戏。2016年3月，他在一次会议上表示，如果每个国家的央行都将利率骤然提高三个百分点，“世界将变得更美好”。但他同时也表示，自己不能确定耶伦三个月前加息的做法是否正确。他还批评美联储最近一次的“前瞻性指引”令市场困惑。他说，比起“所说”，美联储更应该担心自己的“所做”。

除了主管货币政策，美联储还是各家银行最大的监管机构。就此职能而言，科恩与计划放松金融监管的特朗普更能协同一致。然而，这可能也不

大重要。总统最近提名了另一位对近年监管政策持批评态度的兰德尔·夸尔斯（Randal Quarles）为美联储负责金融监管的副主席——该职位自2010年设立以来一直处于空缺状态，不过这项工作实际上是由今年4月从美联储辞职的丹尼尔·塔鲁洛（Daniel Tarullo）承担了。无论谁就任美联储主席，夸尔斯都有可能负责金融监管。

图片中还有另两名候选人。前银行家、2006至2011年担任美联储理事的凯文·沃什（Kevin Warsh，图中最右者）似乎也有意角逐主席之位。国会中的共和党人则可能更支持斯坦福大学学者约翰·泰勒（John Taylor，图中戴眼镜者），他发明了一条数学规则来描述各国央行的货币政策行为。和很多共和党人一样，他希望美联储采用这样一个规则。

获胜希望渺茫的沃什和泰勒各有所长。沃什是一个能言善道的政客，但可能缺乏历任美联储主席的深厚学养。没人能质疑泰勒的学识，但他之前在华盛顿任职期间鲜有建树（最近一次是在小布什第一任期内任职财政部），因此他可能缺乏该职位所需的政治智慧。无论如何，对特朗普来说，沃什和泰勒两人很可能都过于鹰派。金融危机之后，他俩都反对美联储的量化宽松货币政策，即用新增货币购买证券。他们警告此举会引发急剧的通货膨胀。而实际上，从那时起，通胀率大多都过低。

尽管目前还没有名字跳将出来，但特朗普仍有时间去找到这样一个人：一位训练有素的经济学家，是共和党人，但在利率上倾向于耶伦的观点。而即使这样一个保守的鸽派人士仍有可能撼动美联储。长时间来，共和党人对美联储量化宽松的产物——1.8万亿美元的抵押贷款证券投资组合——颇为不满。美联储希望不久之后开始解除量化宽松，但它目前的计划会让一些抵押贷款证券在其资产负债表上留存十年以上。如果一位共和党籍主席能够更快速地清理掉这些证券，那他将一举成名。但是考虑到耶伦任内的稳定性，市场希望尽可能少的变动也情有可原。 ■



Online travel

The Priceline party

Left for dead after the dotcom boom, a low-profile internet company has staged an impressive comeback

NOT since the dotcom boom at the turn of the century have technology shares been on such a tear. On July 19th the S&P 500 index of information-technology stocks hit a record high, closing above its previous peak in March 2000 (see Buttonwood). As titans like Google, Facebook and Amazon hog the limelight, other firms can go unnoticed. One that deserves more attention is Priceline, the world's largest onlinetravel company.

Those old enough to remember the dotcom boom may still associate Priceline, which was founded in 1997, with its "name your own price" feature, which let consumers bid for hotel rooms and flights. Today it is a Goliath. Its stable of online sites for booking hotels, cars, flights and restaurants spans the world and includes Booking.com, Kayak, Agoda and OpenTable. Over the past decade Priceline's pre-tax earnings have grown at a compound annual rate of 42%, faster than Apple, Amazon, Netflix and Alphabet (see chart). It also boasts a 96% gross margin. Its share price has risen by more than 50% over the past 12 months, about four times faster than the broader stockmarket. On July 26th the firm's market value rose above \$100bn.

Perhaps because Priceline is based in Connecticut, not Silicon Valley, it is often overlooked by geeks and technology investors, who revere Airbnb, a platform for booking overnight stays in other people's homes which is valued at around \$30bn. Ask an entrepreneur in San Francisco about Priceline, and you are likely to get a blank stare. Insiders know better. "There's nothing you can point to and say, 'That's something no one else could have done,'" says Adam Goldstein of Hipmunk, another online-travel

firm. “It’s just that Priceline did everything better in every way.”

The most important reason for Priceline’s success is shrewd dealmaking. In 2005 it paid around \$135m to buy Booking.com, a Dutch website that aggregates hotel inventory, and merged it with another acquisition, a British travel site called Active Hotels. Today Booking.com has the world’s largest supply of hotel accommodation and accounts for the lion’s share of Priceline’s revenue and market value. Booking.com was one of the best deals “in the history of the internet”, says Mark Mahaney of RBC Capital, an investment bank.

Priceline’s focus on accommodation helps explain why it is more profitable and more highly valued than Expedia, a rival online-travel company that operates sites such as Orbitz, Travelocity, Trivago and Hotels.com. Expedia does more business booking flights, but these are not as lucrative. Online-travel firms take a meaty commission of 15-18% of a hotel room’s price, compared with a slim 3-4% for airfares, according to Brian Nowak of Morgan Stanley, another investment bank.

Unlike Google and Amazon, Priceline does not aim to be on the cutting edge of technology, but it does make clever use of it. Booking.com excels at bidding for online-search keywords. It is rumoured to be the world’s top spender on Google: last year it spent \$3.5bn on “performance marketing”, which is mostly related to search advertising. Booking.com is also constantly trying new features: it runs around 1,000 tests a day to see what makes users more likely to click “book”. Some of these experiments, such as free cancellations and ranking hotels by the strength of their Wi-Fi, have become permanent features.

Steady management has helped the company, too. Glenn Fogel became Priceline’s boss in January, after the previous boss, Darren Huston, resigned for having an affair with an employee. But Mr Fogel, a former investment

banker and trader, has worked at Priceline for 16 years and is credited with initiating the Booking.com deal. Asked about his firm's success, he attributes some of it to letting acquired firms go about their business. Kayak, an aggregator of travel listings that Priceline purchased for \$1.8bn in 2012, for instance, still retains separate headquarters in Connecticut, six miles away from Priceline.

And then there are the lessons of the firm's own history. One is not to try too many things at once. During the dotcom boom the firm took the "name your own price" concept to extremes, allowing people to bid on petrol, groceries and even mortgages. The ensuing bust was bleak: Priceline's market value dropped by more than 99%, to \$190m (the share price is up by 30,000% since that trough). That experience taught management to prize discipline and profitability. The corporate ethos today is one of a "workhorse, not show-pony", says one person close to the firm.

If analysts have their numbers right, the future looks bright for Priceline. Last year travel accounted for an estimated 10% of global GDP, or \$7.6trn. But only around a third of that is booked online. This share is expected to rise by a couple of percentage points a year over time, about the same pace as e-commerce more broadly. And as people become wealthier, they tend to travel more; many in emerging markets are venturing abroad for the first time.

New markets beckon, too. The concept of "alternative accommodation"—rentals of apartments, villas and homes—was popularised by such firms as Airbnb, HomeAway and VRBO (the last two are both now owned by Expedia). But Priceline is bulking up in this area: last year it offered 568,000 "alternative accommodation" listings on Booking.com, nearly 50% more than a year earlier. Airbnb lists 3m, but many of those are individual rooms for rent in a larger home, whereas Priceline mostly offers entire properties, many of them professionally

managed.

Mr Fogel argues that Priceline's approach of offering both hotels and other accommodation makes sense, because people like having a variety of choices available in one place. But Priceline will increasingly compete with Airbnb, which is expected to go public next year and is hungry for growth. Airbnb is said to have plans to add more listings of boutique hotels and bed-and-breakfasts to its own service and has suggested it could offer flights, although it has not offered any details.

Priceline and Airbnb will also compete over more of consumers' budgets when they travel. Earlier this year Airbnb started selling local "experiences" with guides. Booking.com is experimenting with selling tours and other on-the-ground activities in several cities. The idea is to offer a "holistic system" for travel, says Mr Fogel, so people can use the Booking.com app to check into hotels without queuing, enter their room by swiping their phone as they do to board an airline, and make dinner reservations through OpenTable. Such features are meant not only to increase the company's share of consumer spending, but also to ensure that customers continue to book on Priceline's sites rather than directly with hotels and restaurants.

But becoming a one-stop-shop for all travel needs won't be easy. Priceline's least successful acquisition was OpenTable, for which it spent \$2.6bn in 2014. Last year Priceline wrote down around a third of its value, acknowledging that the restaurant-booking service was not expanding as quickly as had been expected. This suggests that consumers may be comfortable using all-purpose sites to book hotels and flights, but still want to use real-life concierges for local recommendations.

Airbnb is not the only rival Priceline has to worry about. Technology firms will launch more pointed attacks. Google already offers consumers the ability to research flights and routes, directly taking on Priceline's Kayak.

The search giant can use its vast trove of data on consumers to push more deeply into the travel business.

The most dangerous rival, however, may well come from somewhere else entirely. “We’re all waiting for the moment when a big Chinese company comes in and tries to take market share,” says Erik Blachford, a former boss of Expedia. Ctrip, a giant based in Shanghai and worth an estimated \$30bn, is the obvious candidate. But if it indeed makes a move, Priceline will not necessarily suffer. Not only is its Chinese business growing nicely, but it has also invested nearly \$2bn in Ctrip’s debt and equity. Small wonder that some analysts consider Priceline the best-run internet company after Amazon. ■



在线旅游

Priceline的狂欢

这家低调的网络公司在互联网热潮过后曾半死不活，如今卷土重来，令人瞩目

自世纪之交的互联网热潮后，科技股从未如此高歌猛进过。7月19日，标普500指数信息技术板块创下收盘记录新高，超过了上次于2000年3月创下的高点。有谷歌、Facebook和亚马逊这样风头正盛的巨头在，其他公司很容易被忽略。不过有一家公司值得多加关注，那就是世界最大的在线旅游公司Priceline。

Priceline创立于1997年。年纪足够大、记得互联网繁荣期的人也许还是会把这家公司与其“由你定价”（“name your own price”）的功能联系起来。所谓“由你定价”，就是让消费者竞拍酒店房间及航班。如今的Priceline已成为巨头，旗下用于预订酒店、汽车、航班及餐厅的网站分布于全球各处，包括缤客（Booking.com）、客涯（Kayak）、安可达（Agoda）和OpenTable。过去十年，Priceline的税前利润以42%的复合年增长率提升，比苹果、亚马逊、Netflix和Alphabet都快（见图表）。它的毛利率也高达96%。过去12个月，其股价涨幅超过50%，增速几乎是大盘的四倍。7月26日，公司市值突破1000亿美元。

也许是因为Priceline的总部在康涅狄格州而不是硅谷，所以往往会被极客和技术投资者忽视。他们推崇备至的是爱彼迎（Airbnb）这个估值约300亿美元的民宿短租平台。向一个旧金山的创业者打听Priceline，对方可能只会茫然地看着你。业内人士知道得更清楚。“它没有哪件事能让你指着说，‘这事儿应该没人做过’，”另一家在线旅游公司Hipmunk的亚当·戈德斯坦（Adam Goldstein）说，“但Priceline就是能从方方面面把所有事情都做得更好。”

Priceline之所以成功，最重要的原因就是精明的交易。2005年，它以大约1.35亿美元收购了整合酒店客房供应的荷兰网站缤客，并将其与自己收购的另一家旅行网站、英国的Active Hotels合并。如今，缤客拥有全世界最

大的酒店住宿供应，并占据了Priceline营收及市值的最大份额。投行RBC Capital的马克·马哈尼（Mark Mahaney）说，收购缤客是“互联网史上”最划算的交易之一。

从Priceline对住宿服务的专注，就可以了解为什么它的利润和估值都比竞争对手亿客行（Expedia）要高。亿客行运营的网站有Orbitz、Travelocity、Trivago和Hotels.com等。亿客行航班预订的业务要多些，不过这项业务不像住宿那么赚钱。另一家投行摩根士丹利的布莱恩·诺瓦克（Brian Nowak）称，在线旅游公司能抽取酒店房价15%至18%的丰厚佣金，却只能从机票价格中获得微薄的3%到4%。

和谷歌及亚马逊不同，Priceline并不立志走在科技的前端，不过它巧妙利用了科技。缤客在网络搜索关键词竞拍方面表现突出。有传言称它是全世界在谷歌那里花钱最多的公司：去年，它在主要与搜索广告有关的所谓“绩效营销”上花费了35亿美元。缤客还在不断尝试新功能：它每天大约开展1000次测试，看怎样才最有可能让用户点击“预订”。其中一些试验已成为常态功能，例如免费取消预订和根据Wi-Fi信号强弱为酒店排名。

稳健的管理也有所助益。1月，格伦·福格尔（Glenn Fogel）成为Priceline的老板。在此之前，其前任戴伦·哈斯顿（Darren Huston）因与一名员工有染而辞职。不过，曾是投资银行家及交易员的福格尔已在Priceline工作了16年，并被公认为缤客收购案的发起人。当被问及公司成功的要诀时，他指出部分原因在于让收购对象自行其是。例如，公司在2012年以18亿美元收购整合旅行服务信息的客涯后，仍让它保留了位于康涅狄格州的独立总部，与Priceline相隔六英里。

此外还有从公司自身历史中得到的教训。其一是一不要同时尝试太多东西。互联网繁荣时期，Priceline将“由你定价”的理念推行到极致，让人们竞价购买汽油、食品杂货，甚至抵押贷款。紧接着便是惨痛的失败：Priceline的市值跌去超过99%，降至1.9亿美元（自那时的低谷之后，其股价提升了30,000%）。那次经历让管理层认识到，要高度重视纪律和盈利能力。一位与该公司关系密切的人士称，Priceline如今的理念是“要做吃苦耐劳的老

黄牛，而不是一包草的绣花枕头”。

如果分析人士的数字准确无误，Priceline的前景看起来一片光明。去年，旅游出行估计占全球GDP的10%，即7.6万亿美元。不过其中只有大约三分之一来自网上预订。假以时日，预计这一份额每年将增长若干个百分点，大约与范围更广的电子商务增速一致。随着人们日渐富裕，他们会比以往更愿意出门旅行。在新兴市场，很多人正在进行生平第一次国外之旅。

新市场也在招手。爱彼迎、HomeAway和VRBO这样的公司令“替代型居所”——公寓、别墅及房屋的租赁——这一理念风行起来（HomeAway和VRBO现在归亿客行所有）。不过Priceline在该领域正日益壮大：去年，它在缤客上提供了56.8万个“替代型居所”房源，几乎比上一年增加了50%。爱彼迎登记的房源有300万个，不过其中很多都是一套大房的单个房间，而Priceline提供的大多是整套物产，其中很多都由专业人士打理。

福格尔认为，Priceline同时提供酒店和其他住宿服务的做法是明智的，因为人们喜欢在一个地方就能找到各种选择。不过Priceline与爱彼迎之间的竞争将愈加激烈——后者预计明年上市，正迫切寻求增长。据说爱彼迎计划增加更多精品酒店和B&B（bed-and-breakfast）家庭旅馆房源。它还暗示有可能增加航班预订服务，不过尚未透露任何细节。

Priceline和爱彼迎还将与对方争夺更多的消费者出行预算。今年早些时候，爱彼迎开始销售提供导游的当地“体验”之旅。缤客也开始尝试在部分城市出售游览项目以及其他线下活动。福格尔说，Priceline的想法是为旅游出行提供一个“全方位系统”，这样人们用缤客的应用就能办理酒店入住而无需排队，刷一下手机（就像他们登机时那样）就能进房间，然后再用OpenTable预订晚餐。提供这些功能不仅是为了提高公司在消费者支出中所占的份额，还是为了确保消费者能继续在Priceline旗下网站预订各项服务，而不是直接和酒店及餐馆交易。

然而要为所有出行需求提供一站式服务并不容易。Priceline最不成功的收购就是在2014年花费26亿美元买下了OpenTable。去年，Priceline将

OpenTable减记三分之一，承认餐饮预订服务并未如预期那般快速扩张。这显示出，消费者也许愿意使用多用途网站来订酒店和航班，但仍想从现实生活中的酒店礼宾员那里打听当地好吃好玩的地方。

Priceline要担心的对手并不只有爱彼迎一个。科技公司发起的攻击会更猛烈。谷歌已经向消费者提供了搜索航班及出行路线的功能，正面与客涯抗衡。这家搜索巨头可以利用自己巨大的消费者数据宝藏，进一步向旅游业务深入推进。

不过，最危险的竞争对手很可能完全来自其他某个地方。亿客行的一位前任高管埃里克·布拉奇福德（Erik Blachford）说：“我们都等着，看什么时候会有一家中国大公司出现，来抢占市场份额。”总部位于上海、市值约300亿美元的携程显然有望成为这样的公司。不过就算携程真有动作，Priceline也不见得一定会受损。Priceline在中国的业务增长状况良好，还投资了携程的债券及股票近20亿美元。有分析人士认为Priceline是除亚马逊之外运营最佳的互联网公司，也就不足为怪了。■



Economic and financial indicators

Manufacturing activity

China's PMI records a four-month high

The latest manufacturing data from IHS Markit, a research firm, paints a reasonably cheery picture. In Britain the purchasing managers' index (PMI) rose for the first time in three months, to 55.1 (anything above 50 indicates an expansion in activity). The weak pound helped British factories record the strongest rise in export orders since April 2010. Although the rate of expansion slowed in the euro area, activity still increased in all the countries surveyed. China's PMI confounded expectations of a slowdown, recording a four-month high of 51.4. In India, however, the new goods-and-services tax weighed on manufacturing: the sector contracted at its steepest pace in over eight years. ■



经济与金融指标

制造业活跃度

中国的采购经理指数录得四个月来的最高数字

研究公司IHS Markit最新公布的制造业数据还算鼓舞人心。在英国，采购经理指数（PMI）三个月来首次上升，达到55.1（只要在50以上，就表示生产活动趋于活跃）。英镑疲软帮助英国工厂实现2010年4月以来出口订单量最为强劲的增长。虽然欧元区制造业扩张的速度放缓，但所有被调查国家的生产活跃度仍在上升。在中国，与扩张放缓的预期相左，采购经理指数录得四个月来的最高数字51.4。然而在印度，新的商品及服务税令制造业受压，该部门经历了八年多来幅度最大的收缩。 ■



Expenditure among the affluent

How to spend it

A new book looks at how expenditure has changed among America's affluent

STATUS symbols are as old as humanity itself. It was only once ancient Rome became rich enough for plebeians to decorate their homes that elites sought to do one better by installing mosaics in their villas; in Victorian England working-class women began to don worsted stockings to mimic the silk hosiery of the 1%. At the end of the 19th century Thorstein Veblen, an American sociologist, decried the “conspicuous leisure” of the robber barons of his age, who set themselves apart through their ability to avoid labour; he went on to bemoan the “conspicuous consumption” of the working classes seeking to imitate the wealthy’s access to luxury goods.

Conspicuous consumption persists today. But just as the patricians of classical times changed their habits once the masses gained the ability to copy them, so too have modern American elites recoiled from accumulating mere goods now that globalisation has made them affordable to the middle class. Instead, argues Elizabeth Currid-Halkett, a professor at the University of Southern California, in “The Sum of Small Things”, they have begun consuming the fruits of “conspicuous production”: socially worthy things like fair-trade coffee. They also emphasise “inconspicuous consumption”, of services like education. Far from making the world more egalitarian, this shift, in particular, threatens to entrench modern elites’ privileged position more effectively than the habits of their predecessors ever did.

As inequality has increased over the years, so have researchers’ attempts to grapple with its causes and consequences. Ms Currid-Halkett distinguishes herself by bridging the divide between qualitative and quantitative approaches. Her book has no shortage of anecdotes to illustrate cultural

trends and it digs deep into the detail of the Consumer Expenditure Survey, administered by the Bureau of Labour Statistics. Using the survey's data from thousands of respondents, she paints a remarkably fine-grained portrait of how the spending habits of Americans have evolved over the decades.

Defining “conspicuous consumption” as “apparel, watches, jewellery, cars and other socially visible goods”, she finds that even though the poor must dedicate much of their income to basic necessities, they devote a higher share of their total spending to conspicuous consumption than the rich do. And the trend is gaining steam. Between 1996 and 2014 the richest 1% fell further behind the national average in the percentage of their spending dedicated to bling. The middle income quintile went the other way: by 2014 they spent 35% more than the average as a percentage of their annual expenditure.

Rather than filling garages with flashy cars, the data show, today's rich devote their budgets to less visible but more valuable ends. Chief among them is education for their children: the top 10% now allocate almost four times as much of their spending to school and university as they did in 1996, whereas for other groups the figure has hardly budged. They also invest heavily in domestic services such as housekeepers, freeing up time that the less fortunate must spend on chores.

“The Sum of Small Things” both unearths evocative differences between big American cities—for example, Los Angeles leads in bottled-water consumption, while New York does in spending on shoes—and makes clear that the “aspirational class” Ms Currid-Halkett profiles is almost exclusively coastal and urban. However, that may yield a lopsided portrait of the top of the income pile: largely absent from her tale are the business-minded rich in politically conservative states.

The reader learns that residents of Dallas and Houston dedicate unusually low shares of spending to housing costs and to fresh fruit, and a relatively high portion to textiles, furniture and beauty products such as wigs—but not whether the rich among them mimic their blue-state counterparts in seeking to project virtue via heirloom tomatoes and the like. Perhaps a sequel might explore the values of Sun Belt suburbanites, and how this other half of privileged Americans signal status through their spending. ■



富人的开支 如何花钱

一本新书探究美国富裕阶层的开支发生了怎样的改变

自打人类出现，社会地位的象征就存在了。等到古罗马变得足够富庶，平民也得以装饰自己的家之时，精英阶层便开始用马赛克装点大宅，好让自己的家变得更气派。在维多利亚时期的英国，劳动阶级的妇女为模仿社会顶层1%的人穿丝袜的习惯，开始穿精纺的长袜。到了19世纪末，美国社会学家托斯丹·凡勃伦（Thorstein Veblen）痛斥同时代强盗大亨的“炫耀性有闲”——这些人有逃避劳动的能耐，借此将自己与其他人区别开来。凡勃伦继而哀叹劳动阶级为了像富裕阶层那样获取各种奢侈品，也开始了“炫耀性消费”。

炫耀性消费至今仍然存在。不过就像古典时期普通民众一旦获得了效仿贵族的能力，贵族阶层就会改变自己的习惯，当全球化令中产阶级也买得起各种商品之时，现代的美国精英已不再热衷于纯粹积累物品。南加州大学教授伊丽莎白·科瑞德-哈尔基特（Elizabeth Currid-Halkett）在《琐事之和》一书中指出，这些人现已开始享用“炫耀性生产”的成果，例如公平贸易咖啡这种有社会价值的东西。他们还很看重“非炫耀性消费”，例如教育等服务。后面这种转变远远谈不上让世界变得更平等，比起他们先辈的那些习惯，可能还会更有效地巩固现代精英阶层的特权地位。

随着这些年不平等状况的加剧，研究人员也愈加努力地尝试揭开不平等的根源及后果。科瑞德-哈尔基特的研究弥合了定性及定量两种分析手段的差异，因而独树一帜。她的书中不乏阐述文化趋势的趣闻轶事，并深入挖掘了美国劳动统计局开展的《消费者支出调查》的细节。利用参与该调查的数千名受访者的数据，她非常细致地描述了几十年来美国人消费习惯的演变。

作者将“炫耀性消费”定义为购买“服装、手表、珠宝、汽车和其他可向世人展现的商品”。她发现，尽管穷人必须将大部分收入用于购买基本必需

品，但炫耀性消费占他们总支出的比重比富人高，而且这种趋势正愈演愈烈。1996年至2014年间，最富有的1%人群在华服美饰上的消费占其总开支的百分比进一步落后于全国水平。中等收入阶层的人则反其道而行之。到2014年，他们在这方面的消费占其全年开支的百分比较平均值高出35%。

数据表明，今天的富人并不追求在车库里停满炫目豪车，而是将预算投入到不那么夺人眼球但却更有价值的事物上。其中最主要的就是子女的教育：收入前10%的人如今在这方面的支出几乎是1996年的四倍，然而在其他人那里，这项开支的数目却几乎没有变化。这些富人还在家政服务上投入重金，例如聘请管家。这样，他们就不用像境况较差的阶层那样，必须花时间亲自处理家务琐事了。

《琐事之和》揭示了美国大城市之间的不同之处，读来让人颇有共鸣，例如，洛杉矶在瓶装水消费上领跑其他城市，而纽约在鞋子上的开销位居第一。同时，书中也明确表示，作者所描述的“有抱负的阶层”几乎只限于沿海地区和城市。但这样一来，对高收入群体的描述可能就不够均衡——那些来自政治保守州的有商业头脑的富人在很大程度上被忽略了。

读者了解到，在达拉斯和休斯顿居民那里，住房费用及新鲜水果占总开支的比例异常低，纺织品、家具和美容产品（例如假发）的占比相对较高。但他们并不了解的是，这两地的有钱人在通过祖传番茄之类的东西展现自己的优越时，是不是在模仿蓝州的富人【译注：祖传番茄通常指那些非杂交、未经基因改造，最接近原始番茄的番茄；或由一代代种植者传下来的种子种出的番茄】。也许这本书的续篇可以探索一下南部阳光地带市郊居民的价值观，以及这些占据美国特权阶层半壁江山的人是怎样通过花钱来彰显自己的社会地位的。■



China's grand project

Where the twain shall meet

Western multinationals are coining it along China's One Belt, One Road

“MUTUAL benefit, joint responsibility and shared destiny,” sings a choir of enthusiastic schoolgirls in a music video called “The Belt and Road, Sing Along” from Xinhua, a news service run by the Chinese government, that mixes shots of cranes and shipping containers with people enjoying foreign landmarks. Western firms are scarcely less optimistic. Launched by China in 2013, the One Belt, One Road policy, known as OBOR, has two parts. There is a land-based “belt” from China to Europe, evoking old Silk Road trade paths, then a “road” referring to ancient maritime routes.

OBOR will span 65 countries (see map), and China has so far invested over \$900bn in projects ranging from highways in Pakistan to railway lines in Thailand. Western multinationals, spotting a bonanza, are selling billions of dollars of equipment, technology and services to Chinese firms building along it.

America's General Electric (GE) made sales of \$2.3bn in equipment orders from OBOR projects in 2016, almost three times the total for the previous year. John Rice, the firm's vice-chair, expects the firm to enjoy double-digit growth in revenues along OBOR in coming years. Other firms, such as Caterpillar, Honeywell, and ABB, global engineering giants, DHL, a logistics company, Linde and BASF, two industrial gas and chemicals manufacturers, and Maersk Group, a shipping firm, rattle off lists of OBOR projects. Deutsche Bank has structured eight trade deals around it and has an agreement with the China Development Bank, one of China's policy lenders, to fund several OBOR schemes.

All the activity has confounded early sceptics. They noted that in the past 15

years as China industrialised, the country's companies ran construction projects over an expanse approximately equivalent to the built area of all western Europe with very little help from foreign firms.

Yet OBOR has highlighted that Chinese groups have little experience abroad, and that their Western counterparts offer a technological edge and thorough knowledge of local conditions across the OBOR region, from Tajikistan to Thailand. Partnering with Western multinationals also gives Chinese companies credibility, particularly with financial institutions. One Western executive admits that Chinese companies make liberal use of his firm's name in OBOR project presentations to raise finance even though it is only marginally involved.

| *Below the belt*

Some executives worry that OBOR may have its downsides in the longer term. China wants to open up new markets for Chinese firms in sectors that are currently dominated by Western companies, across industries ranging from engineering and telecoms to shipping and e-commerce. Western firms are profiting handsomely from OBOR itself, but Chinese ones even more so. A database of open-source information collated by the Reconnecting Asia Project, run by the Centre for Strategic and International Studies, a think-tank in Washington, DC, shows that 86% of OBOR projects have Chinese contractors, 27% have local ones and only 18% have contractors of foreign origin.

Chinese firms are moving beyond contract work to become operators of projects and investors too. Their Western competitors may win lots of business in the OBOR countries only for as long as their technological advantage lasts. That lead in turn will be eroded as Western companies work with Chinese partners on OBOR. In 2016 alone, ABB did business with more than 400 Chinese enterprises, helping them adjust for huge differences in construction and engineering standards across countries.

Such firms will learn and advance in the process.

Yet for now, Western companies are focused on the opportunities. Jean-Pascal Tricoire, the Hong Kong-based chief executive of Schneider Electric, a French energy-services firm, says that for his company OBOR is one of the most important plans of the early part of this century. Honeywell has recently formed a team called “East to Rest” that manages sales and marketing to mainland firms that are expanding abroad. As a goateed singer in Xinhua’s music video promises Chinese viewers, “when Belt and Road reaches Europe, Europe’s red wine is delivered to the doorstep half a month earlier”. For years to come, OBOR looks likely to be the toast of Western boardrooms, too. ■



中国的宏大项目 殊途在此同归

跟着中国的“一带一路”，西方跨国公司大赚特赚

中国国家通讯社新华社发布的MV《“一带一路”全球唱》里，一群热情洋溢的女学生合唱道：“共同利益，共同责任，共同命运。”起重机、集装箱的镜头时时闪现，还有人在欣赏国外的风景名胜。西方公司也乐观得很。中国在2013年提出的“一带一路”政策（英文简称OBOR）由两部分组成。陆上有从中国到欧洲的“一带”，令人回想起丝绸之路贸易路线；另外还有“一路”，指的是古代海上通道。

“一带一路”将跨越65个国家（见地图），中国目前已投资了九千多亿美元的项目，从巴基斯坦的高速公路到泰国的铁路。西方跨国公司注意到了这个金矿，正在将数十亿美元的设备、技术和服 务卖给建设“一带一路”的中国公司。

美国的通用电气公司2016年在“一带一路”项目上获得的设备订单额达23亿美元，几乎是上一年的三倍。公司副董事长约翰·莱斯（John Rice）预计，今后数年公司在“一带一路”上的收入会有两位数的增长。其他公司，如卡特彼勒（Caterpillar）、霍尼韦尔（Honeywell）和ABB这样的全球工程巨头，物流公司DHL，两大工业气体和化学品生产商林德（Linde）和巴斯夫（BASF），以及航运公司马士基集团（Maersk Group），说起“一带一路”项目来也是如数家珍。德意志银行已经就“一带一路”倡议达成了八项贸易协定，并且已与中国政策性银行之一的中国国家开发银行签署协议，将参与数个“一带一路”计划的融资。

所有这些进展都让之前的怀疑论者困惑不已。他们注意到在过去15年里，随着中国推进工业化进程，中国公司运营的建设项目总面积几乎相当于整个西欧的建筑面积，而几乎没有外国公司从旁协助。

不过“一带一路”也突显出中国集团在海外的经验很少，而西方同行可以提

供先进技术，还有对当地的全面了解——从塔吉克斯坦到泰国，它们对“一带一路”覆盖的各个地区都很熟悉。与西方跨国公司尤其是金融机构的合作也为中国公司积累了信誉。一位西方高管坦言，中国公司在“一带一路”项目展示中随意使用他公司的名字来筹集资金，尽管该公司对这些项目只是略有涉及。

| 潜在威胁

有些高管担心，长远看来“一带一路”会有负面效应。中国想在目前由西方公司掌控的领域为中国公司开辟新市场，包括工程、电信、航运和电子商务等行业。西方公司从“一带一路”中获利颇丰，但中国公司收获更多。位于华盛顿特区的智库美国国际战略研究中心（Center for Strategic and International Studies）开展了“重连亚洲项目”（Reconnecting Asia Project），该项目整理的一个开源信息数据库显示，在“一带一路”的各个项目中，86%有中国承包商，27%有当地承包商，仅18%有来自国外的承包商。

中国公司正超越承建工作，同时成为项目的运营商和投资商。它们的西方竞争对手只要能保持技术优势，就有可能在“一带一路”沿线国家赢得大量生意。但随着西方公司与中国同行在“一带一路”建设中开展合作，这一优势将被削弱。仅2016年，ABB就与400多家中国企业开展业务，帮助它们适应不同国家之间工程建设及工程标准的巨大差异。这些公司将在此过程中学习并成长。

不过到目前为止，西方公司关注的还是机遇。法国能源服务公司施耐德电气（Schneider Electric）的首席执行官赵国华（Jean-Pascal Tricoire）在香港工作，他说，对于他的公司来说，“一带一路”是本世纪初叶最重要的计划之一。霍尼韦尔公司最近组建了一个名为“东方服务世界”（East to Rest）的团队，为正向海外扩张的大陆公司管理销售和市场。正如新华社的MV里一个留着山羊胡子的歌手向中国观众承诺的那样，“一带一路来到了欧洲，这里的红酒提前半个月送到家门口”。未来多年里，看来西方公司的董事会可能也会为“一带一路”举杯相庆。 ■



AI in China

Code red

State-controlled corporations are developing powerful artificial intelligence. That is worrying

IMAGINE the perfect environment for developing artificial intelligence (AI). The ingredients would include masses of processing power, lots of computer-science boffins, a torrent of capital—and abundant data with which to train machines to recognise and respond to patterns. That environment might sound like a fair description of America, the current leader in the field. But in some respects it is truer still of China.

The country is rapidly building up its cloud-computing capacity. For sheer volume of research on AI, if not quality, Chinese academics surpass their American peers; AI-related patent submissions in China almost tripled between 2010 and 2014 compared with the previous five years. Chinese startups are attracting billions in venture capital. Above all, China has over 700m smartphone users, more than any other country. They are consuming digital services, using voice assistants, paying for stuff with a wave of their phones—and all the while generating vast quantities of data. That gives local firms such as Alibaba, Baidu and Tencent the opportunity to concoct best-in-class AI systems for everything from facial recognition to messaging bots. The government in Beijing is convinced of the potential. On July 20th it outlined a development strategy designed to make China the world's leading AI power by 2030.

An AI boom in the world's most populous place holds out enormous promise. No other country could generate such a volume of data to enable machines to learn patterns indicative of rare diseases, for example. The development of new technologies ought to happen faster, too. Because typing Chinese characters is fiddly, voice-recognition services are more

popular than in the West; they should improve faster as a result. Systems to adjust traffic lights automatically in response to footage from roadside cameras are already being tested. According to the McKinsey Global Institute, a research arm of the consultancy, AI-driven automation could boost China's GDP growth by more than a percentage point annually.

Yet the country's AI plans also give cause for concern. One worry is that the benefits of Chinese breakthroughs will be muted by data protectionism. A cyber-security law that came into force in June requires foreign firms to store data they collect on Chinese customers within the country's borders; outsiders cannot use Chinese data to offer services to third parties. It is not hard to imagine tit-for-tat constraints on Chinese firms. And if data cannot be pooled, the algorithms that run autonomous cars and other products may not be the most efficient.

A second area of unease is ethics and safety. In America, the technology giants of Silicon Valley have pledged to work together to make sure that any AI tools they develop are safe. They will look at techniques like "boxing", in which AI agents are isolated from their environment so that any wayward behaviour does not have disastrous effects. All the leading AI researchers in the West are signatories to an open letter from 2015 calling for a ban on the creation of autonomous weapons. If it happens at all, the equivalent Chinese discussion about the limits of ethical AI research is far more opaque.

Chinese AI companies do have incentives to think about some of these issues: rogue AI would be a problem for the planet wherever it emerged. There is a self-interested case for the formulation of global safety standards, for example. But a third concern—that AI will be used principally to the benefit of China's government—is a less tractable problem.

| *Autocratic intelligence*

The new plan is open about AI's value to the state. It envisages the use of the technology in everything from guided missiles to predictive policing. AI techniques are perfect for finding patterns in the massive amounts of data that Chinese censors must handle in order to maintain a grip on the citizenry. It is easy to imagine how the same data could boost the country's nascent plans to create a "social-credit" system that scores people for their behaviour. Once perfected, these algorithms would interest autocratic regimes around the world. China's tech firms are in no position to prevent the government in Beijing from taking advantage of such tools. Baidu, for example, has been appointed to lead a national laboratory for deep learning. Chinese AI will reflect the influence of the state.

Western firms and governments are no angels when it comes to data collection and espionage. But Western companies are at least engaged in an open debate about the ethical implications of AI; and intelligence agencies are constrained by democratic institutions. Neither is true of China. AI is a technology with the potential to change the lives of billions. If China ends up having most influence over its future, then the state, not citizens, may be the biggest beneficiary. ■



人工智能在中国

红色警戒

受国家控制的公司正在研发强大的人工智能，令人担忧

试想一下研发人工智能（AI）的完美环境。构成要素将包括强劲的处理能力、大批计算机科学研究人员、源源不断的资金，以及丰富的数据——用以训练机器识别模式并对模式做出反应。这样的环境听起来似乎是在描绘当下AI领域的领头羊美国，但在某些方面其实更接近中国。

中国正在快速建设云计算能力。如果不谈质量而仅论AI研究的规模，中国研究人员的成就要超过美国同行。2010年至2014年间，在中国提交的AI相关的专利申请数量几乎是前五年的三倍。中国创业公司正吸引着数十亿美元的风险资本。最重要的是，中国的智能手机用户超过七亿，比其他任何国家都多。他们消费数字服务，使用语音助理，用手机付账，过程中不断产生海量数据。这让阿里巴巴、百度和腾讯之类的本土公司有机会炮制各种同类最佳的AI系统，从人脸识别到聊天机器人。中国政府也相信本国研发AI的潜力。7月20日，政府出台了一项发展战略，力争到2030年将中国建设成为世界领先的AI强国。

在这个世界上人口最多的地方，AI的蓬勃发展孕育着巨大的希望。比如，没有哪个国家能产生如此大量的数据，让机器能够学习某些预示罕见疾病的模式。新技术的发展应该也会更快。由于输入汉字很费劲，语音识别服务在中国比在西方更受欢迎。因此，这类技术应该会更快地得到改进。根据摄像头拍摄到的路况来自动调节交通信号灯的系統已在测试中。咨询公司麦肯锡的研究部门麦肯锡全球研究院（McKinsey Global Institute）认为，AI驱动的自动化可以让中国的GDP增长率每年提高一个百分点以上。

不过，该国的AI计划也令人担忧。首先是中国在AI上的突破所带来的好处将被数据保护主义削弱。6月生效的一部网络安全法要求外国公司将它们收集到的中国客户的数据存储在中国境内，外国机构不能使用中国的数据向第三方提供服务。不难想象中国公司也会受到以牙还牙的限制。如果无

法汇集数据，运行自动驾驶汽车和其他产品的算法也许就无法达到最有效的水平。

第二个让人不安的领域是伦理和安全。在美国，硅谷的科技巨头已经承诺共同努力，确保它们开发的任何AI工具都是安全的。他们会考虑例如“装盒”（“boxing”）这样的技术，也就是将AI智能体与所处的环境隔离开来，这样，任何出格的行为都不会产生灾难性的后果。2015年，西方所有主要AI研究人员都签署了一封公开信，呼吁禁止开发自动武器。即便中国也会就AI研究的伦理限制展开讨论，其透明程度也会远远不够。

中国的AI公司确实有动力去思考上述的某些问题，因为无论从何处创生，流氓AI会对整个世界构成问题。比方说，制定全球性的安全标准也会对自己有利。但第三个担忧却是个不那么容易解决的问题：AI将主要服务于中国政府的利益。

| 专制智能

中国政府的新规划明言AI对整个国家的价值。从制导导弹到预测性警务，它展望了AI技术应用的方方面面。为保持对全体公民的控制，中国审查员必须处理大量的数据，而人工智能技术非常适合在这些数据中找到模式。不难想象相同的数据也能够推动该国的新兴计划，建立一个“社会诚信”系统，为人们的行为打分。一旦完善，这些算法将引起世界各地专制政权的兴趣。中国的科技企业无法阻止北京政府利用这些工具。例如，百度已受命主持一个国家级深度学习实验室。中国的AI发展将反映政府的影响力。

说到收集数据和间谍活动，西方公司和政府也非善类。不过，西方公司至少会参与对AI伦理意义的公开辩论，而且情报机构也受到民主制度的制约。在中国，这两样都不存在。AI是一种有可能改变数十亿人生活的技术。如果到头来是中国对AI的未来影响最大，那么最大的受益者可能是其政府而非公民。■



Gender diversity and free speech

Not evil, just wrong

Google had better ways of dealing with an outspoken engineer than immediately sacking him

THE talk in Silicon Valley just now is as likely to be about sex as software. Women in tech firms feel badly treated. And they are right: they rarely get the top jobs, they are sometimes paid less than men and many suffer unwanted sexual advances. Most of their male colleagues sympathise; at the same time some feel they cannot express unorthodox opinions on gender. And they are right, too: they can easily fall foul of written and unwritten rules, and face drastic consequences.

The charged atmosphere helps explain why “Google’s Ideological Echo Chamber”, a memo by a young software engineer, James Damore, has caused such a stir. It says that the firm’s efforts to hire more women are biased. After circulating internally, it went viral. On August 7th Mr Damore was fired. To quote Sundar Pichai, Google’s boss, he advanced “harmful gender stereotypes in our workplace”.

Mr Pichai had good reasons to sack Mr Damore. One is the content of the memo. It says many reasonable-sounding things: that “we all have biases” and that “honest discussion with those who disagree can highlight our blind spots”. But these are just camouflage before a stonking rhetorical “but”: the argument that innate differences, rather than sexism and discrimination, explain why women fare worse in the technology industry than men. “Neuroticism (higher anxiety, lower stress tolerance)”, Mr Damore writes, “may contribute...to the lower number of women in high-stress jobs.”

Research has indeed shown some smallish group-level differences in

personality and interests between the sexes. But drawing a line from this to women's suitability for tech jobs is puerile. An unbiased eye would light on social factors rather than innate differences as the reason why only a fifth of computer engineers are women. Mr Damore claims women are "more interested in people than things" but, if this were true, they would in fact be better than men at the senior software-engineering jobs that involve managing teams. As for blind spots, although he repeatedly uses the words "discriminate" and "discrimination", Mr Damore does so only to describe the unfairness to men of trying to hire more women.

Mr Pichai also has legal arguments on his side. The American constitution protects free speech in public, but within a company's walls that right is limited by what bosses deem acceptable. After Mr Damore had suggested they are less qualified because of their sex, women at Google could have refused to work with him and taken legal action. Moreover, he may have known that his memo would be seized on in Alt-Right circles (it got top billing on Breitbart and far-right websites).

Still, there was a better response to Mr Damore than immediately giving him the sack. Other firms may limit their workers' speech, but the largest search engine, with a mission to "organise the world's information and make it universally accessible", should hold itself to a higher standard. It should not be suspected of limiting the debate of thorny subjects.

| *Speak up*

It would have been better for Larry Page, Google's co-founder and the boss of Alphabet, its holding company, to write a ringing, detailed rebuttal of Mr Damore's argument. Google could have stood up for its female employees while demonstrating the value of free speech. That might have led to the "honest discussion" Mr Damore claimed to want—and avoided the ersatz one about his firing. It would have shown that his arguments are not taboo, but mostly foolish and ill-informed. And it would have countered his more

defensible claim: that Google, and the Valley, so welcoming of gender diversity, are narrower-minded about unorthodox opinions. ■



性别多样性与言论自由

并非恶行，只是不对

比起迅速把一名直言不讳的工程师炒掉，谷歌原本还有更好的处理方法

在硅谷，性别问题眼下差不多成了和软件一样常见的话题。科技公司的女员工觉得自己的待遇很差。她们是对的：高层中女性很少见，女员工的薪酬有时会比男员工低，很多女员工还会遭到性骚扰。大多数男同事都表示同情，但同时也有一些人觉得自己不能就性别问题发表非正统的意见。这些人也没错：他们很容易就会违反各种成文或不成文的规定，并因此面对严重的后果。

气氛如此紧张，也就不难理解为什么年轻的软件工程师詹姆士·达莫尔（James Damore）的备忘录《谷歌的意识形态回音室》会搅起如此大的波澜。备忘录中写道，谷歌积极雇用更多女员工，实为偏见之举。这篇备忘录先是在内部流传，后来迅速向外传播开来。8月7日，达莫尔被解雇。谷歌CEO桑德尔·皮查伊（Sundar Pichai）的说法是，达莫尔“在工作场合中宣扬有害的性别成见”。

皮查伊有充分的理由炒掉达莫尔。其中之一是备忘录本身的内容。里面说了很多听起来很合理的事情，如“我们谁都会有偏见”，“与意见相左者进行坦诚的讨论，会让我们注意到自己的盲区”。然而，这些只是掩饰，接下来话锋便猛地一转，来了一个“但是”：女性在科技行业的发展较男性差，原因并不是性别偏见和歧视，而是男女之间与生俱来的差异。他写道，“神经质（焦虑程度更高，抗压能力较低）也许是造成高压岗位上女性较少的原因。”

确实有研究表明，男女在个性和兴趣方面存在群体层面的差别，但差别并不大。然而，把这一点同女性是否适合从事技术工作联系起来就太幼稚了。未被偏见所蒙蔽的眼睛会发现，是社会因素造成了只有五分之一的计算机工程师是女性，而非先天性的差别。达莫尔声称，女性“对人的兴趣比对东西的兴趣更大”，但如果这种说法是对的，那么女性其实要比男性

更能胜任软件工程方面的高级职务，因为这涉及团队管理。至于盲点，虽然达莫尔一再使用“歧视”这个词，但只不过为了表明尝试雇用更多女性对男性造成了不公。

皮查伊这边还有法律依据作为支撑。美国宪法保护公民在公开场合的言论自由，不过在一家公司内，这项权利是有限度的，言论是否得宜要视老板们的意见而定。达莫尔道出女性的性别决定了她们资质不足的想法后，谷歌的女员工本可拒绝与他共事并采取法律行动。再者，他可能已料到他的备忘录会被另类右翼圈子抓住大做文章（该备忘录在布赖特巴特新闻网以及极右翼网站上占据最显眼的位置）。

不过，还是有比立马炒掉他更好的应对方式。其他公司也许会限制员工的言论，不过，谷歌既身为世界最大的搜索引擎，且肩负着“整合全球信息，供大众使用，使人人受益”的使命，就应以更高的标准来要求自己。它不应该有限制员工探讨敏感问题的嫌疑。

| 大声说出来

如果谷歌创始人兼谷歌母公司Alphabet的老板拉里·佩奇（Larry Page）当时能写一篇雄文，详尽驳斥达莫尔的观点，会更好些。谷歌本可以在维护女员工权益的同时证明言论自由的价值。这样也许就可促成达莫尔宣称要进行的“坦诚的讨论”，后来成为讨论主题的也就不会是他被辞退这件事了。如果这样的讨论得以实现，那么就可表明达莫尔的观点并非触犯了禁忌，而是很大程度上既愚蠢又一知半解；这样还可以反驳他那个看似有理的说法：谷歌和硅谷那么欢迎性别多样性，却没有直面非正统意见的胸襟。 ■



Bitcoin's civil war

Breaking the chains

The digital currency may avoid a split, but the causes of a bitter conflict between rival camps remain

IN DIFFERENT circumstances the two people could be good friends. Each is rather shy and very smart. And each is passionate about bitcoin, a digital currency. One invented hashcash, which foreshadowed components of the crypto-currency; the other is the author of the first Chinese translation of the white paper in which Satoshi Nakamoto, the elusive creator of bitcoin, first described its inner workings.

Adam Back is the chief executive of Blockstream, a British startup, which employs some of the main developers of the software that defines bitcoin's inner workings. Jihan Wu is the boss of Bitmain, a Chinese firm, which makes about 80% of the chips that power "miners", specialised computers that keep the bitcoin network secure, confirm payments and mint new digital coins. But far from being fellow-travellers, each represents one of the two main camps in what has come to be called a "bitcoin civil war", fought over how, if at all, the system should grow.

The worst seems to have been avoided. On July 21st a large majority of miners signalled their support for a compromise, reducing the risk of a split of bitcoin into different currencies and driving its price back up towards \$3,000 (see chart). But a "fork", as some call this possible split, may only have been delayed: the issues underlying the dispute have not been truly resolved.

At issue is the size of a "block", the name given to the batches into which bitcoin transactions are assembled before they are added to a decentralised digital ledger, called "blockchain", that contains the payment history of all

bitcoins in circulation. Mr Nakamoto limited the block size to one megabyte, meaning that the system can only handle a maximum of seven transactions a second. Payment systems like Visa can process thousands in that time. With demand growing steadily, the system started to slow; users had to offer miners fees of several dollars a pop to get their transactions processed speedily.

The answers seem obvious: make the blocks larger or pack transactions more densely. Yet bitcoin's growing pains are less technical than political. "The big question is who gets to lead an organisation that is supposed to be leaderless," says Jeff Garzik, the boss of Bloq, a bitcoin startup.

Bitcoin is big business: the combined value of coins in circulation is now \$40bn. The number of transactions a day is approaching 300,000 on average, generating a trading volume of \$1.5bn. And bitcoin has become a global platform for hundreds of startups, offering services from trading the currency to providing market data and operating bitcoin ATMs.

As bitcoin's ecosystem has grown, however, so have the divisions within it. Many stem from a fundamental difference in vision: whether bitcoin should be more like gold or more like cash. This echoes a dichotomy between two schools of thought on the nature of money: whether, as "metallists" argue, it is more of a bottom-up affair, emerging naturally as a medium of exchange and a store of value in the same way as gold; or whether, as "chartalists" say, money is mostly a top-down creation by a government to enable it to collect taxes and provide citizens with a user-friendly way to settle their debts.

Unhelpfully, bitcoin is a bit of both. It is bottom-up: people freely opt into the system, to speculate or make payments that governments cannot block. But it is also top-down: Mr Nakamoto set not only the block size but other technical parameters, including the stipulation that there would only ever

be 21m bitcoins in circulation.

Mr Back says it all comes down to a trade-off: let bitcoin grow too large too quickly and it will turn into a more centralised payment system that governments can interfere with. That is because, if the blockchain becomes too big, individual holders will no longer be able to use their own computers to check whether a transaction is valid. Consequently, Mr Back wants to keep the blocks relatively small and change the system in other ways, such as bundling smaller transactions before they are confirmed (an approach known as “lightning”). To alleviate the system’s congestion, Mr Back and other leading coders, collectively called “Bitcoin Core”, have developed a solution to pack blocks more densely, using a technique known as “segregated witness”, or SegWit.

If Mr Black is the theorist, Mr Wu is the pragmatist. He sees no trade-off between scale and security, at least not in the foreseeable future. To him, bitcoin is held back by a decision on block size that Mr Nakamoto only made for practical reasons. Not changing it would “kill the golden goose”. He has thrown his weight behind those who want to double the block size as quickly as possible and increase it even more later on.

Behind these differences in philosophy lurk divergent economic interests. Bitmain is not only selling mining hardware, but minting bitcoin for its own account (Mr Wu claims he controls about 10% of the system’s computing power). It also operates big “mining pools”, to which smaller operators can connect. He is also said to have amassed a sizeable amount of bitcoins. All these assets provide a strong incentive for him to keep the system growing but intact.

In the case of Mr Back and his fellow coders the mix of interests is more complex. Blockstream is not the same as Bitcoin Core: only a few of the group’s developers work for the firm. They are in it partly for the

intellectual challenge and because of their libertarian ideology. But Blockstream, as well as the venture capitalists backing it, would clearly benefit if bitcoin develops in the way preferred by Mr Back. It wants to make money from versions of lightning and other blockchain-scaling software.

In its early days the internet itself saw similar fights. It developed institutions to overcome them, such as the Internet Engineering Task Force. Bitcoin has an IETF-like “improvement process” of its own, but agreeing on changes to a protocol that directly manages billions of dollars has proved hard. The growing power of the miners had added to the difficulty in reaching a consensus. Their main source of revenue is the “block reward”: every ten minutes miners engage in a race over who gets to update the blockchain; the winner is awarded 12.5 bitcoin, about \$30,000 at the current exchange rate.

Mr Nakamoto had planned for mining to be a very fragmented activity, done by individual bitcoin holders. But because bigger mining operations have an advantage over smaller ones, the industry has quickly become highly concentrated. More than 60% of mining power is thought to be generated in China, where electricity is cheap and data centres easy to build. This gives their operators a veto: only if enough of them implement changes do they become the rule.

The dispute over how to scale bitcoin is now best described as a conflict between Chinese miners and Western developers. Whereas Mr Wu and Mr Back are surprisingly polite when talking about each other, the foot-soldiers in this fight haven't pulled punches: mining farms have been attacked and the bitcoin system spammed to worsen congestion. Several attempts have been made to force the issue to a vote, using blocks as ballots.

This wrangling could have gone on for ages. But bitcoin is no longer the only kid on the crypto block; it is facing competition, in particular from Ethereum, a new type of blockchain. It was launched only a couple of years ago, and has grown fast. It has also given rise to a wave of “initial coin offerings” (ICOs), a novel way of crowdfunding. “While bitcoin is stuck in a stalemate, the competition has moved on,” says Emin Gun Sirer of Cornell University.

Worries about competition prompted the July 21st decision. A group of bitcoin activists earlier this year launched what was, in effect, an attempt to fire miners if they don’t implement SegWit. In response, Mr Wu in June released a “contingency plan” that amounts to getting rid of the developers: should the other side force his hand, he would extend a blockchain of his own and move to a block size of two megabytes—which would have led to a bitcoin split.

To avert that outcome, a group of bitcoin businesses came up with a compromise called “SegWit2x”, which provided for the implementation first, in mid-August, of SegWit and then, three months later, a block size of two megabytes. It is this compromise that won the official support of almost all miners.

A split has been averted—for now. Whereas SegWit seems a given, it is not clear whether the second step will be taken. Developers have already said that the timeframe is too ambitious—a deadline of 12-18 months is more realistic. If things drag on, a schism could become inevitable. And if that happens, expect an epic battle over who can lay claim to the bitcoin brand.

Whatever the outcome, one lesson of this conflict is clear. Decentralised crypto-currencies and other blockchain-based systems need robust governance mechanisms if they want to be able to evolve and stay relevant. Otherwise they risk ossification. Since crypto-currencies “were created to

replace institutional decision-making,” argues Andreas Antonopoulos, the author of “Mastering Bitcoin”, they will have to find other ways to evolve.

Tezos, another blockchain, will soon test one such mechanism: it will not only have regular votes on competing proposals for how to change the system, but a more scientific approach to evaluating them and a way to compensate the developers for coming up with ideas. If their proposals are accepted, they will get paid in Tezos coins. The approach appears to have resonated within the crypto world: when Tezos closed its ICO earlier this month, it had raised a record \$232m.

Even if bitcoin does not split, therefore, the fight over block sizes marks a fork in the road for crypto-currencies. The era of bitcoin’s dominance is ending; the future belongs to many competing digital monies. And the winners among them will be those currencies that can adapt their rules without having strong rulers. ■



比特币内战

打破链条

这种数字货币也许能避免分裂，但令竞争阵营产生激烈冲突的根由仍然存在

换在其他情况下，这两个人可能会成为好朋友。他们都很害羞、很聪明，而且都对数字货币比特币充满激情。一个人发明了哈希现金机制，这一机制日后成了加密货币的组成要素。另一个将比特币白皮书首次翻译成中文。在这份白皮书中，行踪神秘的比特币创造者中本聪（Satoshi Nakamoto）首次描述了比特币的内部工作原理。

亚当·巴克（Adam Back）是英国创业公司Blockstream的首席执行官，该公司的一些员工是定义了比特币内部工作原理的软件的主要开发者。吴忌寒是中国公司比特大陆（Bitmain）的老板，其公司生产了约80%的“比特币挖矿机”所用的芯片（挖矿机是保持比特币网络安全、确认付款和铸造新数字货币的专用计算机）。但这二人远非同道中人，而是各自代表了“比特币内战”中的两个主要阵营，就系统扩容问题（如果应该扩容的话）争论不休。

最糟糕的情况似乎已得以避免。7月21日，绝大多数比特币挖矿公司表示支持达成妥协，降低了比特币分裂成不同货币的风险，并将价格重新向3000美元推进（见图表）。有些人把原本可能出现的分裂称之为“分叉”，但现在“分叉”也许只是推迟了而已，因为争议背后的问题尚未真正解决。

有待解决的是“区块”大小的问题。“区块”指一部分比特币交易记录，这些记录累加起来构成一个去中央化的数字分类账，即“区块链”，区块链包含了所有流通比特币的支付历史。中本聪将区块大小限制为1兆字节，意味着系统每秒最多只能处理7笔交易，而Visa这样的支付系统每秒可以处理数千笔交易。随着需求稳步增长，系统开始变慢。用户为谋求快速处理交易，不得不向比特币挖矿公司支付每笔交易几美元的费用。

解决方案似乎很明显：扩展区块的大小或者让区块包含更密集的交易信

息。然而，比特币成长的烦恼更多来自政治层面，而非技术层面。比特币创业公司Bloq的老板杰夫·加西克（Jeff Garzik）说：“关键问题是由谁来领导一个本应没有领导者的组织。”

比特币市场规模巨大：现在流通中的比特币总价值为400亿美元。日均交易量将要达到30万笔，交易额达15亿美元。比特币也已成为一个拥有数百家创业公司的全球性平台，提供的服务包含比特币交易、提供市场数据和运营比特币ATM等。

然而，随着比特币生态系统的发展，内部的分歧也在增加。许多分歧源于对未来展望的根本差异：比特币应该更像黄金还是更像现金？这反映了有关货币性质的两种思想流派的根本差异：“货币金属论者”认为货币是自下而上产生的，像黄金一样自然而然地成为了交换媒介和价值储存工具；“货币国定论者”则认为，货币主要是政府自上而下的一种创造，便于政府征税，并方便公民偿付债务。

让人挠头的是，比特币两者兼而有之。它既是自下而上的——人们可以自由进入系统，开展政府无法阻止的投机或支付行为；它也是自上而下的——中本聪不仅设定了区块的大小，还设置了其他技术参数，包括只能有2100万个流通比特币的规定。

巴克说这主要是一个权衡问题：如果让比特币发展过快、规模过大，它就会变成一个政府可以干预的、更加集中的支付系统。这是因为，如果区块链太大，个人持有者将无法再使用自己的计算机来验证交易的有效性。因此，巴克想要把区块维持在相对较小的规模，通过其他方式来改变系统，例如将数额较小的交易捆绑在一起再来确认（这种技术称为“闪电网络”）。为了减轻系统堵塞，巴克和“比特币核心开发团队”（Bitcoin Core）的其他顶尖程序员开发出一种使用“隔离见证”技术（SegWit）的解决方案，让区块包含更密集的信息。

如果说巴克是理论家，吴忌寒就是实用主义者。他认为，至少在可预见的未来，无需在规模和安全性之间权衡。对他来说，比特币的发展因中本聪

出于实际原因限制区块的大小而受到阻碍，不改变这种限制会“杀死下金蛋的鹅”。他已经全力去支持那些想要尽快把区块大小翻倍、且日后还会进一步扩大区块的人。

这些不同理念的背后潜藏着不同的经济利益。比特大陆不仅销售挖矿硬件，而且还为自己的账户铸造比特币（吴忌寒声称自己控制着约10%的系统计算能力）。比特大陆还经营着大型“挖矿池”，较小的运营商可以接入。据说吴忌寒也已积累起大量的比特币。所有这些资产都让他有强烈动机保持系统不断增长，同时保持原有结构。

巴克和他的程序员同事之间的利益牵扯则更为复杂。Blockstream和比特币核心开发团队不是一回事：核心开发团队中只有少数人为Blockstream工作。他们在那里工作的部分原因是为了接受智力挑战，也是缘于自己自由主义的意识形态。但是，如果比特币按照巴克推崇的方式演变的话，Blockstream及其背后的风投机构无疑将会受益。Blockstream想通过不同版本的闪电网络和其他区块链扩容软件来赚钱。

互联网发展的早期也出现过类似的纷争，孕育出国际互联网工程任务组（Internet Engineering Task Force，简称IETF）等机构来调和解决。比特币有自己类似IETF的“改进过程”，但经验证明，要就直接管理数十亿美元的协议如何更改达成一致并非易事。挖矿公司日益增长的实力增加了达成共识的难度。这些公司的主要收入来源是“区块奖励”：公司每十分钟参与一次争先更新区块链的竞赛，获胜者可获得12.5个比特币，按现行汇率计算约值30,000美元。

中本聪最初设计的挖矿是一项非常分散的活动，由比特币个人持有者完成。但由于大规模的挖矿比小规模的优势，所以行业迅速高度集中。据信60%以上的挖矿能力都来自中国，因为那里电价低，容易建设数据中心。这让中国的运营商有了否决权：只有当足够的中国运营商实施变革时，才会形成规则。

有关比特币扩容的争议，现在最明白的说法就是，这其实是中国挖矿公司

和西方开发者之间的冲突。吴忌寒和巴克在谈及对方时语气客气得令人吃惊，但参与作战的兵马可没有手下留情：比特币矿场遭到攻击；比特币系统涌入大量垃圾邮件，加剧了拥堵。多次有人企图就此问题强制投票并以区块计票。

这一纷争本可能持续好几年，但是比特币已不再是加密区块中唯一的宠儿，它正面临竞争，特别是来自新型区块链以太坊（Ethereum）的竞争。以太坊几年前才推出，但发展迅速，还催生了一波名为“首次代币公开预售”（ICO）的新奇众筹方式。康奈尔大学的艾明·居恩·西雷尔（Emin Gun Sirer）说：“比特币的发展陷入僵局，但竞争已经继续推进了。”

对竞争的担忧促成了7月21日的决定。今年早些时候，一群比特币活动分子提出来一个方案，实际是要抛开不实施SegWit的挖矿公司。作为回应，吴忌寒在6月发布了一项相当于是抛开开发者的“应急计划”：如果对方强逼，他将扩大自己的区块链，把区块向两兆字节扩大。果真如此的话，将会导致比特币的分裂。

为了避免这种结果，一群比特币公司想出了一个名为“SegWit2x”的折衷办法：在8月中旬先实施SegWit，三个月后再将区块大小扩容至两兆字节。正是这种妥协赢得了几乎所有挖矿公司的正式支持。

分裂已得以避免——至少暂时如此。尽管实施SegWit似乎已成定局，但仍不清楚是否真会执行第二步。开发人员已经表示时间订得太紧，12至18个月的最后期限更为现实。如果继续拖下去，分裂也许在所难免。果真如此的话，就等着爆发争夺比特币品牌的大战吧。

无论结果如何，都可从这场冲突中得到一个清楚的教训。去中央化的加密货币和其他基于区块链的系统如果想要不断发展、保住地位，就需要强大的治理机制，否则就可能陷于僵化。《精通比特币》（Mastering Bitcoin）一书的作者安德烈亚斯·安东诺普洛斯（Andreas Antonopoulos）认为，由于加密货币“创造出来是为了取代机构决策”，因

此它们必须要找到其他的演进方式。

另一个区块链平台Tezos将很快测试一个这样的治理机制：不仅要就关于如何改变系统的不同建议定期投票，而且还会有一种更为科学地评估建议的方法，并向提出建议的开发者提供奖励。如果开发者的建议被采纳，他们将获得Tezos币作为回报。这一方法似乎已经在加密世界中产生了共鸣：Tezos本月早些时候结束ICO时，融得创纪录的2.32亿美元。

因此，即使比特币没有分裂，区块大小之争也标志着加密货币发展的一个分岔路口。比特币的统治时代走到了尽头，未来属于众多相互竞争的数字货币，而其中的赢家将是那些无需强大的统治者就能调整自身规则的货币。■



The death of the internal combustion engine

Roadkill

The internal combustion engine had a good run. But the end is in sight for the machine that changed the world

“HUMAN inventiveness...has still not found a mechanical process to replace horses as the propulsion for vehicles,” lamented *Le Petit Journal*, a French newspaper, in December 1893. Its answer was to organise the Paris-Rouen race for horseless carriages, held the following July. The 102 entrants included vehicles powered by steam, petrol, electricity, compressed air and hydraulics. Only 21 qualified for the 126km (78-mile) race, which attracted huge crowds. The clear winner was the internal combustion engine. Over the next century it would go on to power industry and change the world.

| *The big end*

But its days are numbered. Rapid gains in battery technology favour electric motors instead. In Paris in 1894 not a single electric car made it to the starting line, partly because they needed battery-replacement stations every 30km or so. Today’s electric cars, powered by lithium-ion batteries, can do much better. The Chevy Bolt has a range of 383km; Tesla fans recently drove a Model S more than 1,000km on a single charge. UBS, a bank, reckons the “total cost of ownership” of an electric car will reach parity with a petrol one next year—albeit at a loss to its manufacturer. It optimistically predicts electric vehicles will make up 14% of global car sales by 2025, up from 1% today. Others have more modest forecasts, but are hurriedly revising them upwards as batteries get cheaper and better—the cost per kilowatt-hour has fallen from \$1,000 in 2010 to \$130-200 today. Regulations are tightening, too. Last month Britain joined a lengthening list of electric-only countries, saying that all new cars must be zero-emission by 2050.

The shift from fuel and pistons to batteries and electric motors is unlikely to take that long. The first death rattles of the internal combustion engine are already reverberating around the world—and many of the consequences will be welcome.

To gauge what lies ahead, think how the internal combustion engine has shaped modern life. The rich world was rebuilt for motor vehicles, with huge investments in road networks and the invention of suburbia, along with shopping malls and drive-through restaurants. Roughly 85% of American workers commute by car. Carmaking was also a generator of economic development and the expansion of the middle class, in post-war America and elsewhere. There are now about 1bn cars on the road, almost all powered by fossil fuels. Though most of them sit idle, America's car and lorry engines can produce ten times as much energy as its power stations. The internal combustion engine is the mightiest motor in history.

But electrification has thrown the car industry into turmoil. Its best brands are founded on their engineering heritage—especially in Germany. Compared with existing vehicles, electric cars are much simpler and have fewer parts; they are more like computers on wheels. That means they need fewer people to assemble them and fewer subsidiary systems from specialist suppliers. Carworkers at factories that do not make electric cars are worried that they could be for the chop. With less to go wrong, the market for maintenance and spare parts will shrink. While today's carmakers grapple with their costly legacy of old factories and swollen workforces, new entrants will be unencumbered. Premium brands may be able to stand out through styling and handling, but low-margin, mass-market carmakers will have to compete chiefly on cost.

Assuming, of course, that people want to own cars at all. Electric propulsion, along with ride-hailing and self-driving technology, could mean that ownership is largely replaced by “transport as a service”, in

which fleets of cars offer rides on demand. On the most extreme estimates, that could shrink the industry by as much as 90%. Lots of shared, self-driving electric cars would let cities replace car parks (up to 24% of the area in some places) with new housing, and let people commute from far away as they sleep—suburbanisation in reverse.

Even without a shift to safe, self-driving vehicles, electric propulsion will offer enormous environmental and health benefits. Charging car batteries from central power stations is more efficient than burning fuel in separate engines. Existing electric cars reduce carbon emissions by 54% compared with petrol-powered ones, according to America's National Resources Defence Council. That figure will rise as electric cars become more efficient and grid-generation becomes greener. Local air pollution will fall, too. The World Health Organisation says that it is the single largest environmental health risk, with outdoor air pollution contributing to 3.7m deaths a year. One study found that car emissions kill 53,000 Americans each year, against 34,000 who die in traffic accidents.

| *Autos and autocracies*

And then there is oil. Roughly two-thirds of oil consumption in America is on the roads, and a fair amount of the rest uses up the by-products of refining crude oil to make petrol and diesel. The oil industry is divided about when to expect peak demand; Royal Dutch Shell says that it could be little more than a decade away. The prospect will weigh on prices long before then. Because nobody wants to be left with useless oil in the ground, there will be a dearth of new investment, especially in new, high-cost areas such as the Arctic. By contrast, producers such as Saudi Arabia, with vast reserves that can be tapped cheaply, will be under pressure to get pumping before it is too late: the Middle East will still matter, but a lot less than it did. Although there will still be a market for natural gas, which will help generate power for all those electric cars, volatile oil prices will strain

countries that depend on hydrocarbon revenues to fill the national coffers. When volumes fall, the adjustment will be fraught, particularly where the struggle for power has long been about controlling oil wealth. In countries such as Angola and Nigeria where oil has often been a curse, the diffusion of economic clout may bring immense benefits.

Meanwhile, a scramble for lithium is under way. The price of lithium carbonate has risen from \$4,000 a tonne in 2011 to more than \$14,000. Demand for cobalt and rare-earth elements for electric motors is also soaring. Lithium is used not just to power cars: utilities want giant batteries to store energy when demand is slack and release it as it peaks. Will all this make lithium-rich Chile the new Saudi Arabia? Not exactly, because electric cars do not consume it; old lithium-ion batteries from cars can be reused in power grids, and then recycled.

The internal combustion engine has had a good run—and could still dominate shipping and aviation for decades to come. But on land electric motors will soon offer freedom and convenience more cheaply and cleanly. As the switch to electric cars reverses the trend in the rich world towards falling electricity consumption, policymakers will need to help, by ensuring that there is enough generating capacity—in spite of many countries' broken system of regulation. They may need to be the midwives to new rules and standards for public recharging stations, and the recycling of batteries, rare-earth motors and other components in “urban mines”. And they will have to cope with the turmoil as old factory jobs disappear.

Driverless electric cars in the 21st century are likely to improve the world in profound and unexpected ways, just as vehicles powered by internal combustion engines did in the 20th. But it will be a bumpy road. Buckle up. ■



内燃机之死 死于路上

内燃机曾经辉煌，但这种改变了世界的机器末日渐至

“以人类的创造力.....竟仍未找到一种取代马匹拉动车辆的机械方式。”1893年12月，法国报纸《小日报》（Le Petit Journal）发出如此哀叹。次年7月举办的巴黎至鲁昂的“无马马车”比赛对此哀叹做出了回应。102辆车报名，动力方式包括蒸汽、汽油、电力、压缩空气和液压装置。最终只有21辆车获得参加这一126公里比赛的资格，吸引了大量民众前来观看。内燃机大获全胜。在接下来的一个世纪里，它又为工业发展提供动力，改变了整个世界。

| 大限将至

但属于内燃机的日子不多了。电池技术的快速进步对电动汽车更有利。在1894年的巴黎，没有一部电动汽车最终驶出起跑线，部分原因是当时的电动汽车需要每30公里左右就设置一个电池更换站。如今的电动汽车由锂离子电池供电，续航能力倍增。雪佛兰博尔特的续航里程为383公里；特斯拉车迷最近驾驶的一辆Model S在一次充电后行驶了超过1000公里。瑞银（UBS）估计，到明年，一辆电动汽车的“总拥有成本”将与燃油汽车持平——虽然电动车的制造商仍然会亏钱。瑞银乐观地预测，到2025年，电动汽车将占全球汽车销量的14%，远高于今天的1%。其他机构的预测要谨慎些，但也在加紧调高预测结果，原因是电池的成本降低、性能提升——每千瓦时的成本已经从2010年的1000美元降至今天的130至200美元。对燃油车的监管也在收紧。禁售燃油汽车的国家不断增多，英国也于上月加入这一行列，声明到2050年，所有新车必须实现零排放。

从燃油和活塞向电池和电动机的转变可能用不着这么长时间。内燃机的第一轮临终哀鸣已回荡在世界各地，而内燃机消亡带来的大部分结果也将为世人所乐见。

要估计未来的前景，可以想想内燃机如何塑造了现代生活。富裕国家以汽

车为出发点进行了重建，投入巨资修建道路网络，发明了郊区以及大型购物中心和汽车餐厅。约85%的美国上班族开车上下班。在二战后的美国和其他地方，汽车制造业也一度是经济发展和中产阶级扩张的动力。如今全世界的汽车保有量约为10亿辆，几乎全部靠化石燃料驱动。虽然美国的汽车和卡车发动机多数处于停止状态，它们却可以产生十倍于美国发电站发电量的能量。内燃机是历史上最强大的发动机。

但电动化让汽车业陷入了动荡。最好的汽车品牌建立在工程技术传承的基础上，特别是在德国。与现有车辆相比，电动汽车要简单得多，零部件也更少，更像是装在轮子上的电脑。这意味着电动车不需要那么多人来组装，需要专业供应商提供的辅助系统也更少。在不生产电动汽车的汽车工厂里，工人担心他们可能饭碗不保。发生故障的情况少了，维修和零部件市场也会随之萎缩。工厂陈旧，员工队伍臃肿，这样的历史包袱让如今的汽车制造商不堪重负，而后来者将可轻装上阵。高端品牌也许仍能依靠外形设计和操控性能保有一席之地，但面向大众市场的低利润汽车制造商未来只能主要在成本方面展开竞争。

当然，这是在人们想要拥有车辆的假设下做出的判断。电力推进系统，加上共享汽车和无人驾驶技术，可能会让“交通即服务”的模式——即车辆按需提供出行服务——取代大部分自有车辆。最极端的估计是，汽车行业规模可能缩减高达90%。大量共享的无人驾驶电动汽车将会让城市把停车场（在某些地方占总面积24%之多）改成新的住房。人们可以住得更远，并在通勤的路上睡觉，城市郊区化的趋势将发生逆转。

即使安全的无人驾驶汽车无法大行其道，电力动力也将带来巨大的环境和健康效益。通过中央发电站给汽车电池充电要比单个发动机燃烧燃料更有效率。根据美国国家资源保护委员会（National Resources Defence Council）的统计，现有电动汽车比燃油汽车降低了54%的碳排放。随着电动汽车变得更高效、电网发电更加环保，这一数字还会上升。局部空气污染也会下降。世界卫生组织表示，室外空气污染每年造成370万人死亡，是最大的环境卫生风险。一项研究发现，汽车排放每年造成5.3万名美国人死亡，而在交通事故中死亡的人数为3.4万人。

然后还有石油问题。美国大约三分之二的石油都被汽车所消耗，至于为生产汽油及柴油而进行的炼油所产生的副产品，则全部被其他很多领域消耗。石油行业对需求何时见顶意见不一，荷兰皇家壳牌公司表示可能只要十年多一点的时间。而远在需求见顶之前，石油价格就会受到影响。由于没有人愿意到最后在地下囤着无用的石油，因此新投资将会不足，特别是在北极这样高成本的新地区。相反，沙特阿拉伯这样的石油生产国储量丰富、开采成本低，将会有压力在还用得上之时尽快开采：中东地区仍然会很重要，但远不及以往。尽管天然气仍然会有市场，可以为所有电动汽车提供电力，但油价波动将使依靠碳氢化合物收入填充国库的国家备受压力。需求量下降时，调整过程将令人担忧，特别是长期围绕着石油资源控制权进行权力斗争的国家。在安哥拉和尼日利亚这样的国家，石油经常是种诅咒，石油产业的影响力降低可能会带来巨大好处。

同时，锂资源的争夺战已然打响。碳酸锂的价格从2011年的每吨4000美元上涨到了1.4万多美元。对电动机里钴和稀土元素的需求也在飞涨。锂不仅用于电动汽车的电池，电力公司还希望巨型电池能在用电低谷时储存电力，在用电高峰时释放。所有这一切会让锂资源丰富的智利成为下一个沙特吗？也不尽然，因为电动汽车不直接消耗掉锂：汽车的旧锂电池可以在电网中再利用，然后再加以回收。

内燃机历史辉煌，未来几十年来仍然可以主导航运和航空业。但是在陆地上，电动马达将很快以更便宜、更清洁的方式带来自由和便利。随着电动汽车逐步取代燃油汽车，富裕国家电力消耗下降的趋势将会扭转，政策制定者需要确保有足够的发电能力来满足需求，尽管目前许多国家的监管系统还不完善。他们可能需要促成有关公共充电站的新规则和标准，规范如何回收利用“城市矿山”中的电池、含稀土的电机和其他部件，还将不得不应对随传统工厂就业岗位消失而来的社会动荡。

二十一世纪的无人驾驶电动汽车可能会以深刻而意想不到的方式造福世界，就像二十世纪的内燃机汽车一样。不过前路崎岖，要系好安全带。■



Schumpeter

Reinventing Uber

An action plan for the ride-sharing firm's next chief executive

IT IS said that Travis Kalanick, who resigned as Uber's boss in June, has been reading Shakespeare's "Henry V". Prince Hal's transformation, from wastrel prince to sober monarch, is doubtless one he would like to emulate. But as a guide to the ride-hailing firm's financial dilemma, "Macbeth" is the best play. This line especially resonates: "I am in blood stepp'd in so far that, should I wade no more, returning were as tedious as go o'er."

Uber has bled money for years in an attempt to become the absolute ruler of its industry. Once Mr Kalanick's replacement is found, voices will whisper that the firm, like Macbeth himself, is in too deep to alter course. But the new boss must change Uber from a company that sacrifices anything for its ambitions, to one which has a realistic valuation and uses resources efficiently.

Its product is elegantly simple. Uber makes a market between drivers and passengers and takes a cut of about a fifth of the fare. The more people use its service, the better it functions, with lower waiting periods for passengers, and better use of drivers' time. Some 55m people in 574 cities use it every month. Underlying sales were \$4bn in 2016, over double what they were the year before (all figures exclude Uber's Chinese arm, which it sold to a local rival, Didi Chuxing, last year). Uber's main trouble is high expectations. Its supporters think it will become the next Alphabet or Facebook. At its last funding round in 2016 (it is private), investors valued it at a whopping \$68bn.

But the next boss will have to deal with an income statement that is scarier than the Thane of Cawdor. Underlying pre-tax losses were \$3bn-3.5bn last

year and about \$800m in the most recent quarter. Some \$1bn-2bn of last year's red ink was because of subsidies that Uber paid to drivers and passengers to draw them to its platform. At least another \$1bn went on overheads and on developing driverless cars; money is also being splashed on a new food-delivery venture and a plan to build flying cars.

To put its 2016 loss in perspective, that number was larger than the cumulative loss made by Silicon Valley's least profit-conscious big company—Amazon—in 1995-2002. Measured by sales, Uber is the world's 1,158th-biggest firm. Judged by cash losses, it ranks in the top 20. It is now eight years old, but still probably years away from being stable enough to make an initial public offering of shares. In contrast, Amazon went public at the age of three, Alphabet at six and Facebook at eight.

Investors rationalise its valuation by assuming that in the long run it will be highly profitable, with a dominant share of a large market. In 2014 Bill Gurley, a well-known tech investor who was then an Uber director, estimated that the pool of consumer spending that it could try and capture might be over \$1trn, with ride-hailing and ride-sharing replacing car ownership. Today many Silicon Valley types think that estimate is too conservative.

But a discounted cashflow model gives a sense of the leap of faith that Uber's valuation requires. After adjusting for its net cash of \$5bn and for its stake in Didi, worth \$6bn, you have to believe that its sales will increase tenfold by 2026. Operating margins would have to rise to 25%, from about -80% today.

That is a huge stretch. Admittedly, Amazon and Alphabet, two of history's most successful firms, both grew their sales at least that quickly in the decade after they reached Uber's level, and Facebook is likely to do as well. But over the same periods these firms' operating margins show an total average

rise of only one percentage point. Put simply, Uber finds it desperately hard to make money. It is not clear that it breaks even reliably across the group of cities where it has been active for longest.

So the new chief executive will have to deliver a bleak message; that ride-hailing is locked in a vicious circle. Low prices and high subsidies lead to losses, so firms must raise capital continually, requiring them to exhibit rising valuations. To justify these they must frequently enter new cities and dream up new products. Even more speculative capital is then drawn in by the paper gains seemingly on offer. In the past year, ten of Uber's competitors, such as Lyft in America and Grab in South-East Asia, have together raised or are raising, roughly \$11bn. That will be used to finance still more price wars to win market share.

| *Double, double toil and trouble*

Uber is on course to use up its existing cash and credit lines in three years. Its next boss must break the cycle before then by cutting subsidies and talking down its valuation. It could lose market share and may need to exit scores of cities. On July 13th it said that it will merge its operations in Russia with a competitor. Similar deals need to follow. Although Uber should continue to invest in driverless cars, some of its more experimental "moon shot" projects will probably be for the chop. Its investors, including Goldman Sachs, Saudi Arabia's government and Jay-Z, a rapper, could face paper losses. Staff paid in stock will be furious.

Yet over time the aim should be a firm with a lower market share of a more stable industry. Successful, dominant firms, such as Google and AT&T, don't seek absolute monopolies by killing off weaker rivals. They allow them enough space to plod on. That lowers the risk of antitrust problems and deters new entrants. By signalling that Uber's valuation is too high its new boss would knock valuations across the ride-hailing industry and slow the flood of speculative capital—in the end, a good thing.

Once the losses abate, the priority should be to create a more “capital light” model. Perhaps Uber could license its brand and technology to local partners in some markets. It could concentrate subsidies on customers who sign up to long-term contracts. The biggest impediment may be Mr Kalanick. With allies, he still controls a significant share, probably a majority, of the company’s voting rights. Anyone taking on tech’s toughest job must have the inner steel to confront him. They should remember another quote from the bard; “I must be cruel only to be kind.” ■



熊彼特

重塑优步

一份行动计划，供这家拼车公司下一任CEO参考

六月，特拉维斯·卡兰尼克（Travis Kalanick）辞去优步CEO一职。据说他一直在读莎士比亚的《亨利五世》。从浪荡王子蜕变成为冷静持重的君主——这样的哈尔亲王无疑是卡兰尼克想要效仿的对象。不过，要了解这家网约车公司的财务困境，《麦克白》这部剧才是最合适的指南。其中有这么一句台词尤其引人共鸣：“我已经两足深陷血泊之中，要是不再涉血前进，那么回头的路也是同样令人厌倦的。”

优步尝试成为行业内绝对的统治者，过程中已亏损多年。等到公司找到卡兰尼克的继任者之时，将会有传言称这家公司就像麦克白本人一样，已陷得太深，无法改弦更张了。但新老板必须将优步从一家为了实现抱负不惜牺牲一切的公司，转变成估值实事求是、资源利用有效的公司。

优步的产品非常简洁。它在司机和乘客之间建立一个交易场所，并从车费中抽取大约五分之一的佣金。优步服务的用户越多，便能越好地发挥作用：乘客减少了等候时间，司机更好地利用了自己的时间。优步的服务遍布574个城市，大约有5500万人每月使用该服务。公司2016年的基础销售收入为40亿美元，较前一年翻了一倍有余（所有的数字均未计入优步在中国的业务。优步中国去年被当地竞争对手滴滴出行收购。）优步主要的问题是市场对它的高预期。其支持者认为该公司将成为下一个Alphabet或Facebook。2016年优步进行最后一轮融资时（优步是家私营公司），投资者将其估值推高至680亿美元。

然而，摆在下一任老板面前的公司损益表可比那位考德的领主还可怕。去年优步的基础税前损失在30到35亿美元之间，最近一个季度大约为8亿美元。去年的赤字中，大约有10到12亿美元是为把司机及乘客吸引到自己的平台而向他们发放补贴造成的。营运费用以及开发无人驾驶汽车也耗掉至少10亿美元。公司还在新的外卖送餐项目以及打造飞行汽车的计划上砸下

大把钞票。

比较起来，优步单是2016年的亏损数字，就高过硅谷盈利意识最淡泊的大公司亚马逊1995年到2002年间的累积亏损。以销售额来衡量，优步是世界第1158“大”公司；以现金损失计，它能排进前20。优步如今已成立八年，但也许仍需好多年才能稳定到足以进行首次公开募股。相比之下，亚马逊上市是在成立的第三年，Alphabet和Facebook分别是在第六年和第八年。

投资者为优步的估值寻求合理解释。他们认为长远来看公司会在一个广阔的市场中占据主要份额，从而赚取高额利润。2014年，时任优步董事的知名科技投资人比尔·格利（Bill Gurley）估计，随着叫车及拼车服务取代私家车，或许将有超过一万亿的消费支出可供优步去努力争取。而今很多硅谷人士认为这个估计太保守了。

不过利用现金流折现模型做一番评估，便可大致了解得有怎样的信仰才支撑得起优步的估值。剔除公司50亿美元的净现金及价值60亿美元的滴滴股份后，投资者得相信到2026年公司的销售额将增长十倍才行。营运利润则需从如今的-80%提高至25%。

这是个极为艰巨的任务。当然，史上最成功的两家公司亚马逊和Alphabet在达到优步如今的水平之后的十年里，销售额均至少达到了上述增长速度，Facebook可能也会如此。但在同一时期，这些公司营运利润的增长总平均仅为一个百分点。简单地说，优步要赚钱极其困难。至于优步在业务开展时间最长的那些城市里是否确切实现了收支平衡，目前也并不清楚。

因此，新任首席执行官须传递一个灰暗惨淡的信息：网约车业务陷入了一个恶性循环。低价格和高额补贴导致亏损，因此公司必须不断融资，这就要求它们展现出日益提高的估值。为了让自己的估值站得住脚，它们就必须频繁地打入新城市、构想新产品。更多的投机资本会被看似有望获得的收益吸引进来。过去一年中，包括美国的Lyft和东南亚的Grab在内，优步的十家竞争对手公司已募得或正在募集的资本总额将近110亿美元。有了这笔钱，各家公司将会为争夺市场份额发起更多的价格战。

| 不憚辛勞不憚煩

按目前趨勢，優步將在三年內用盡現有現金和信貸額度。在此之前，下任老板必須削減補貼，壓低公司估值，從而打破上述循環。這麼做也許會損失市場份額，或許還需從大量城市中退出。7月13日，優步稱將把公司在俄羅斯的業務與當地競爭對手合併。今後還需訂立一系列類似的協議。優步應當繼續投資無人駕駛汽車，但某些更具實驗性的“探月”項目可能會被砍掉。包括高盛、沙特阿拉伯政府和說唱歌手Jay-Z在內的優步投資人可能將面臨賬面損失。以公司股權為部分薪酬的員工將會憤怒。

然而，優步最終的目標應該是在一個更穩定的行業中擁有稍小一些的市场份額。像谷歌和AT&T這樣成功且佔據主導的公司並沒有把較弱的競爭對手趕盡殺絕以尋求絕對的壟斷地位，而是給它們足夠的空間去慢慢開拓。這降低了招致反壟斷干預的風險，還能阻擋新進者闖入。優步的新老板如果釋放“優步估值過高”的信號，整個網約車行業的估值都會降溫，滾滾湧入的投機資金也會放緩腳步——到頭來，這會是件好事。

等到虧損問題得以緩解，打造一個更“輕資本”的模式就應成為首要任務。優步也許可以在某些市場內授權當地合夥人使用其品牌和技术。或許還可以集中向簽訂了長期合同的客戶發放補貼。最大的障礙也許是卡蘭尼克——他和盟友仍把持着公司相當份額（也許超過半數）的表決權。如果有誰要承擔起這個科技圈最艱巨的工作，得有鋼鐵般的意志與卡蘭尼克對峙。他們還應謹記莎翁的另一句妙語：“要想行善，必須狠毒。”■



Renewable-energy targets

A green red herring

The goal should be to curb global warming, not to achieve 100% renewable energy

NOT that long ago, the world wondered whether clean energy could survive without lavish government support. Now the question is how far it can spread. The number of electric vehicles, which breached 1m in 2015, last year reached 2m; countries like France and firms like Volvo are looking ahead to the demise of the internal combustion engine. In electricity generation, too, momentum is with the greens. In June the Chinese province of Qinghai ran for seven consecutive days on renewable energy alone; in the first half of this year wind, solar and hydro generated a record 35% of Germany's power.

Greater success is breeding greater ambition. California is proposing to reach 60% renewable energy by 2030; 176 countries have clean-energy goals. Hawaii, America's most oil-dependent state, has pledged to be 100% renewable by the middle of the century. So have 48 poor countries vulnerable to climate change. In July the number of multinationals making a commitment to running their operations on 100% renewable energy rose to 100.

Even if such targets are never met, they galvanise effort. They also provide reassurance about long-term climate policy, despite reversals such as America's withdrawal from the Paris agreement. The resulting economies of scale help bring down the costs of wind and solar projects.

But not every target is helpful. To see why, consider that goal of 100% renewable energy. It makes solving climate change seem deceptively easy. In fact, though wind and solar can generate all a country's electricity on some days, renewables still account for less than 8% of the world's total

power output. Moreover, cleaning up electricity is only part of the battle. Even though gas-fired heating and cooking can be at least as big a source of greenhouse-gas emissions, renewable heating gets minuscule attention. Transport policy is erratic, too. Carmakers may hit their goal of annual sales of 10m electric vehicles in a decade, but battery-powered road haulage, shipping and aviation are dreams. A much-quoted claim that America could rely on wind, solar and hydro alone for its electricity has recently been witheringly criticised by a group of respected academics.

Most important, a 100% renewables target confuses means with ends. The priority for the planet is to stop net emissions of greenhouse gases, especially carbon dioxide. Putting too much emphasis on wind, solar and other renewables may block off better carbon-reduction paths. After decades of investment, it is wrong to leave nuclear power off the table. Carbon emissions in Germany actually rose because it chose to phase out nuclear power and so burned more coal. New technologies, such as “direct air capture” systems designed to separate carbon dioxide from the air, may in time prove vital.

Likewise, greater energy efficiency could reduce emissions by even more than deploying renewables would. Indians last year consumed twice as much energy from newly installed air conditioners as they produced from new solar farms. More accurate metering of energy consumption could encourage companies and households to rein in power demand.

| *Putting the wind up*

It would be better, as the Paris agreement urges, for countries to focus on reductions in emissions rather than to set goals for renewable energy. Global emissions have stabilised in the past three years, which is encouraging. But to stand a chance of mitigating global warming, they must start falling sharply and keep doing so for decades. The world will move in that direction with the help of wind and solar. It will not get there without

big advances on every other front as well. ■



可再生能源发展目标

喧宾夺主的绿色能源

目标应该是遏制全球变暖，而不是100%使用可再生能源

不久之前，整个世界还不确定清洁能源是否能在没有政府大力支持的情况下维持下去，现在的问题则是它的影响能有多深远。2015年电动汽车保有量突破100万辆，去年达到200万辆；法国这样的国家和沃尔沃这样的公司都在为淘汰内燃机做准备。在发电方面，清洁能源同样势头强劲。今年6月，中国的青海省连续七天仅靠可再生能源供电；今年上半年，风力、太阳能和水力发电量占到了德国总发电量的35%，创下历史最高水平。

更大的成功滋长了更大的雄心。加州正在提案，到2030年要让该州可再生能源发电量的占比达到60%。176个国家都设立了清洁能源目标。美国各州中最依赖石油的夏威夷承诺，本世纪中叶实现100%使用可再生能源。其他48个面临气候变化威胁的穷国也制定了同样的目标。7月，承诺100%使用可再生能源提供运营用电的跨国公司数量升至100家。

这样的目标即使永远不能实现，也会激发人们的行动，还为长期气候政策提供了保证，尽管出现了美国退出《巴黎协定》等挫折。由此产生的规模经济也有助于降低风能和太阳能项目的成本。

但不是每个目标都是有益的。为了解这其中的原因，我们来仔细思考一下100%使用可再生能源供电这个目标。此目标让人误以为解决气候变化问题似乎很简单。事实上，虽然风能和太阳能可以产生满足一个国家几日所需的全部电力，可再生能源占世界总发电量仍不足8%。此外，清洁能源发电只是对抗气候变化努力的一部分。尽管燃气取暖和烹饪至少是同样大的温室气体排放来源，但可再生能源供热却只得到了微不足道的关注。交通运输政策也飘忽不定。汽车制造商可能会在十年内实现年销售1000万辆电动汽车的目标，但靠电池供电进行公路运输、航运和航空都还只是愿望。一个常被提及的说法是，美国可以仅靠风力、太阳能和水力供电，但近来已遭到一些备受尊敬的学者严厉批驳。

最重要的是，100%使用可再生能源供电的目标混淆了手段与目的。对地球而言，首要任务是遏制温室气体尤其是二氧化碳的净排放。过分强调风能、太阳能及其他可再生能源可能会阻断更好的碳减排途径。在投资核电长达数十年之后，把核电排除在外是错误之举。德国选择逐步淘汰核能，结果燃烧了更多煤炭，令碳排放不降反升。从空气中分离二氧化碳的“直接空气捕获”系统等新技术最终可能会至关重要。

同样，提高能效比部署可再生能源更能实现减排。去年，印度新装空调所消耗的电力相当于该国新建太阳能电厂发电量的两倍。更准确地计量能源消耗可以鼓励公司和家庭控制用电需求。

| 风声鹤唳

各国最好是能像《巴黎协定》所敦促的那样，侧重减排而不是制定发展可再生能源的目标。过去三年全球温室气体排放量趋于稳定，令人鼓舞。但若想有机会缓解全球变暖，温室气体排放量必须开始急剧下降，并持续几十年。风能和太阳能会帮助世界朝着这个方向前进，但如果其他方面不同样有巨大发展，这样的目标就无法实现。■



The Trump family's businesses (1)

Searching for a Kushy landing

In the first of two articles on the Trump family's firms, we examine how Jared Kushner's White House job could harm both his firm and trust in policymaking

WHEN the deal was struck just over a decade ago, for \$1.8bn, 666 Fifth Avenue, a 41-storey Manhattan skyscraper, became the most expensive office building ever sold in America. Now it is in limbo, awaiting billions of dollars of investment to rebuild it and raise it almost twice as high. Across the Hudson River, another hunt for money is under way, to build a property called One Journal Square in Jersey City. In June a property-investing start-up called Cadre attracted financial backing from Silicon Valley luminaries including Andreessen Horowitz, a venture-capital company.

The thread linking these ventures is Jared Kushner, Donald Trump's senior adviser and son-in-law, whose family business, like that of the president, is in property. Mr Kushner helped conceive all three projects. He has a "passive ownership interest" in Cadre (meaning he is not actively involved in its management). His family co-owns 666 Fifth Avenue and One Journal Square.

Unlike the president, Mr Kushner is not exempt from federal conflict-of-interest laws. He has taken steps to distance himself from his wide-ranging property business. Kushner Companies, a complex enterprise that is made up of dozens of limited-liability companies, or LLCs, has more than 20,000 flats and 13m square feet (1.2m square metres) of commercial space across six states. Before joining the Trump administration he stepped down as the head of Kushner Companies and sold his stake in several properties, including 666 Fifth Avenue and One Journal Square.

Yet Mr Kushner kept his stake in many of the LLCs that make up the

business. He still has a passive ownership interest in about 90% of his holdings in property, worth up to \$408m, according to his disclosures. His father, Charles Kushner (photographed with his son), has a big role at Kushner Companies. Jared Kushner's stakes in 666 Fifth Avenue and One Journal Square went into trusts owned by his family. A long list of lenders and partners to the family business could benefit from White House policies.

| *Property fights*

Jared Kushner is the chief architect of Kushner Companies in its current form. His grandfather, Joseph Kushner, a Holocaust survivor, developed garden apartments in New Jersey. Charles Kushner founded the business called Kushner Companies in 1985 and led it until being convicted for tax evasion, illegal campaign donations and tampering with a witness. Jared Kushner was 24 in 2005 when his father went to prison; the next year he bought the *New York Observer*, a newspaper, and went to work restoring his family's reputation. But the bigger transformation came later in 2006, when Kushner Companies said it would buy 666 Fifth Avenue.

The financial market quickly plunged and office rents fell with it. The company went on to sell 666 Fifth's prime retail space to a Spanish firm, Inditex, owner of Zara, and other investors. It also refinanced its debt in a transaction in 2011 that gave a 49.5% stake to Vornado, a real-estate investment trust founded by Steven Roth, a longtime partner of Mr Trump.

For a while the company's appetite for big acquisitions declined. But in 2011, with 666 Fifth refinanced, Mr Kushner began buying again (see chart), according to Real Capital Analytics, a data firm. His targets included modest residential buildings in lower Manhattan and in Midwestern cities such as Toledo and Akron. He envisaged bigger developments, too, including One Journal Square and another in Brooklyn, now called Panorama, for its views of the Manhattan skyline.

Now that Mr Kushner is in the White House, two questions preoccupy observers. First, is his family business benefiting financially from his role and from his proximity to the president? Second, is he conflicted despite the steps he has taken to adhere to federal law?

Start with the question of financial benefits. This is a pivotal moment for the firm. It is seeking tenants for Panorama and new loans for a residential building along Jersey City's waterfront (in both of which Mr Kushner still has a stake). More important, it is also looking for investors for 666 Fifth Avenue and One Journal Square (in which Mr Kushner does not have a stake). But the scrutiny that has accompanied Mr Kushner's White House role appears to be hindering, not helping.

In January the *New York Times* reported that Kushner Companies was seeking equity capital for 666 Fifth from Anbang, one of China's biggest insurers, which has ties to Beijing's political elite. At the moment 666 Fifth Avenue's debt—of \$1.4bn, according to Vornado's recent filings—eclipses the value of the office building itself, says Jed Reagan of Green Street, a research firm. That is partly Kushner Companies' own doing, because of the price it paid and because it is intentionally letting the building slowly empty of its office tenants so it can be rebuilt. The new design, created by Zaha Hadid, an architect who died last year, would include a hotel, luxurious flats, new space for shops and would cost \$7.5bn.

The talks with Anbang fell apart in March amid protests from ethics experts and from Democrats, who fretted about conflicts of interest and threats to national security. Another avenue also recently closed. For over two years, Kushner Companies has talked to Sheikh Hamad bin Jassim al-Thani, an eminent Qatari, about investing in 666 Fifth. In July *The Intercept*, a news site, reported that HBJ, as he is known, had agreed to invest \$500m if Mr Kushner could raise other money elsewhere. Kushner Companies confirmed on July 11th that talks had recently ended and that it is

reassessing the financing structure of the redevelopment project.

Some speculate that Mr Kushner has looked elsewhere, too. In December he met with the head of a government-owned Russian bank that is subject to American sanctions. Vnesheconombank said it was a business meeting. The White House said that Mr Kushner was “acting in his capacity as a transition official”.

The proposed One Journal Square development has also hit trouble. In May Nicole Meyer, Mr Kushner’s sister, courted Chinese investors as part of America’s “EB-5” visa programme, which offers a path to citizenship for certain investors. In Beijing Ms Meyer touted One Journal Square, explained Mr Kushner’s new role in Washington and said the building “means a lot to me and my entire family”. That sparked accusations that the family was exploiting Mr Kushner’s public role. Kushner Companies apologised “if that mention of her brother was in any way interpreted as an attempt to lure investors”.

On May 7th Jersey City’s mayor, Steven Fulop, said the project would not receive the tax breaks and bonds that Kushner Companies had sought. The city might not have granted them in any circumstance—the Kushners had asked for a particularly generous package. But Mr Fulop, a Democrat, and city councilmen are up for re-election, and Mr Trump received just 14% of the city’s vote in November. Kushner Companies had already lost its anchor tenant, WeWork, a shared-office company.

If Kushner Companies is not yet benefiting from proximity to the presidency, the potential for conflicts remains enormous. Corporate-tax reform would have a sizeable impact on property firms, for example. Mr Trump has said he wants a 15% corporate tax to apply to pass-through entities, which would include the LLCs that comprise much of the Kushner businesses (and Mr Trump’s as well). Loosening of financial regulation,

expected under Mr Trump, ought to benefit lenders to Kushner Companies. Citigroup, for example, recently provided \$425m to refinance one of its projects in Brooklyn. Blackstone, which lent \$375m for Panorama, is raising an infrastructure fund that might be expected to find investment opportunities in Mr Trump's infrastructure plan. And so on.

Richard Painter, the chief ethics lawyer under President George W. Bush, says that some of this "stinks to high heaven". That does not mean that Mr Kushner has or is likely to violate any law. The rules governing conflicts of interest bar him from "personally or substantially" participating in matters with a "direct and predictable" effect on his finances. But policies that benefit Mr Kushner's parents or Kushner Companies' partners may be allowed, depending on circumstances. "That's the grey area," says Larry Noble of the Campaign Legal Centre in Washington, DC.

What seems to have developed, in sum, is a lose-lose situation. Mr Trump's presidency appears to be doing Kushner Companies as much harm as good. If potential business partners continue to be wary of the scrutiny that comes with involvement with a firm bearing his name, Mr Kushner might end up having to choose between his property interests and his public role.

Yet the list of potential conflicts is so long that public confidence in policymaking is at risk. A White House spokesman says Mr Kushner will recuse himself in any matter with "a direct and predictable effect" on entities in which he retains a financial interest. Those issues include EB-5 financing and affordable housing, he notes. But the White House has not published a complete list of matters in which Mr Kushner would decline to participate. And no such list is planned. ■



特朗普家族企业 (1)

寻找库什纳安全着陆点

在关于特朗普家族企业两篇专题文章中的第一篇里，我们研究了贾瑞德·库什纳在白宫的职务将如何损害其公司利益并影响公众对决策的信任

十多年前，曼哈顿第五大道666号这幢41层的摩天大楼以18亿美元售出，成为当时美国史上成交价最高的写字楼。如今这栋大楼前途未明，正等待数十亿美元的投资来重建它并把高度增加近一倍。在哈德逊河对岸，另一个项目也在寻找投资，为的是在泽西城（Jersey City）兴建一座名为One Journal Square的大楼。6月，房地产投资创业公司Cadre吸引到了硅谷知名公司的资金支持，包括风投公司安德森·霍洛维茨（Andreessen Horowitz）。

将这些投资项目关联起来的人物是贾瑞德·库什纳（Jared Kushner），特朗普的女婿兼高级顾问。和总统一样，其家族企业主营地产。库什纳参与策划了以上所有三个项目，并在Cadre公司中有“被动所有者权益”（即他不主动介入公司管理）。他的家族拥有第五大道666号和One Journal Square的共同所有权。

与总统不同，库什纳不能免于联邦利益冲突法的约束。他已采取措施，与自己范围广泛的房地产业务保持距离。库什纳公司（Kushner Companies）是由数十家有限责任公司组成的综合性企业，在六个州拥有两万多间公寓和1300万平方英尺（120万平方米）的商业地产。加入特朗普政府之前，他辞去了库什纳公司（Kushner Companies）首席执行官的职务，并出售了自己在多个物业中的股份，包括第五大道666号和One Journal Square。

然而，库什纳保留了自己在许多库什纳公司下属有限责任公司里的股份。他对外披露的财务文件表明，在他掌握的物业股份中，他仍对其中的90%左右拥有被动所有者权益，价值高达4.08亿美元。他的父亲查尔斯·库什纳（Charles Kushner，见与库什纳的合影）在库什纳公司担任重要角色。贾瑞德·库什纳在第五大道666号和One Journal Square的股份都进入了其

家族拥有的信托。大批为其家族提供贷款的企业以及其他合作伙伴都有可能从白宫的政策中获益。

| 地产之战

贾瑞德·库什纳是当前库什纳公司的总设计师。他的祖父约瑟夫·库什纳（Joseph Kushner）是犹太大屠杀的幸存者，在新泽西州开发了花园公寓。查尔斯·库什纳于1985年创立了名为库什纳公司的企业，一直是公司的主要负责人，直到因逃税、非法竞选捐款和干扰证人被定罪。2005年父亲入狱时，贾瑞德·库什纳24岁，次年他买下《纽约观察家》报（*New York Observer*），开始努力恢复家族声誉。不过更大的转变发生在2006年底，当时库什纳公司宣布将购买第五大道666号。

后来金融市场迅速下滑，写字楼租金也随之下跌。库什纳公司继而把第五大道666号的黄金零售空间卖给了拥有Zara的西班牙公司Inditex以及其他投资者，还在2011年向房地产投资信托公司Vornado转让了49.5%的股权，以进行债务再融资。Vornado的创立者是特朗普的长期合伙人史蒂文·罗斯（Steven Roth）。

有一段时间，公司对大型收购项目的胃口有所减弱。然而据数据公司Real Capital Analytics的统计，在2011年对第五大道666号再融资之后，库什纳又踏上了收购的征程（见图表）。他的收购目标包括曼哈顿下城以及托莱多（Toledo）和阿克伦（Akron）等中西部城市的中端住宅楼。他还谋划了更大的发展，包括One Journal Square和布鲁克林的另一个项目。后者现获名“全景”（Panorama），因其位置能将曼哈顿的天际线尽收眼底。

如今库什纳已在白宫任职，有两个问题成为观察家关注的焦点。首先，他的家族企业是否因他的职务以及与总统的关系而在经济上受益？第二，尽管他采取了措施以遵守联邦法律的规定，是否仍存在利益冲突？

先从经济利益的问题说起。现在是库什纳公司发展的关键时期，公司正在为Panorama招租，并为泽西市一栋滨海住宅楼项目寻求新的贷款（库什纳在这两个项目中仍持有股份）。更重要的是，公司还在为第五大道666

号和One Journal Square（这两个项目中库什纳没有股份）寻找投资者。但是看起来，库什纳任职白宫所引来的密切关注不但无益于公司发展，反而有阻碍。

今年1月，《纽约时报》报道，为了第五大道666号大楼的重建，库什纳公司正在寻求来自安邦集团的主权资本。安邦是中国最大的保险公司之一，与北京的政治精英有关联。Vornado最近提交的文件显示，目前第五大道666号的债务高达14亿美元。研究公司Green Street的杰德·里根（Jed Reagan）认为，这令该写字楼本身的价值相形见绌。这在一定程度上是库什纳公司自己造成的，因为当初购买的价格就很高，而且公司为了进行重建，有意让写字楼的租户慢慢迁走。新大楼由去年去世的建筑师扎哈·哈迪德（Zaha Hadid）设计，将耗资75亿美元，包含一间酒店、豪华公寓和新的商铺空间。

库什纳公司与安邦的谈判在3月份终止。道德专家及民主党人士对利益冲突和国家安全感到担忧，因而反对该项目。另一条路近期也行不通了。过去两年多以来，库什纳公司一直在与卡塔尔的显赫人物谢赫·哈马德·本·贾西姆·阿勒萨尼（Sheikh Hamad bin Jassim al-Thani，人称HBJ）就投资第五大道666号谈判。7月，新闻网站The Intercept报道说，HBJ表示，如果库什纳可以通过其他渠道筹集其余所需资金，他就投资5亿美元。7月11日，库什纳公司证实谈判已于近期终止，公司正在重新评估重建项目的融资结构。

有人猜测库什纳还寻求了其他的可能性。去年12月，他会见了正受美国制裁的俄罗斯国有开发银行（Vnesheconombank）的负责人。该银行表示，此次是商务会见。白宫称库什纳在会见中是“以过渡官员的身份行事”。

拟开发的One Journal Square项目也遇到了麻烦。5月，库什纳的妹妹妮可·迈耶（Nicole Meyer）借美国的“EB-5”签证项目招徕中国投资者，该项目允许符合一定条件的投资者移民美国。迈耶在北京大力宣传One Journal Square，解释了库什纳在华盛顿的新角色，并表示该项目“对我个人和整

个家族来说意义重大”。这引发了对库什纳家族利用库什纳政府职务的指责。库什纳公司表示，“无论如何，如果提到她哥哥被理解成企图以此招徕投资者”，公司为此道歉。

泽西市市长史蒂芬·富洛普（Steven Fulop）5月7日说，该项目不会得到库什纳公司所寻求的减税待遇和债券支持。市政府可能在任何情况下都不会答应这些条件——库什纳家族寻求的是特别优厚的一揽子条件。不过，民主党人富洛普和市议会议员即将参加连任竞选，而特朗普在去年11月大选时只得到全市14%的选票。库什纳公司已经失去了主要租户——众创空间公司WeWork。

就算库什纳公司尚未因与总统的关系而受益，发生利益冲突的可能性仍然很大。例如，企业税改革会对房地产企业产生重大影响。特朗普已表示，他想令15%的公司税适用于纳税中间实体（pass-through entities），构成库什纳公司主体的有限责任公司就属于这类（特朗普的公司也一样）。特朗普执政期间有望放松金融监管，为库什纳公司提供贷款的机构应该会受益。例如花旗集团最近为库什纳公司在布鲁克林的一个项目提供了4.25亿美元的再融资。黑石集团（Blackstone）向“全景”项目贷款3.75亿美元。它正在筹建一个基础设施基金，或许预期通过该基金在特朗普的基建计划中找到投资机会。这样的例子不一而足。

曾任小布什政府首席道德律师的理查德·彭特（Richard Painter）说，其中一些利益关系“浊臭熏天”。但这并不意味着库什纳已经或可能会违反任何法律。依照管理利益冲突的法规，他不可“亲自或实质性地”参与对其财务具有“直接和可预测”影响的事务。但根据具体情况，有利于库什纳父母或库什纳公司合作伙伴的政策可能被允许。华盛顿特区竞选法律中心（Campaign Legal Centre）的拉里·诺布尔（Larry Noble）说：“这是片灰色地带。”

总而言之，目前的局面似乎对谁都没好处。特朗普的总统职位对库什纳公司的影响似乎好坏参半。如果潜在的商业伙伴还是心存犹疑，担心因与挂着库什纳名号的企业合作而受到密切关注，库什纳最终可能不得不在

他的地产事业和政府职务之间做出抉择。

然而，存在潜在利益冲突的项目太多，可能会引发公众对政府决策的信任危机。一位白宫发言人说，库什纳将会回避任何会对其拥有经济利益的实体产生“直接和可预测影响”的事务，并指出这些事务包括EB-5投资移民和经济适用房项目。不过白宫尚未公布库什纳将不再参与的事务的完整清单，而且也没打算制定这样的清单。 ■



Buttonwood

How to kill a corporate zombie

The answer may hold the key to enhancing productivity

WHAT is the best way to kill a zombie? Fans of Daryl Dixon, a character in “The Walking Dead”, a television series, will know the answer: a crossbow bolt to the brain. Getting rid of corporate zombies, however, is a much more complicated process.

Ageing populations mean that the workforces in developed economies are likely to stagnate, or even shrink, in coming decades. That means almost all the burden of economic growth is likely to fall on productivity improvements. There has been a lot of focus on labour-market flexibility as the key to solving this problem, but the flexibility of the corporate sector may be just as important. Indeed, there is a growing belief that the persistence of zombie firms—companies that keep operating despite a poor financial performance—may explain the weak productivity performance of developed economies in recent years.

An inability to kill off failing companies seems to have two main effects. First, the existence of the zombies drives down the average productivity level of businesses. Second, capital and labour are wrongly allocated to such firms. That stops money and workers shifting to more efficient businesses, making it harder for the latter to compete. In a sense, therefore, the corporate zombies are eating healthy firms.

One definition of a zombie company is a business whose earnings before tax do not cover its interest expenses. The latest annual report from the Bank for International Settlements examines 14 developed countries and finds that, on this measure, the average proportion of zombies among listed companies increased from less than 6% in 2007 to 10.5% in 2015.

That analysis builds on the work of an OECD paper* published earlier this year which found that, within industries, a higher share of capital invested in zombie firms was associated with lower investment and employment growth at healthier businesses. A new paper** from the OECD examines the link between zombie firms, capital misallocation and the design of corporate-insolvency regimes.

The idea is simple. The easier it is for companies to become insolvent, the more quickly capital can be reallocated from inefficient to efficient uses. The OECD's new paper highlights 13 key features in insolvency regimes, including personal costs to failed entrepreneurs, the rights of creditors and the ability to distinguish between honest and fraudulent bankruptcy. The authors circulated a questionnaire on these issues within 35 OECD member countries and 11 non-member states; 39 responded. It then constructed a set of indicators based on the survey responses.

Britain was the country with the best-designed insolvency regime, based on these criteria; Estonia had the most cumbersome set-up. Sure enough, the study finds that insolvency regimes that make it easier to restructure companies, and limit the personal costs associated with entrepreneurial failure, reduce the amount of capital tied up in zombie firms. Dispatching the living dead on TV and in movies may require the maximum amount of brutality; when it comes to the corporate undead, it is best to kill with kindness.

This is an important issue. The OECD estimates that, in 2013, the share of capital sunk in zombie firms in Greece, Italy and Spain was 28%, 19% and 16%, respectively. Countries have realised the need for change; 15 of those surveyed have changed their insolvency regimes in recent years. The authors reckon a further shift towards the British model could reduce the zombie-capital share by at least nine percentage points in some countries.

There is a lot more to the productivity puzzle than just the nature of insolvency regimes; weak productivity is a big concern in Britain, for example. It seems clear that a squeeze on real wages in recent years has meant that some companies have been happy to employ more workers rather than buy productivity-enhancing machines. Robert Gordon of Northwestern University has suggested that innovations like the internet have been less transformative than previous developments such as the internal combustion engine. But the idea that the corporate sector is becoming more ossified, as seen in the decline of new business formation, deserves a lot more attention.

* “The Walking Dead? Zombie Firms and Productivity Performance in OECD countries”, Working paper 1372

** “Insolvency Regimes, Zombie Firms and Capital Reallocation”, Working paper 1399 ■



梧桐

如何消灭企业僵尸

这一问题的答案可能是提高生产率的关键

消灭僵尸最好的办法是什么？达里尔·迪克森（Daryl Dixon，电视剧《行尸走肉》中的角色）的粉丝们应该知道答案，那就是用十字弓一举射中僵尸的大脑。然而，要消灭企业僵尸，过程却复杂得多。

由于人口的老龄化，发达经济体的劳动力总量在未来数十年里有可能停滞甚至缩减。这样一来，几乎所有的经济增长或许都要依赖生产率的提高。劳动力市场的灵活性受到广泛关注，并被视作解决经济增长问题的关键，但企业部门的灵活性也许同样重要。事实上，越来越多人相信，近年来发达经济体生产率表现疲软或许就是因为僵而不死的僵尸企业。所谓僵尸企业，就是指那些财务状况糟糕却仍在运营的公司。

无法消灭失败的企业可能有两大影响：首先，僵尸企业的存在拉低了行业的平均生产率水平；第二，资本和劳动力被错误配置到此类企业，阻碍了它们向高效企业的流动，影响了高效企业的竞争力。因此，从某种意义上说，僵尸企业正在吞噬健康企业。

僵尸企业也可定义为税前收益不足以支付利息支出的企业。国际清算银行最新一期年报调查14个发达国家后发现，按照这一衡量标准，上市公司中僵尸企业的平均比例从2007年的不到6%增加到2015年的10.5%。

该分析是基于经合组织（OECD）今年稍早时发布的一份报告*。该报告发现，在各行业内，对僵尸企业投入的资本份额越高，健康企业获得的投资和就业增长就越低。经合组织一份新的报告**考查了僵尸企业、资本错配与企业破产制度设计之间的联系。

背后的理念很简单——企业破产程序越简单，资本就能越快实现重新配置，从无效利用转为有效利用。经合组织的新报告突出了破产制度中的13

个关键特征，包括破产企业主的个人成本、债权人的权利，以及鉴别诚信破产和欺诈性破产的能力等。针对这些问题，该报告作者对35个经合组织成员国及11个非成员国进行了一次问卷调查，共收到39份回复。随后，作者在这些调查回复的基础上建立了一套指标。

根据这些标准，英国是破产制度最完善的国家，而爱沙尼亚的破产制度最复杂低效。不出所料，研究发现，如果破产制度的设计让公司更易重组，并对与企业破产相关的个人成本做出限定，就会减少套牢在僵尸企业里的资本数额。电视和电影里消灭“活死人”的手段往往残暴至极，然而对僵而不死的企业，最好是施以“安乐死”。

这个问题很重要。经合组织估计，2013年，套牢在希腊、意大利和西班牙的僵尸企业中的资本份额分别是28%、19%和16%。一些国家已经意识到改革势在必行。接受经合组织问卷调查的国家中有15个近年已经修订了破产制度。报告作者估算，如果进一步向英国模式靠拢，一些国家的僵尸资本份额可能会减少至少九个百分点。

生产率难题的解决之道绝不仅限于破产制度，英国就依然深受生产率疲软之累。近年来实际工资的紧缩显然已经导致一些公司乐于雇用更多的工人，而不是购买提高生产率的机器。美国西北大学的罗伯特·戈登（Robert Gordon）认为，互联网之类的创新并不像过去的内燃机等发明那样具有革命性。但是，新创企业数量减少也反映出企业部门日趋僵化，这一点值得更多的关注。

* 《行尸走肉？经合组织成员国的僵尸企业及生产率表现》，工作论文，编号1372

** 《破产制度、僵尸企业，以及资本重新配置》，工作论文，编号1399 ■



China Inc

Reinstatement

Reforms meant to fix China's ailing government-owned firms instead have emboldened them

ACCORDING to company lore, Yunnan Baiyao, a musty-smelling medical powder, played a vital role during the Long March. As China's Communist troops fled from attacks in the 1930s, trekking thousands of miles to a new base, they spread its yellow granules on their wounds to stanch bleeding. To this day, instructions on the Yunnan Baiyao bottle recommend application after being shot or stabbed. Many Chinese households keep some in stock to deal with more run-of-the-mill cuts. But the government has recently put its maker into service to treat a different kind of ailment: the financial weakness of state-owned enterprises (SOEs).

Yunnan Baiyao has emerged as a poster-child of China's new round of SOE reform. The company, previously owned by the south-western province of Yunnan, sold a 50% stake to a private investor earlier this year. The same firm had tried to buy a slice of Yunnan Baiyao in 2009 but was blocked. Its success this time has been held up in the official press as proof that a push to overhaul sluggish state companies is at last gaining momentum under Xi Jinping, China's president.

But for many investors and analysts, the Yunnan Baiyao case proves just the opposite: that SOE reforms are stuck in a rut. The sale, after all, left half the company in state hands. And a traditional Chinese medical powder is far removed from industries such as energy and finance, which the government deems strategic and is less willing to open to private capital.

It is hard to overstate the importance of getting SOE reforms right. In the 1980s, when China was starting to open to the world, the state sector

dominated its economy, accounting for nearly four-fifths of output. A big factor behind China's remarkable growth since then has been the relative decline of SOEs, to the point that they account for less than a fifth of output today. As state firms stood still, a vibrant private sector sprouted around them.

Over the past few years the state sector has, by several measures, stopped shrinking. There are still more than 150,000 SOEs in operation, two-thirds owned by local governments and the rest under central control. Private firms are much more productive, but state firms gobble up a disproportionate share of resources. They take about half of all bank loans and are the main culprits behind China's big increase in corporate debt. Since 2015 investment by SOEs has grown faster than private-sector investment, reversing a decades-long trend (see chart 1).

For China this has the makings of a damaging cycle. As growth slows, the government leans on SOEs to spend more; but this drives up their debt further and so weighs on the economy. Putting a stop to this sequence is vital for China if it is to become wealthy. The IMF estimates that an ambitious programme of SOE reform could expand the Chinese economy by nearly 10%, or about \$1trn, over the next decade.

The fate of China's state firms is also a global concern. By international standards, they are already massive. China's 200 biggest SOEs account for 18% of global revenues of integrated oil and gas companies, 6% in carmaking and 5% in construction (see chart 2). A series of mega-mergers currently under way is concentrating even more power in the hands of a few, giving them the heft to barge into new markets. For foreign firms this can smack of unfair competition, as if they are fighting against the Chinese state. The temptation for other countries to block foreign investments by SOEs will only increase, setting the stage for bitter disputes.

| *Market failure*

Back in 2013 Mr Xi seemed to grasp that change was needed. He vowed that market forces would play a “decisive role” in allocating resources and declared that reform of SOEs was a priority. Although a big-bang privatisation was never on the cards, the hope was that the government would make SOEs better run, more competitive and less coddled. There has been a bewildering array of directives and pilot programmes since then but little real progress. The fear is that the reforms, taken together, not only fail to solve the most pressing problems, but might even be aggravating them. SOEs are getting bigger, not smaller; their management has become more conservative; and their deficiencies are beginning to infect the economy more widely.

Keeping track of all the different experiments that fall under the heading of “SOE reform” is a full-time job. When Mr Xi put it on the agenda in 2013, the government broke it down into 34 separate initiatives, farmed out to different departments and agencies. It has since published at least 36 supplementary documents and launched reform trials at 21 different firms. Provinces and cities have followed up with dozens of plans, guidelines and trials of their own.

Some promising ideas are afoot. After years of discussion, China has started to let state firms award shares to employees as part of their pay packages. SOEs had tried such schemes in the 1980s and 1990s, but the government stopped them, fearing that senior executives were siphoning off state assets, much like Russia’s oligarchs.

Shanghai International Port Group (SIPG), a city-owned firm, is one of the companies pioneering employee ownership of shares. It also demonstrates how local SOEs, though smaller than their national peers, are often huge themselves: SIPG is the principal operator of Shanghai’s cargo port, the world’s busiest. In June 2015, as a first step, it allocated 1.8% of company

shares to employees; some 16,000 of its 22,000 employees now hold a stake. Ding Xiangming, vice-president of the port group, believes he is already seeing results. “Workers are more focused on our company’s growth,” he says.

| *Public and private*

Shanghai is also an example of how parts of the country can outpace others in SOE reform. Last August the *People’s Daily*, the Communist Party’s main newspaper, hailed the city as a model for other local governments.

Shanghai moved quickly to classify its SOEs as either commercial (eg, SAIC Motor) or in public service (eg, Shanghai Metro). This is a distinction that the central government wants to see applied nationwide, so that companies classified as commercial can be treated more like private firms. Shanghai’s commercial SOEs have more leeway to hire managers from the private sector and to pay market rates.

Another potentially promising idea is “mixed-ownership reform”, a fancy term for allowing SOEs to sell stakes to private investors, as in the case of Yunnan Baiyao. The thinking is that private shareholders will demand more from SOEs, especially if their investment is combined with a seat on the board. As a concept it is not new: many big SOEs have been listed on the stockmarket since the early 2000s, attracting outside investors. But Cao Zhilong of Shanghai United, a law firm, thinks this round of mixed-ownership reform could lead to bigger deals: “The word privatisation is not used. It is too sensitive. But the state can sell a majority.”

At national level, the mixed-ownership trials have been disappointing. The state is mainly selling minority stakes in the subsidiaries of large groups, such as a 45% share in the logistics arm of China Eastern Airlines, a deal completed in June. But for local SOEs, outright sales are easier. Tuopai, a small town in Sichuan, sold a majority stake in its struggling liquor company to a Chinese private-equity firm last year. The change in culture is

already apparent. The company has rolled out slick new adverts and uses designer bottles instead of the old ones with ill-fitting labels. It has also cut about a third of production staff to make way for more automation, the kind of unpopular decision that a government-owned company is loth to make.

In general, though, such deals are rare. This cannot just be blamed on the government; a basic dynamic is also at work. “Profitable SOEs don’t want to sell to outsiders and no one wants to buy a struggling SOE,” says Hong Liang of Everbright Law.

What can be blamed on the government are conflicting messages. Less noted at the time of Mr Xi’s 2013 pronouncement about market forces, but more glaring now, was his declaration that SOEs should continue to play a dominant role in the economy. The implication is that he wants state firms to be better run—hence the emphasis on the market—but only so that they better serve the party by helping it to manage the economy at home and carry China’s flag into foreign territory. Mr Xi has made this point in increasingly strident terms. At a meeting on SOEs last October he devoted his comments not to reform but to the necessity of strengthening the party’s grip. “The party’s leadership of SOEs is a major political principle, and that principle must be insisted on,” he said.

People who work in and with SOEs report a palpable change in atmosphere in recent years. “Party officials are not the same as the technocrats who used to run the SOEs,” says a top banker. “They don’t take risks. Doing nothing is what’s safe.” Some of the most capable employees are leaving SOEs altogether. Political education, always a part of life in state firms, has been stepped up. One manager who recently quit a big state bank said that a campaign exhorting workers to study the party constitution had been unusually intense.

At the same time the government has capped pay for senior executives, concerned that they were getting more than government employees of equivalent ranks, stoking resentment. Yet on an international basis, SOE bosses are dramatically underpaid. The president of PetroChina, the country's biggest oil company, earned 774,000 yuan (\$112,000) in 2016; the CEO of Chevron, a firm of roughly the same market value, pulled in a handsome \$24.7m.

Signs suggest that after seeing morale suffer without any improvement in performance, the party is rethinking at least some of its policies. A senior official in charge of supervising SOEs said in June that it would be wise to delegate power to company boards, giving them more say over long-term planning and hiring decisions. Li Keqiang, China's prime minister, told a meeting of 100 leading executives in April that the government might try to implement a system of performance-linked pay at big state firms. At a conference on July 15th, Mr Xi said it was vital that SOEs reduce their excessive debts (see chart 3).

But Mr Xi's emphasis on party leadership has also created cover for those seeking to defend and even expand state power. The most important role in this is played by SASAC, the arm of the government that oversees most SOEs. It has pushed for the creation of bigger "national champions" under its control. It has combined China's two biggest railway-equipment makers and its two biggest shipping groups, and is reportedly working to knot together its two biggest chemical producers. Medium-sized companies, too, have seen plenty of such activity, affecting property, ports, cement and more.

Some mergers make sense: for instance, the steel sector is highly fragmented, a result of local protectionism. But most combinations look more dubious, because state firms are already oversized. The average SOE has about 13 times more assets than the average private-sector firm,

according to World Bank estimates. What is more, in many industries, the only competition faced by state firms is from other state firms. Indeed, part of the rationale for the mergers is to prevent SOEs from butting up against each other as they go abroad to win business, as had happened with railway-equipment makers.

In the 1990s, when SOE reforms began, the vision was of the state controlling whole industries but with the companies in them battling each other to promote better management. The imperfections of this scheme are clear, judging by weak returns in the state sector. But the government's response is to create even bigger monsters. Chinese economists have described them as “red *zaibatsu*”, a reference to Japan's sprawling, slow-moving conglomerates. Yanmei Xie of Gavekal Dragonomics, a research firm, is even blunter: policymakers “are trying to create conglomerates that can dominate domestic and international markets through sheer size”.

The risk is that such supersized SOEs could hurt the global economy. In a paper published earlier this year, Caroline Freund and Dario Sidhu of the Peterson Institute of International Economics, a think-tank, argued that businesses around the world were operating in more fragmented environments, with the exception of sectors in which Chinese SOEs have large footprints. In these sectors, such as mining and civil engineering, concentration has increased as China's state firms have bulked up. Normally, it is the most productive companies that grow the fastest. China's SOEs, by contrast, are much less efficient than their international counterparts, even when they are growing more quickly, according to Ms Freund and Mr Sidhu.

| *The business of state*

The saving grace in the past was that the vast majority of SOE business was within China. That is changing: industries from construction to steel to railways are looking abroad. The “One Belt, One Road” strategy—the core of

Mr Xi's foreign policy—has made foreign expansion an explicit part of their mandate. The danger is not just that they will elbow Chinese private-sector competitors aside but that in doing so, they will provoke a backlash. Big firms in other countries will demand state backing in order to level the playing field. Foreign regulators, already wary of Chinese capital, will turn more hostile. The drift away from free trade could easily gather steam.

This is not the only worry. One of the keys to China's economic rise hitherto has been its success in restricting the sprawl of state firms. They control the commanding heights of the economy, from transportation to power, but have largely been confined to these sectors. Hard-charging entrepreneurs have been free to break into new businesses around them. The manufacturers that led China's export assault on global markets were private. The tech firms that dominate the internet are private. The restaurants, cafés and shops that line city streets are private.

This model still works, for now. Within the MSCI index of large listed Chinese firms, the state accounts for more than 80% of market capitalisation in sectors such as energy, industry and utilities, according to Morgan Stanley. But the state accounts for 40% or less of market value among consumer, health-care and IT companies, says the bank. With these newer sectors growing far more quickly than smoke-stack industries, private companies may well continue to outflank SOEs.

There is a big looming worry, however. One aspect of SOE reform is in fact making quick progress: the creation of what are known as "state capital investment and operation" companies (SCIOs), to help manage existing state assets and invest in new ones. This initially looked like part of the solution for China. It borrows an approach honed in Singapore, where Temasek, a government-owned holding company, manages a portfolio of state firms but does not meddle in their operations, apart from demanding that they deliver good returns. It is now clear that this is not what China has

in mind. Government officials say that SCIOs should not seek to make money in their investments; rather, they are meant to be more like “policy funds”, seeding firms and industries with government cash or money raised from SOE dividends without worrying about profit.

The other striking feature of SCIOs is that they are expressly enjoined to break into new high-tech sectors. Provincial governments around the country have published plans over the past two years in which they promise to guide more than 80% of their funds into infrastructure, public services and, crucially, “strategic emerging industries”, a category that refers to new energy, biotechnology and IT, among other areas. The upshot is that SCIOs, armed with cheap capital, seem set on expanding the state’s reach into the private sector. “We should anticipate the emergence of literally thousands of well-resourced SCIOs,” says Barry Naughton at the University of California in San Diego.

State-backed private-equity funds, which can be seen as forerunners to the investment function of the SCIOs, are already making a big impact. To give three examples from last year: the city of Shenzhen launched a 150bn yuan fund; Jiangxi, a relatively poor central province, created a 100bn yuan fund; and the city of Chengdu set up a 40bn yuan fund. This influx of cash is pushing up valuations. Bain & Co, a consultancy, calculates that private-equity deals in China were priced last year at a frothy 26-times earnings before interest, tax, depreciation and amortisation, compared with ten times in America. The state may turn out to be a wise investor but experience suggests otherwise. More likely, the state will crowd out private investors, hogging capital and allocating it poorly.

The outcome does not have to be this bleak. Optimists still think that Mr Xi could spring a surprise after a big Communist Party congress later this year. With his authority firmly entrenched, he might feel emboldened to unleash the market forces that he spoke of four years ago. But based on his rhetoric

and actions so far, this looks like wishful thinking. SOEs, far from retreating, are on the march, drawing on government support to compensate for their weakness. They are making conquests at home and abroad. Cutting state firms down to size and opening them up to competition ought to be the point of SOE reform. Instead, China is beefing them up and driving them into new territory. ■



中国股份有限公司

故态复萌

旨在解决国企弊病的改革反而壮大了国企

据云南白药公司的掌故，这种带着股霉味的药粉在长征期间发挥了至关重要的作用。上世纪30年代，中国共产党的军队为躲避攻击，跋涉数千英里转移到新根据地。一路上，他们把黄色的云南白药粉末敷在伤口上止血。直到今天，云南白药瓶身上的说明仍建议在受枪击或刀伤后使用。许多家庭都备有此药，但主要是应付日常小外伤。而中国政府最近则以它的制造商来治疗另一种小病：国企的财务困境。

云南白药公司已成为中国新一轮国企改革的榜样。该公司原本是中国西南省份云南的省属企业，今年早些时候向一家私人投资商出让了50%的股份。早在2009年，同一家公司就曾试图购入云南白药公司的部分股权，但遭阻挠。这一次的成功被官方媒体引为佐证，称在国家主席习近平的领导下，针对疲弱国企的改革终于开始发力。

但在许多投资者和分析人士看来，云南白药的案例所印证的恰与前述相反：国企改革实则停滞不前。毕竟，这次出售的只是半数股权，仍有一半掌握在政府手中，而且涉及的只是中药药粉，远非能源、金融等被政府认为具有战略意义而更不情愿对私人资本开放的行业。

搞好国企改革的重要性，怎么强调都不为过。上世纪80年代中国开始对外开放时，国有部门主宰着全国经济，其产出占总量的近五分之四。这之后中国经济大幅增长，一大因素便是国企力量相对减弱，今天其产出还不到总量的五分之一。国企停步之际，周遭的私营部门则是一片欣欣向荣。

过去几年里，按多种衡量方式，国有部门都已停止了萎缩。目前仍有超过15万家国企在运营，其中三分之二为地方政府所有，其余受中央政府管控。私企远比国企高效，但国企却占用了巨额资源，与产出不成比例。它们拿走了约一半的银行贷款，还是中国企业债务大幅增长的罪魁祸首。自

2015年以来，国企投资的增长速度一直高于私营部门，逆转了已持续数十年的走势（见图表1）。

对中国来说，这是进入恶性循环之象。随着经济增长放缓，政府依赖国企增加投资，但这又进一步推高国企的债务，对经济造成压力。中国要实现富裕，遏止这一恶性循环至关重要。国际货币基金组织估计，如果推进宏大的国企改革，未来十年中国经济可增长近10%，即大约一万亿美元。

中国国企的命运也是全球关注的问题。按国际标准衡量，这些企业的规模已经很庞大。中国最大的200家国企占综合性油气公司全球总收入的18%，占汽车制造业的6%，建筑业的5%（见图表2）。目前正在进行的连串大型并购进一步把力量集中到少数企业手中，使其拥有足够分量闯入新市场。对外国公司来说这颇有不公平竞争之感，好像自己是在与中国政府一较高下。这只会让其他国家更倾向于阻挠中国国企在海外的投资，从而可能引发激烈的纷争。

| 市场失灵

2013年时，习近平似乎意识到必须实施改革。他誓言市场力量在资源分配方面将发挥“决定性作用”，并宣称国企改革为首要任务。尽管中国从来不可能大举推行全面私有化，外界还是希望政府能促使国企改善经营，加强竞争力，不再那么娇纵。自此以后政府出台了名目繁多的指令和试点项目，但鲜有实质性的进展。令人担心的是，这些改革总体来说不但没解决最迫切的问题，反而可能加剧了危机。国企没变小，反而越变越大，管理也变得更保守。国企的缺陷开始更广泛地侵蚀整个经济。

要追踪所有在“国企改革”的名头下开展的不同试验，需要花一番功夫。2013年习近平将改革提上日程之时，政府将其分拆为34项措施，分派给不同的部门和机构执行。此后又发布了至少36份补充文件，并在21家不同企业里启动了改革试点。各省市又随之出台了各自的数十个计划、纲要及试点。

一些好点子正在推进。经过多年讨论，中国已开始允许国企给予员工股

权，作为其薪资的一部分。国企在上世纪八九十年代曾作过类似的尝试，但政府担心国企高管会像俄罗斯的寡头那样侵吞国有资产，于是将其喊停。

市属国企上海国际港务集团（以下简称上港集团）是推行员工持股的先锋企业之一。从该集团也可看出，地方国企虽比央企小，但通常规模仍然庞大：上港集团是上海货运港口这一全球最繁忙港口的主要运营商。2015年6月，作为第一阶段，上港集团向员工派发了1.8%的股份。如今，其22,000名员工中约有16,000人持有公司股份。集团副总裁丁向明相信这一举措已初见成效。“员工们更关注公司的成长了。”他说。

| 公与私

上海的例子也表明，在国企改革方面，一些地区可以领先其他地区。去年8月，党报《人民日报》称赞上海市是供其他地方政府学习的典范。上海行动迅速，将市属国企分为两类：商业性（如上汽集团）或公益性（如上海地铁）。这是中央政府希望推向全国的分类模式，如此一来，那些被界定为商业性的国企就可更多地被当作私营企业来对待。上海的商业性国企拥有更大的自由度，可从私营部门聘请管理人员，并按市场价格支付薪酬。

另一个有潜力的举措是“混合所有制改革”，这个新奇的名词指的是允许国企向私人投资者出售股权，就像云南白药那样。背后的思路是，私人股东对国企的要求会更高，假如其投资还获得了董事会席位的话就更是如此。这种想法并不新鲜：自本世纪初以来，许多大型国企已在股票市场上市，吸引外部投资者。但上海市联合律师事务所的曹志龙认为，这轮混合所有制改革可能造就更大规模的交易：“大家不说‘私有化’，这个词太敏感了。但政府可以出售多数股份。”

在央企层面，混合所有制的试点令人失望。政府出售的主要是大型国有集团子公司的少数股权，例如中国东方航空公司于6月出售了下属物流公司45%的股权。而地方国企要全盘出售股权则更容易。在四川小镇沱牌镇，当地政府去年将镇上经营困难的酒业公司的多数股权出售给一家中国私募

股权公司。企业文化已明显改变。该公司推出了考究的新广告，采用设计师精心打造的酒瓶，舍弃了贴有蹩脚标签的旧瓶子。公司还削减了约三分之一的生产人员，更多地采用自动化技术，这种不讨好的决策正是国企不愿去做的。

然而，总的来说，这类交易并不多。这不能仅仅归咎于政府，一个基本的动态也在起作用。“盈利的国企不愿对外人出售股份，亏损的国企又没人想买。”光大律师事务所的洪亮说。

政府的问题在于发出的信号互相矛盾。2013年习近平宣告市场力量的重要性时，还表示国企应当继续在经济中发挥主导作用。这一点在当时没太引起注意，现在其涵义却愈发显见。这其中暗含的意思是，他希望国企改善经营——所以才强调了市场的重要性——但目的是让它们帮助党管理国内经济并代表中国进军海外，更好地为党服务。习近平已经用愈发强硬的措辞挑明了这一点。去年10月在一次有关国企问题的会议上，他的讲话专注于加强党的掌控的必要性，而非改革。他说：“坚持党对国有企业的领导是重大政治原则，必须一以贯之。”

在国企工作以及与国企打交道的人纷纷表示，近年感受到气氛有明显变化。“党的官员跟以往管理国企的技术官僚不同，”一位银行高层说，“他们不冒险，不作为就最安全。”一些最能干的员工干脆离开了。在国企工作免不了要接受政治教育，现在抓得更紧了。一位刚从大型国有银行辞职的经理表示，规劝员工学习党章的活动近年异常频密。

与此同时，由于担心国企高管的报酬高于同级公务员会引发不满，政府对高管的薪酬做出了限制。但以国际标准来看，国企高管的薪酬太低了。中国最大的石油公司中石油的总裁2016年的年薪为77.4万元（11.2万美元），而与中石油市值相当的雪佛龙公司的CEO年薪高达2470万美元。

有迹象表明，眼见士气受挫而国企业绩未有改善，党至少正对一部分政策作反思。今年6月，一位负责监管国企的高级官员表示，明智的做法是将权力下放给公司董事会，使其在长期规划和人员聘用问题上拥有更大的话

语权。4月，中国总理李克强在与100位知名企业高管会面时表示，政府可能在大型国企推行与绩效挂钩的薪酬制度。在7月15日召开的一次会议上，习近平说国企减少过量债务至关重要（见图表3）。

然而，习近平强调党的领导，这也为那些希望保护甚至扩大政府权力的人提供了幌子。这方面，最重要的角色是国资委，这个国务院下属部门监管着大多数国有企业。国资委一直推动组建受其控制的、更大规模的“国家龙头企业”，已经促成中国两大铁路设备制造商以及两家最大航运集团的合并，据称目前正在推进两大化工集团合并的计划。中型国企也有大量这样的活动，涉及地产、港口、水泥等业务。

有些合并是合理的，例如由于地方保护主义而高度分散的钢铁业。但大部分合并似乎都很可疑，毕竟国企规模已经过于庞大。据世界银行估计，国企的平均资产规模是私企的13倍。而且，在许多行业中，国企面对的竞争仅仅来自其他国企。事实上，合并的部分理由是防止国企在国外争取业务时相互竞争——轨道交通设备制造商就曾经出现过这种情况。

中国国企改革始于上世纪90年代，当时的设想是由政府掌控整个产业，但让业内各个企业互相竞争以提升管理水平。就国有部门收益低下的情况来看，此计划的缺点很明显。但政府的应对之策却是创造更大的“巨兽”。中国的经济学者称之为“红色财阀”，就像日本那些庞大而行动缓慢的大型企业集团。研究公司龙洲经讯（Gavekal Dragonomics）的谢艳梅更为尖锐地指出，政策制定者“正试图创造纯以规模称霸国内外市场的大型企业集团”。

风险在于，这样的超大型国企可能损害全球经济。在今年早前发表的一篇文章中，智库彼得森国际经济研究所（Institute for International Economics）的卡罗琳·弗罗因德（Caroline Freund）和达里奥·西杜（Dario Sidhu）认为，全球企业都在更为分散的环境下经营，唯有中国国企高度参与的行业是例外。在矿业和土木工程等行业中，随着中国国企的壮大，集中程度也在提高。弗罗因德和西杜表示，一般来说，增长最快的应该是那些最高效的企业，但中国国企正好相反，它们虽然增长比国际同

行更快，效率却低得多。

| 政府的生意

过去总算还好，国企的绝大多数业务都在中国境内。但这一点正在改变：建筑、钢铁以至铁路等产业纷纷把目光投向海外。习近平外交战略的核心“一带一路”已把向国外拓展明列为国企的任务之一。风险不仅仅在于它们会挤掉中国的私营竞争者，而且在此过程中还会引发抵制。其他国家的大企业将寻求政府的支持以实现公平竞争。外国的监管机构本已对中国资本心存警惕，今后只会更加敌对。这些偏离自由贸易的做法很容易愈演愈烈。

这并非唯一的忧虑。迄今为止，中国经济崛起的关键之一就是政府成功遏制了国企的扩张。从运输到电力，这些国企控制着中国经济的制高点，但大体上也仅限于这些行业。在国企周围，拼劲十足的私营企业家可以自由闯入新市场。引领中国商品攻陷全球市场的是私人企业。雄霸互联网市场的科技公司是私人企业。城市街道上鳞次栉比的餐厅、咖啡馆和商店也都是私人企业。

这种模式眼下还在有效运转。据摩根士丹利的数据，进入MSCI指数的中国大型上市公司中，国企占能源、工业及公用事业等部门市值的80%以上，但在消费品、医疗及信息技术领域则为40%或更低。这些新兴行业的增速远高于重工业，因此私企很可能继续领先国企。

然而存在着一大隐忧。实际上，国企改革在一个方面进展神速：成立所谓的“国有资本投资运营”公司，帮助管理现有国有资产及投资新资产。最初，这看似有助中国解决问题。它借鉴的是新加坡打造的一套模式：该国的政府控股公司淡马锡（Temasek）管理着投入到多家国有企业中的资本，但不插手其经营，只要求这些企业提供良好的回报。但如今可明显看出，这并非中国想要的。政府官员称国有资本投资运营公司的投资不应以赚钱为目的，所以它们更像是“政策性基金”，以政府资金或国企红利来培育企业和行业，而不操心盈利。

国有资本投资运营公司的另一个突出特点是，这些公司明确受命要打入新兴的高科技行业。过去两年来，全国各地的省级政府已出台计划，承诺将引导80%以上的资金投入基础设施、公共服务，以及关键的“战略性新兴产业”，即新能源、生物科技及信息技术等行业。结果是，拥有廉价资本之利的国有资本投资运营公司似乎蓄势待发，要把国有力量拓展至私营部门。“可以预见，将有数以千计实力雄厚的国有资本投资运营公司涌现。”加州大学圣地亚哥分校的巴里·诺顿（Barry Naughton）说。

政府出资的私募股权基金可被视为国有资本投资运营公司投资职能的开路先锋，现已发挥巨大影响。且看去年的三个例子：深圳市推出规模达1500亿元的基金；相对贫穷的中部省份江西省成立了规模为1000亿元的基金；成都市设立了400亿元的基金。资金涌入推高了估值。据贝恩咨询公司（Bain & Company）计算，去年，中国私募股权交易的估值为息税、折旧与摊销前收益的26倍，充满泡沫，在美国该数字仅为10倍。政府也许是个明智的投资者，但从经验来看并非如此。更有可能发生的是，政府将挤走私人投资者，独占资本却分配不善。

结局不必定如此灰暗。乐观主义者仍然认为，在今年稍后召开中共十九大后，习近平会带来惊喜。随着权力的稳固，他可能如四年前所说的那样，大胆释放市场力量。但目前为止，就其言行来看，这似乎只是人们的一厢情愿。国企根本没有后退，反而大步迈进，借助政府的支持来弥补自身弱势，征服国内外市场。国企改革的重点本该是收缩其规模，并开放市场引进竞争。然而中国却在壮大国企，并推动它们进入新领域。■



Economic and financial indicators

Cigarette prices

Cigarettes are most expensive in high-income countries

The average price of a pack of cigarettes (adjusted for purchasing power) was \$4.87 last year, according to the World Health Organisation. Excise tax, value-added tax and custom duties account for most of the price variation around the world: the non-tax share of the retail price is fairly similar. In high-income countries, where cigarettes are most expensive, taxes make up on average 65% of the total price. Tax accounts for over half the price in almost 80% of high-income countries, compared with around 50% of middle-income countries and less than 20% of low-income countries. The WHO reckons there is ample scope to raise taxes on tobacco products, which is also the best way to reduce consumption. ■



经济与金融指标

香烟价格

香烟在高收入国家价格最高

据世界卫生组织的数据，去年一包香烟的平均价格（依据购买力调整后）为4.87美元。全世界范围内，香烟价格存在差异大多是由于消费税、增值税以及关税不同，零售价格中无税的部分相当接近。香烟在高收入国家价格最高，税金平均占总价的65%。在近80%的高收入国家中，税金占香烟售价的一半以上，而在中等收入国家及低收入国家，这一比重分别为50%左右和不到20%。世界卫生组织认为仍有充足的空间来提高烟草制品的税收，而这也是减少相关消费的最佳途径。 ■



Artificial intelligence

Admiring the scenery

Computer analysis of what people find scenic may help town planners

BEAUTY, proverbially, is in the eye of the beholder. But surroundings matter. A paper published two years ago in *Nature* found a correlation between people's sense of well-being and the "scenicness" of where they lived. The paper's authors measured scenicness by asking volunteers to play an online game called Scenic-or-Not, which invites participants to look at photographs of neighbourhoods and rate their scenic value on a scale of one to ten.

The correlation, the paper's authors found, held true whether a neighbourhood was urban, suburban or rural. It bore no relation to respondents' social and economic status. Nor did levels of air pollution have any influence on it. The authors also discovered that differences in respondents' self-reported health were better explained by the scenicness of where those respondents lived than by the amount of green space around them.

Pinning down what scenicness actually is, though, has always been a frustrating exercise for scientific types. The team behind that *Nature* paper, Chanuki Seresinhe and her colleagues at Warwick Business School, have nevertheless decided to have a go. And they think they have succeeded. As they report in *Royal Society Open Science*, they have adapted a computer program called Places to recognise beautiful landscapes, whether natural or artificial, using the criteria that a human beholder would employ.

Places is a convolutional neural network (CNN), a type of program that can learn to recognise features in sets of data, such as images, presented to it. CNNs often form the basis of face-recognition software. Places, though, as

its name suggests, is optimised to recognise geographical features. Ms Seresinhe and her team taught the program to identify such things as mountains, beaches and fields, and various sorts of buildings, in pictures presented to it. Having done so, they then fed it with 200,000 photos that had been assessed by players of Scenic-or-Not. The program's task was to work out, by analysing each photograph's features in the context of its Scenic-or-Not ratings, what it is that makes a landscape scenic.

Most of the results are not surprising. Lakes and horizons scored well. So did valleys and snowy mountains. In artificial landscapes castles, churches and cottages were seen as scenic. Hospitals, garages and motels not so much. Ms Seresinhe's analysis did, however, confirm one important but non-obvious finding from her previous study. Green spaces are not, in and of themselves, scenic. To be so they need to involve contours and trees.

This observation plays into an idea promulgated 30 years ago by Edward Wilson, an evolutionary biologist at Harvard University. He suggested that the sorts of landscapes people prefer—and which they sculpt their parks and gardens to resemble—are those that echo the African savannahs in which *Homo sapiens* evolved. Gently undulating ground with a mixture of trees, shrubs and open spaces, in other words (though, ideally, without the accompanying dangerous wild animals).

In particular, the parks laid out by 18th-century European magnates often fit these criteria. And those parks are also replete with follies—small buildings or imitation ruins of the sort Ms Seresinhe's work suggests people generally find scenic, too. There is a message here for town planners. Less grass and more trees and bushes would be welcome. And perhaps, also, the odd deliberate folly dotted around, as opposed to the accidental follies that make up so much of modern architecture. ■



人工智能

欣赏美景

用计算机分析人们认为何处是美景，可能会帮助到城市规划人员

正如谚语所说，美或不美，各花入各眼。不过周围环境的确重要。两年前在《自然》杂志上发表的一篇论文发现，人们的幸福感和住处风景的优美程度有关联。论文作者让志愿者玩一个名为“风景美不美”（Scenic-or-Not）的在线游戏来衡量风景的优美程度。玩家要浏览一些社区的照片，从1到10给这些地方风景的宜人度打分。

作者发现，无论是在城市、郊区还是乡村，这一相关性均成立，而且与受访者的社会和经济地位无关。空气污染程度对其也没有任何影响。作者还发现，相比周边的绿地面积，受访者居住地风景的优美程度能更好地解释他们自述的健康状况的差异。

不过对于搞科学的人，要弄清楚怎样才算“优美”的风景从来都是件麻烦事。尽管如此，这篇论文背后的团队---华威商学院（Warwick Business School）的查努基·赛热辛（Chanuki Seresinhe）和她的同事们还是决定试一试。而且他们觉得自己已经成功了。他们在《皇家学会开放科学》（Royal Society Open Science）上发表文章，说他们训练出了一个名叫“地方”（Places）的计算机程序，可用人类观者的标准识别出美丽的风景，不管是天然的还是人造的。

“地方”是一个卷积神经网络（convolutional neural network，简称CNN），将图片等数据集呈献给这种程序，它就能学着去辨认数据集的特征。CNN通常被用作人脸识别软件的基础。不过顾名思义，“地方”经过优化是为了用来识别地理特征。赛热辛和她的团队用图片训练这一程序辨认山脉、海滩、田野和各种各样的建筑物。完成这一步后，他们又向程序输入20万张“风景美不美”玩家评定过的图片。它的任务是结合“风景美不美”的评分，分析每张图片的特征，弄清楚到底是什么因素让一个地方显得风景优美。

大部分结果并不令人意外。湖泊和地平线得分较高。山谷和雪山也是如此。人工景致中，城堡、教堂和村舍被认为是优美的风景。医院、车库和汽车旅馆就差些意思。但是赛热辛的分析确定了她之前研究中一个重要但不明显的发现：绿地本身并不是美景。想让绿地成为美景，得有高低起伏的轮廓和树木。

这一发现支持了哈佛大学的进化生物学家爱德华·威尔逊（Edward Wilson）在30年前提出的一个观点。他认为人们喜欢的那类风景，也就是他们在打造公园和花园所模拟的景观，与非洲热带草原的景致相似——那里是智人进化的地方。换句话说，就是要地面稍有起伏，有树木和灌木，还有空地（不过身边最好没有危险的野生动物）。

18世纪的欧洲权贵建造的公园往往特别符合这些标准。而且这些公园也满是装饰性建筑——也就是赛热辛的研究认为人们通常会觉得赏心悦目的那类小建筑或遗迹仿品。接下来是要告诉城市规划人员的信息：少些草，多些树和灌木，会受到欢迎。可能还要故意点缀一些奇奇怪怪的装饰性建筑，而不是现代建筑中那么多不小心成了无用装饰品的糟糕设计。 ■



Artificial intelligence

The algorithm kingdom

China's deep pool of data means it has a chance to lead in artificial intelligence

AT THE start of this year, two straws in the wind caught the attention of those who follow the development of artificial intelligence (AI) globally. First, Qi Lu, one of the bosses of Microsoft, said in January that he would not return to the world's largest software firm after recovering from a cycling accident, but instead would become chief operating officer at Baidu, China's leading search engine. Later that month, the Association for the Advancement of Artificial Intelligence postponed its annual meeting. The planned date for the event in January conflicted with the Chinese new year.

These were the latest signals that China could be a close second to America—and perhaps even ahead of it—in some areas of AI, widely considered vital to everything from digital assistants to self-driving cars. China is simply the place to be, explains Mr Lu, and Baidu the country's most important player. “We have an opportunity to lead in the future of AI,” he says.

Other evidence supports the claim. In October 2016 the White House noted in a report that China had overtaken America in the number of published journal articles on deep learning, a branch of AI. PwC, a consultancy, predicts that AI-related growth will boost global GDP by \$16trn by 2030; nearly half of that bonanza will accrue to China, it reckons. The number of AI-related patent submissions by Chinese researchers has increased by nearly 200% in recent years, although America is still ahead in absolute numbers (see chart).

To understand why China is so well placed, consider the inputs needed for

AI. Of the two most basic, computing power and capital, it has an abundance. Chinese firms, from giants such as Alibaba and Tencent to startups such as CIB FinTech and UCloud, are building data centres as fast as they can. The market for cloud computing has been growing by more than 30% in recent years and will continue to do so, according to Gartner, a consultancy. In 2012-16 Chinese AI firms received \$2.6bn in funding, according to the Wuzhen Institute, a think-tank. That is less than the \$17.9bn that poured into their American peers, but the total is growing quickly.

Yet it is two other resources that truly make China a promised land for AI. One is research talent. As well as strong skills in maths, the country has a tradition in language and translation research, says Harry Shum, who leads Microsoft's AI efforts. Finding top-notch AI experts is harder in China than in America, says Wanli Min, who oversees 150 data scientists at Alibaba. But this will change over the next couple of years, he predicts, because most big universities have launched AI programmes. According to some estimates, China has more than two-fifths of the world's trained AI scientists.

The second advantage for China is data, AI's most important ingredient. In the past, software and digital products mostly obeyed rules laid down in code, giving an edge to those countries with the best coders. With the advent of deep-learning algorithms, such rules are increasingly based on patterns extracted from reams of data. The more data are available, the more algorithms can learn and the smarter AI offerings will be.

China's sheer size and diversity provide powerful fuel for this cycle. Just by going about their daily lives, the country's nearly 1.4bn people generate more data than almost all other nations combined. Even in the case of a rare disease, there are enough examples to teach an algorithm how to recognise it. Because typing Chinese characters is more laborious than Western ones, people also tend to use voice-recognition services more

often than in the West, so firms have more voice snippets with which to improve speech offerings.

| *The Saudi Arabia of data*

What really sets China apart is that it has more internet users than any other country: about 730m. Almost all go online from smartphones, which generate far more valuable data than desktop computers, chiefly because they contain sensors and are carried around. In the big coastal cities, for instance, cash has all but disappeared for small purchases: people settle with their devices using services such as Alipay and WeChat Pay.

Chinese do not seem to be terribly concerned about privacy, which makes collecting data easier. The country's bike-sharing services, which have taken big cities by storm, for example, not only provide cheap transport but are what is known as a "data play". When riders hire a bicycle, some firms keep track of renters' movements using a GPS device attached to the bike.

Young Chinese appear particularly keen on AI-powered services and relaxed about use of their data. Xiaoice, an upbeat chatbot operated by Microsoft, now has more than 100m Chinese users. Most talk to it between 11pm and 3am, often about the problems they had during the day. It is learning from interactions and becoming cleverer. Xiaoice no longer just provides encouragement and tells jokes, but has created the first collection of poems written with AI, "Sunshine Lost Its Window", which caused a heated debate in Chinese literary circles over whether there can be such a thing as artificial poetry.

Another important source of support for AI in China is the government. The technology figures prominently in the country's current five-year plan. Technology firms are working closely with government agencies: Baidu, for example, has been asked to lead a national laboratory for deep learning. It is unlikely that the government will burden AI firms with over-strict

regulation. The country has more than 40 laws containing rules about the protection of personal data, but these are rarely enforced.

Entrepreneurs are taking advantage of China's talent and data strengths. Many AI firms got going only a year or two ago, but plenty have been progressing more rapidly than their Western counterparts. "Chinese AI startups often iterate and execute more quickly," explains Kai-Fu Lee, who ran Google's subsidiary in China in the 2000s and now leads Sinovation Ventures, a venture-capital fund.

As a result, China already has a herd of AI unicorns, meaning startups valued at more than \$1bn. Toutiao, a news aggregator based in Beijing, employs machine learning to recommend articles using information such as a reader's interests and location; it also uses AI to filter out fake information (which in China mainly means dubious health-care announcements). Another AI startup, iFlytek, has developed a voice assistant that translates Mandarin into several languages, including English and German, even if the speaker uses slang and talks over background noise. And Megvii Technology's face-recognition software, Face++, identifies people almost instantaneously.

| *Skynet lives*

At Megvii's headquarters, visitors are treated to a demonstration. A video camera in the lobby does away with the need for showing ID: employees just walk in without showing their badges. Similar devices are positioned all over the office and their feeds are shown on a video wall. When a face pops up on the wall, it is immediately surrounded by a white rectangle and some text giving information about that person. In the upper right-hand corner of the screen big letters spell "Skynet", the name of the AI system in the Terminator films that seeks to exterminate the human race. The firm already enables Alipay and Didi, a ride-hailing firm, to check the identity of new customers (their faces are compared with pictures held by the

government).

Reacting to the success of such startups, China's tech giants, too, have begun to invest heavily in AI. Baidu, Alibaba and Tencent, collectively called BAT, are working on many of the same services, including speech- and face-recognition. But they are also trying to become dominant in specific areas of AI, based on their existing strengths.

Tencent has so far kept the lowest profile; it established its AI labs only in recent months. But it is bound to develop a big presence in AI: it has more data than the other two. Its WeChat messenger service has nearly 1bn accounts and is also the platform for thousands of services, from payments and news to city guides and legal help. Tencent is also a world-beater in games with blockbusters such as League of Legends and Clash of Clans, which have more than 100m players each globally.

Alibaba is already a behemoth in e-commerce and is investing billions to become number one in cloud computing. At a conference in June in Shanghai it showed off an AI service called "ET City Brain" that uses video recognition to optimise traffic in real time. It uses footage from roadside cameras to predict the behaviour of cars and can adjust traffic lights on the spot. In its home town of Hangzhou, Alibaba claims, the system has already increased the average speed of traffic by 11%. Alibaba is also planning to beef up what it calls "ET Medical Brain", which will offer AI-powered services to discover drugs and diagnose medical images. It has signed up a dozen hospitals to get the data it needs.

But it is Baidu whose fate is most tied to AI, in part because the technology may be its main chance to catch up with Alibaba and Tencent. It is putting most of its resources into autonomous driving: it wants to get a self-driving car onto the market by 2018 and to provide technology for fully autonomous vehicles by 2020. On July 5th the firm announced a first

version of its self-driving-car software, called Apollo, at a developer conference in Beijing.

Getting Apollo right will not only involve cars safely navigating the streets, but managing a project that is open to outsiders. Rivals such as Waymo, Google's subsidiary, and Tesla, an electric-car firm, jealously guard their software and the data they collect. Baidu is planning not only to publish the recipe for its programs (making them "open-source", in the jargon), but to share data. The idea is that carmakers that use Baidu's technology will do the same, creating an open platform for data from self-driving cars—the "Android for autonomous vehicles", in the words of Mr Lu.

| *Drive like a Beijinger*

It remains to be seen how successful Chinese firms will be in exporting their AI products—for now, only a tiny handful are used abroad. In theory they should travel well: a self-driving car trained on China's chaotic streets ought to have no problem navigating the more civilised traffic in Europe (in contrast, a vehicle trained in Germany may not get far beyond the first intersection in Beijing). But consumers in the West may hesitate to use self-driving cars that have been trained in a laxer safety environment that is more tolerant of accidents. Chinese municipalities are said to be falling over themselves to be testing grounds for autonomous vehicles.

There is another risk. Data are the most valuable input for AI at the moment, but their importance may yet diminish. AI firms have started to use simulated data, including those from video games. New types of algorithms may be capable of getting smart with fewer examples. "The danger is that we stop innovating in algorithms because of our advantage in data," warns Gansha Wu, chief executive of UISEE, a Beijing startup which is developing self-driving technology. For now, though, China looks anything but complacent. In the race for pre-eminence in AI, it will run America close. ■



人工智能

算法的王国

中国数据资源丰富，有机会在人工智能领域占据领先地位

今年年初，关注全球人工智能（AI）发展动向的人注意到两件小事。先是微软高管之一陆奇在1月表示，自己从自行车事故中恢复后不会回归这家世界最大的软件公司，而是将加入中国领先的搜索引擎百度，担任该公司的首席运营官。当月晚些时候，国际人工智能协会推迟了年会举办的时间。会议原计划在1月举行，但时间与中国新年发生了冲突。

这两件事再度显现了一种可能性：在人工智能的某些领域，中国将紧随美国而位居第二，甚至可能赶超美国。人们普遍认为，从数字助手到自动驾驶汽车，人工智能对一切事物都至关重要。陆奇解释说，中国无疑是未来的热点所在，而百度是这个国家最重要的玩家。“我们有机会引领人工智能的未来。”他说。

其他证据支持他的这一说法。2016年10月，白宫在一份报告中提到，中国在深度学习（人工智能的一个分支）领域的期刊论文发表数量已超过美国。咨询公司普华永道预测，到2030年，与人工智能有关的增长将令全球GDP增长16万亿美元。它估计这笔“横财”有将近一半都将流向中国。近年来，中国研究人员提交的与人工智能相关的专利申请数量已增加近200%，尽管美国在绝对数量上仍然领先（见图表）。

要了解中国为何占据优势，不妨试想一下人工智能所需的投入。其中最基本的两种投入——计算能力和资本，在中国十分充裕。从阿里巴巴和腾讯这样的巨头到兴业数金和UCloud等创业公司都在尽可能快地打造数据中心。咨询公司高德纳（Gartner）称，近年中国云计算市场保持了超过30%的增速，而且这一势头还将继续。据乌镇智库的数字，2012年至2016年，中国的人工智能公司获得了26亿美元的资金投入。这一数字少于美国同行获得的179亿美元，但总额正在迅速增长。

然而，真正让中国成为人工智能福地的其实是另外两大资源。一是研究人才。微软人工智能事业部门的负责人沈向阳说，中国除了数学很强，还有语言及翻译研究的传统。阿里巴巴的闵万里手下有150名数据科学家。他说，在中国，寻找顶尖的人工智能专家要比在美国难。不过他预测这种局面在两三年里就会发生改变，因为多数大型高校都开设了人工智能项目。据一些估计数字，全世界培养的人工智能科学家中，超过五分之二在中国。

中国的第二个优势是数据，这也是人工智能最重要的“原料”。过去，软件和数字产品主要是按代码编写的规则行事，因而拥有最优秀的编程人员的国家占据优势。随着深度学习算法的出现，这些规则日益建立于从大量数据中提取的各种规律之上。供试用的数据越多，算法能学到的东西就越多，人工智能所提供的服务也就越智能。

中国的体量和多样性为这样的循环提供了强劲的动力。单靠开展日常生活，该国近14亿人口就能产生大量数据，几乎超过其他所有国家的总和。就算是某种罕见病，在中国也能获得足够的病例去训练算法识别该疾病。由于输入中国的汉字要比西方国家的字母费时费力，人们使用语音识别服务的频率通常也高于西方国家，企业也就获得了更多的语音片段来改善语音服务。

| 数据的沙特阿拉伯

真正令中国与众不同的一点是，它的互联网用户比任何国家都多：大约有7.3亿人。几乎所有网民都用智能手机上网，产生的数据比来自台式电脑的数据有价值得多。这主要是因为智能手机包含传感器，而且由机主随身携带。以沿海大城市为例，在进行小额交易时几乎已经没人使用现金了，通过手机上的支付宝和微信支付等服务就可以搞定。

中国人似乎不是特别担心隐私的问题，这就使得收集数据变得更容易了。例如，风靡该国各大城市的共享单车服务不仅提供了廉价的交通方式，而且还是个所谓的“数据游戏”。一些公司会在用户租用自行车时利用装在车上的GPS设备追踪租车者的活动。

年轻的中国人似乎尤其热衷由人工智能驱动的服务，对于自身数据被使用也比较淡然。微软运营的聊天机器人、阳光正向的小冰如今有超过一亿个中国用户，多数都是在晚上11点到凌晨3点和它聊天，通常都是谈论自己在白天遇到的问题。小冰从互动中学习，过程中又变得更聪明。如今它不再只是给人鼓励和讲笑话，还运用人工智能创作出了首部诗集——《阳光失了玻璃窗》。中国的文学界为此展开了激烈的争论，探讨人工智能生成的诗歌算不算诗歌。

中国的人工智能还有一个重要的支持力量：政府。在该国当前的五年计划中，科技是其中的重点。科技公司正与政府部门开展密切的合作，例如，百度已受命领导一个深度学习的国家级实验室。政府也不大可能用过于严格的监管增加人工智能公司的负担。中国有40多部法律包含了个人数据保护规则，但很少执行。

创业者正在利用中国的人才及数据优势。许多人工智能公司一两年前才开始运营，但其中有不少公司发展速度都快过西方的同类。李开复解释说，“中国的AI创业公司通常有更快的迭代及执行速度。”他在本世纪初曾负责管理谷歌在中国的子公司，如今领导风险投资基金创新工场。

结果是，中国已经出现了一批人工智能独角兽公司，即估值超过十亿美元的创业公司。总部位于北京的新闻聚合器“头条新闻”根据读者的兴趣及位置，利用机器学习来推荐文章，还运用人工智能过滤掉虚假信息（在中国，这类信息主要是各种可疑的养生资讯）。另一家人工智能创业公司科大讯飞开发了一款语音助手，可将普通话翻译成包括英语和德语在内的若干种语言，即使说话者话语间夹杂俚语或背景有杂音也没影响。旷视科技的人脸识别软件Face++几乎可以瞬间将人识别出来。

| “天网”恢恢

在旷视科技的总部，公司向来访者做了一番演示。大堂里的一个摄像机省去了展示身份证件的必要：员工不用出示工作牌就可进入公司。办公楼各处都安置了类似的装置，其所收集的数据显示在一面视频墙上。当墙上跳出一张人脸时，周围立刻就出现一个白色方框，以及关于这个人的一些文

字信息。屏幕的右上角，几个大大的字母拼写出“Skynet”（天网），也就是《终结者》系列电影中那个试图消灭人类的人工智能系统的名字。旷视科技已向支付宝以及网约车公司滴滴提供支持，帮助它们核查新客户的身
份（将他们的面孔与政府持有的照片做对比）。

眼见创业公司取得了成功，中国的科技巨头也开始大举投资人工智能。百度、阿里巴巴和腾讯（合称为BAT）正在开发许多类似的服务，包括语音及人脸识别。不过它们也在试图利用现有优势成为特定人工智能领域里的主导力量。

目前来看，腾讯最为低调，直到最近几个月才建立起自己的人工智能实验室。不过它拥有的数据比百度和阿里巴巴都要多，势必会在人工智能领域占据重要地位。其即时通讯服务微信有近10亿用户，同时还是数千种服务的平台，例如支付、新闻、城市指南以及法律咨询等。腾讯还是全球最大的游戏公司，其大热游戏《英雄联盟》和《部落冲突》在全球的玩家都超过一亿人。

已是电商巨头的阿里巴巴正豪掷数十亿元，力争在云计算领域取得领先。6月于上海举行的一次会议上，阿里巴巴展示了一项名为“ET城市大脑”的人工智能服务，可利用视频识别来实时优化交通。该服务运用路边摄像头拍摄的视频片段来预测车辆的行为，即刻调整交通信号灯。阿里巴巴声称，在其总部所在地杭州，该系统使交通的平均速度提高了11%。该公司还计划加强其“ET医疗大脑”系统，提供各种人工智能服务来帮助研发新药和诊断医学影像。为获取所需数据，公司已与十几家医院签约。

不过，自身命运与人工智能最休戚相关的还是百度，这在某种程度上是因为这项技术也许是它追上阿里巴巴和腾讯的主要机会。如今它将大部分资源都投入到了自动驾驶技术上，目标是在2018年前将无人驾驶汽车投放市场，到2020年为全自动驾驶汽车提供技术。7月5日，百度在北京的一次开发者大会上推出了其首款自动驾驶汽车软件“阿波罗”。

阿波罗系统不仅涉及安全行驶汽车，还要管理一个向外部人士开放的项

目。竞争对手如谷歌的子公司Waymo和电动汽车公司特斯拉都对自己的软件和收集来的数据严防死守。而百度不仅计划公开自己项目的“秘方”（用行话说就是将它们“开源”），还计划共享数据。百度的设想是，采用百度技术的汽车制造商也会效法，从而打造出一个无人驾驶汽车数据的开放平台——用陆奇的话说，就是“自动驾驶汽车领域的安卓系统”。

| 像北京人那样开车

至于中国公司将自己的人工智能产品推向海外时成绩如何，仍有待观察。就目前而言，只有少数产品走向了海外。理论上说，这些产品的海外之旅应该很顺利，比如在中国混乱的道路上训练出来的自动驾驶汽车，在欧洲更文明有序的交通环境中行驶时应该也没问题（相反，在德国受训的汽车到了北京，过了一个十字路口可能就寸步难行了）。不过，中国的对道路安全的要求不如西方严格，对事故的容忍度更高，西方国家的消费者对在如此环境中训练出来的汽车可能有所顾虑。据说，中国城市都在力争成为自动驾驶汽车的测试场。

还有一个风险。眼下数据还是人工智能最重要的因素，但数据的重要性也许会减弱。人工智能公司已开始使用模拟数据，包括来自视频游戏的数据。新型的算法也许用较少的数据就能变得智能。趋势科技的CEO吴甘沙警告说：“怕就怕我们会因为自己在数据上的优势而停止在算法上的创新。”这是北京的一家创业公司，开发自动驾驶技术。不过，目前来看，中国毫无自满之意。在争夺人工智能卓越地位的竞赛中，中国将是美国的劲敌。■



Business technology

A new way to work

Authors of “The Second Machine Age” seek to explain the business implications of new digital technologies

IN 2014 Andrew McAfee and Erik Brynjolfsson of the Massachusetts Institute of Technology published “The Second Machine Age”. The book was a balanced portrait of how new digital technologies were poised to improve society, even as they increased unemployment and depressed wages. In their latest work, “Machine, Platform, Crowd”, the authors seek to explain the business implications behind these developments.

Mr McAfee and Mr Brynjolfsson believe that the latest phase of computers and the internet have created three shifts in how work happens. The first is artificial intelligence (AI): a move from man to machine. In the past people worked with computers and, at the same time, were augmented by them: what the authors call the “standard partnership”. But that model is breaking down as computers improve and take more control.

You need only look at self-driving cars, online language translation and Amazon’s prototype cashierless shops to see that something big is happening. Digital technologies used to be applied to information—first numbers and text, and, later, music and video. Now, the digital technologies are invading the physical world.

For instance, designing a “heat exchanger”, a part in appliances like refrigerators, means balancing many different specifications and constraints. Humans settle for one that works well enough because to find the optimal one is too hard. But new “generative design” means AI-infused software can run zillions of tiny permutations to find the best possible design—one that a human might not come up with. And with 3D printing,

those designs might be shared, modified and manufactured anywhere.

The second is a shift from products to platforms. Many people encounter evidence of this every day. The largest cab service owns no vehicles (Uber), the biggest hotelier has no property (Airbnb), the most comprehensive retailer holds no inventory (Alibaba) and the most valuable “media” company creates some content but not much (Facebook). There are more than 2.2m apps in Apple’s store, almost none of which the company developed itself.

Platforms are a way for companies to create marketplaces that allow both sides of the transaction to flourish—while the firm, as gatekeeper, enjoys a tidy revenue stream. This is hard to pull off. The platform must ensure that standards are high, and also attract different sets of participants (like drivers or app developers on one side and customers on the other). But platforms are very valuable when they work, since they scale beautifully in a digital setting. The meatiest part of the book is the treatment of platform economics, replete with demand-curve charts.

The third shift is from the core to the crowd. The core refers to centralised institutions, like central banks or the “Encyclopedia Britannica”; the crowd refers to the decentralised, self-organising participants, be it bitcoin nodes that manage the virtual currency or contributors to Wikipedia.

When transaction costs are high, companies do things internally, as Ronald Coase, an economist, once noted. Yet as digital technologies lower the cost of interacting, more things can be done by informal groups. This leads to greater experimentation and innovation. “The core is often mismatched for the kinds of challenges and opportunities it faces, while the crowd, because it’s so big, almost never is,” the authors write.

Pedants will quibble that the book is built on individual themes that others

have looked at more deeply. Some readers will be aghast that chapters end with bullet-point summaries and questions, evoking the worst of unctuous business tomes. But tolerate this. For an astute romp through important digital trends, “Machine, Platform, Crowd” is hard to beat. ■



商业技术

全新工作方式

《第二次机器革命》的作者试图解释新数字技术的商业影响

2014年，麻省理工学院的安德鲁·迈卡菲（Andrew McAfee）和埃里克·布莱恩约弗森（Erik Brynjolfsson）出版了《第二次机器革命》（The Second Machine Age）一书。这本书平衡客观地描述了新数字技术势将如何改善社会，尽管与此同时它们增加了失业，压低了工资。在最新著作《机器、平台、大众》（Machine, Platform, Crowd）中，两位作者试图解释这些发展背后的商业影响。

迈卡菲和布莱恩约弗森认为，电脑和互联网的 latest 发展阶段为工作方式带来了三类转移。第一是人工智能（AI）：从人到机器的转移。过去，人和电脑联手合作，过程中又利用电脑增强了自己的能力，作者称之为“标准合作伙伴关系”。但随着计算机不断改进、有了更多掌控权，这种模式正在瓦解。

只需看看无人驾驶汽车、在线翻译软件和亚马逊正在测试的无人收银商店，就会知道重大转变正在发生。数字技术以前被应用于信息——先是数字和文本，然后是音乐和视频。现在，数字技术正在入侵实体世界。

例如，设计冰箱这类电器中的“热交换器”，需要在许多不同尺寸规格和限制条件中找到平衡。只要找到一个还不错的平衡点，人类就会将就着用，因为要找到最优的那一点非常困难。但新的“生成设计”意味着AI软件可以进行无限次的微小排列，找到可能的最佳设计——一项人类可能无法做出的设计。而且有了3D打印，这些设计也许就可以在任何地方共享、修改、投产。

第二是从产品向平台的转移。许多人每天都在见证这种变化。最大的出租车公司没有一辆汽车——优步；最大的酒店经营公司没有任何酒店物业——爱彼迎（Airbnb）；商品最丰富的零售商没有库存——阿里巴巴；最

有价值的“媒体”公司创造了一些内容，但并不多——Facebook。苹果商店中有超过220万个应用，几乎都不是苹果公司自己开发的。

企业利用平台创造市场，让交易双方实现双赢，同时作为把关人享有可观的收入流。要做到这点并非易事。平台必须确保高标准，同时还要吸引不同的参与者（例如一方面要吸引司机或应用开发人员，另一方面要吸引客户）。但平台一旦运作成功，就会产生巨大的价值，因为它们会在数字化环境中实现精彩的扩张。这本书的重头戏是对平台经济学的分析，而且辅以大量的需求曲线图表。

第三是从核心机构到大众的转移。核心机构是指中央集权机构，如央行或《大不列颠百科全书》。大众是指分散的、自行组织的参与者，如管理比特币这一虚拟货币的节点，或撰写维基百科词条的人。

经济学家罗纳德·科斯（Ronald Coase）曾经指出，当交易成本较高时，公司会在内部完成所有工作。然而由于数字技术降低了互动的成本，非正式群体将会承担更多的工作，从而带来更多的实验和创新。两位作者在书中写道：“在面临各类挑战和机遇时，核心机构往往无法面面俱到，而大众群体规模庞大，几乎无往不利。”

老夫子们可能会挑刺，说本书只是把他人更深入地探讨过的单个主题捏在一起。一些读者会惊讶地发现，各章节都是以要点陈列和提问结尾，让人联想到那些最难啃的大部头商业书籍中最糟糕的体验。但请容忍这一点。

《机器、平台、大众》带我们领略了重要的数字化趋势，反应机敏，内容又妙趣横生，其他书籍难出其右。■



New retail techniques

Body language

Shoppers' emotions may help physical retailers compete with online ones

FOR eight months up to this April, a French bookstore chain had video in a Paris shop fed to software that scrutinises shoppers' movements and facial expressions for surprise, dissatisfaction, confusion or hesitation. When a shopper walked to the end of an aisle only to return with a frown to a bookshelf, the software discreetly messaged clerks, who went to help. Sales rose by a tenth.

The bookseller wants to keep its name quiet for now. Other French clients of the Paris startup behind the technology, Angus.ai, are testing it in research shops that are not open to the public. They include Aéroports de Paris, an airport owner; LVMH, a luxury conglomerate; and Carrefour, a chain of hypermarkets. In a test at a Mothercare shop in Tallinn, Estonia, software from Realeyes, an emotion-detection firm based in London, showed that shoppers who entered smiling spent a third more than others.

Simple video yields a lot of insight. But there are far more sophisticated and intimate ways of learning about emotions of shoppers. Thermal-imaging cameras can detect the heart rate. Wirelessly captured data from smartphone accelerometers can suggest when shoppers become fascinated (movement often stops) or are fretting over prices (a phone is repeatedly raised to search for cheaper products online).

For even more insights, shoppers are sometimes asked to don special kit, typically in exchange for a discount or other reward. Wearable "galvanometer" gadgets, for example, measure moisture and electrical resistance on hand skin to reveal arousal.

All of this could be a chance, some say, for bricks-and-mortar retailers to trim the advantage that data have long given online sellers. A race is on to work out how best to collect and use emotions data, be it to improve packaging, displays, music, or the content and timing of sales pitches, says Rana June, chief executive of a firm in New York called Lightwave. It measures shoppers' emotions for retailers, for malls, and for consumer-goods firms such as PepsiCo, Procter & Gamble and Unilever.

Not everyone is impressed. Some find it all a little creepy. Nielsen, a consumer-research giant, deems using technology to work out shopper emotions en masse too "avant-garde" for now, says Ricardo Gutiérrez, head of shopper insights at Nielsen Colombia in Bogotá.

But it is much cheaper than old-fashioned interviews. Nielsen charges roughly \$10,000 to interview 25 shoppers about three products. Angus.ai's service costs just €59 (\$66) a month per camera. For \$15,000 or so, iMotions, based in Copenhagen, gives retailers an EEG cap that detects brain activity, an eye-tracking headset that notes when an attractive object dilates pupils, and a galvanometer. iMotions' 150 or so consumer-goods clients include Mondelez International, Nestlé and Unilever, which use them in mock-up stores and real ones.

What's more, conventional market research can mislead. People typically "edit" verbal responses to make themselves sound rational, when purchases are often driven by subconscious emotions. The key is in tracking the unconscious things that shoppers do, says Jeff Hershey of VideoMining, a firm in Pennsylvania whose software also analyses store video. And surveys can also ask the wrong questions—such as how much people like a product when what really matters, notes Simon Harrop of BrandSense, a consultancy in Britain, is whether, say, it makes them feel attractive.

The notion of “retail therapy”, consumers driven to spend when they are feeling blue, is an obvious example of shopping’s emotional side. Whichever store is first to work out how to spot mildly depressed customers could make a bundle. ■



零售新技巧

身体语言

消费者的情绪可能有助于实体店与网店竞争

今年4月之前的8个月里，法国一家连锁书店一直在用软件分析巴黎一个分店里的监控视频，仔细观察购物者的动作，以及他们惊讶、不满、困惑或犹豫时的面部表情。当顾客走到过道尽头，却又皱着眉头回到书架旁，软件就会悄悄向店员发出消息，店员就会上前帮忙。销售额因此增长了十分之一。

这家书店暂时还不想公开自己的名字。提供这项技术的是巴黎创业公司Angus.ai，该公司其他法国客户正在一些不对外开放的实验店铺内做技术测试。这些客户包括巴黎机场集团（Aéroports de Paris）、奢侈品集团LVMH和大型连锁超市家乐福。爱沙尼亚首都塔林的一家Mothercare婴童用品分店进行的一次测试中，伦敦情感检测公司Realeyes开发的软件表明，微笑着走进商店的顾客的消费额比其他顾客高三分之一。

简单的视频带来了大量发现。但要了解顾客的情绪，还有复杂得多也更贴近的方式。热成像摄影机能检测心率。以无线方式从智能手机加速度计捕捉的数据能揭示顾客什么时候被商品吸引（运动经常会停止）或为价格发愁（反复拿起手机在线搜索更便宜的产品）。

为了发现更多讯息，购物者有时会被要求穿戴特殊的设备，作为交换，他们通常会获得折扣或其他奖励。例如，可穿戴式“电流计”能测量手部皮肤的湿度和电阻，从而揭示兴奋感。

有人说，所有这些都是一个机会，让实体零售店得以削弱网店长久以来因数据获得的优势。纽约Lightwave公司的首席执行官拉纳·钟（Rana June）表示，一场竞赛正在进行，目的是研究如何最好地收集和利用情绪数据，不管是用它们来改进包装、展示和背景音乐，还是改进推销话术的内容和使用时机。Lightwave为零售商、商场，以及百事可乐、宝洁公司

和联合利华等消费品公司提供测评消费者情绪的服务。

也有人不为所动。有些人觉得有点毛骨悚然。里卡多·古铁雷斯（Ricardo Gutiérrez）供职于消费者研究巨头尼尔森（Nielsen），主管波哥大哥伦比亚分公司的购物者洞见部门。他透露，尼尔森认为就目前而言，利用技术来全面了解顾客的情绪过于“前卫”。

但这种方法比老式的访谈要便宜多了。尼尔森就三个产品采访25名购物者收费约一万美元。Angus.ai每台相机每月的服务费仅为59欧元（66美元）。位于哥本哈根的iMotions公司向零售商提供一顶检测大脑活动的脑电图帽、一个眼球追踪头戴设备（能注意到瞳孔何时因看到感兴趣的物品而扩大），以及一个电流计，总费用约为1.5万美元。iMotions约有150个消费品客户在模拟商店和真实商店里使用这些设备，包括亿滋国际（Mondelez International）、雀巢和联合利华等。

此外，传统的市场调查可能会误导人。人们往往会“编辑”口述的答案，好让自己听起来很理智，而购买行为却往往是由潜意识的情绪所驱动的。VideoMining的杰夫·赫希（Jeff Hershey）表示，关键是要跟踪购物者的无意识行为。这家公司位于宾夕法尼亚，其软件也分析商店视频。英国咨询公司BrandSense的西蒙·哈洛普（Simon Harrop）指出，调查问卷还会提出错误的问题，比如有多少人喜欢一个产品，而真正重要的却是，这个产品能不能让他们觉得自己增添了吸引力。

消费者在心情沮丧时的消费行为，即所谓的“购物疗法”，便是购物行为感性一面的明显例子。无论哪家商店，只要能最先研究出如何识别轻度抑郁的顾客，就能大赚一笔。■



Immersive experiences

VR in La La land

Hollywood studios try out virtual reality

OUTSIDE a squat grey building in Santa Monica, the California sun melts the tar. Inside, in a dark room roughly the size of a small shipping container, two men are exploring the world by means of virtual reality (VR). They squash spiders in an abandoned temple, hit a home run at Yankee Stadium and float through a Blade Runner-esque landscape, all in the span of eight minutes. It feels much longer than that, and also shorter—time is hard to grasp in VR.

The creator of the experience is Walter Parkes, a former boss of DreamWorks Pictures, a film studio, who last year co-founded Dreamscape Immersive. The startup plans a chain of VR multiplex cinemas offering ten-minute interactive experiences for around \$15 each. The first will open at a shopping mall near Beverly Hills at the end of the year; another 14 are planned for 2018. Mr Parkes says it costs about \$2m to make a ten-minute VR experience, compared with around \$200m for a big-budget Hollywood movie (not counting marketing and distribution). The economics work even though people are entertained for much shorter periods, he argues.

The men and women over in Burbank, where the big studios are based, are interested. Dreamscape has attracted around \$10m in investment from Fox, Warner Brothers and MGM, along with Steven Spielberg and Westfield, a shopping-centre operator. Disney has invested \$66m in Jaunt, which makes tools for creating VR content. Warner Brothers recently announced a partnership with IMAX, which specialises in large-screen cinemas, to fund and create VR “experiences” for three upcoming films.

Promotional and extra material for films in VR is the first priority. Later on

studios expect VR to become a format of its own, a cross between movies and games. “The lines are getting blurred. They use a lot of the same tech, the same tools,” says Thomas Husson, an analyst at Forrester, a research firm.

Hollywood is in a battle for attention as well as dollars. In the future Harry Potter fans, for example, may consider it a waste to go to an attraction in the English countryside when they can visit Diagon Alley at home in a headset. They may even do both. If studios get a grip of VR, every minute spent in a cinema could mean an extra one in a park and yet another in a headset. ■



沉浸式体验

幻想之城的虚拟现实

好莱坞电影公司试水虚拟现实

在圣莫尼卡（Santa Monica）一座低矮的灰色建筑外，加州的阳光几乎要将路面上的沥青烤化。在这个建筑内，一间与小集装箱差不多大小的暗室中，两名男子正在用虚拟现实技术（VR）探索世界。他们在一个废弃的寺庙里压扁蜘蛛，在纽约扬基体育场打出一个本垒打，还从电影《银翼杀手》式的场景中漂浮而过，所有这些都可在八分钟之内完成。感觉上比八分钟长得多，但也好像更短——在虚拟现实中，时间难以掌握。

创造出这种体验的是电影公司梦工厂的前老板沃尔特·帕克斯（Walter Parkes），去年他与别人共同创立了Dreamscape Immersive公司。这家创业公司计划推出VR连锁多厅影院，提供每十分钟售价15美元的互动体验。第一家影院将于年底在比弗利山庄（Beverly Hills）附近的一家购物中心开业，另外14家影院计划在2018年开业。帕克斯表示，制作一次十分钟VR体验的成本约为200万美元，相比之下，一部大制作好莱坞电影（不包括市场营销和发行）的成本约为2亿美元。他认为，尽管人们体验的时间短很多，但这在经济效益上是可行的。

在大电影公司扎堆的伯班克（Burbank），人们对此很感兴趣。

Dreamscape已从福克斯、华纳兄弟、美高梅、史蒂文·斯皮尔伯格和购物中心运营商韦斯特菲尔德（Westfield）那里吸引到大约1000万美元的投资。迪士尼也向生产VR制作工具的Jaunt投资了6600万美元。华纳兄弟最近宣布与专注于大屏幕影院的IMAX合作，提供资金为三部即将上映的电影制作VR体验片。

为电影制作VR形式的宣传片和特别内容是目前的第一要务。之后，电影公司期待VR自成一种类型，即电影和游戏的结合。“区分（这两者）的界限越来越模糊。它们使用许多相同的技术、相同的工具。”研究公司弗雷斯特（Forrester）的分析师托马斯·赫森（Thomas Husson）说。

好莱坞正在进行一场争夺关注和美元的战斗。未来，当哈利·波特的粉丝们在家里戴着头显就能参观对角巷（Diagon Alley）时，他们也许会觉得没必要跑去英国乡村造访这个景点。他们甚至可能既虚拟参观也实地造访。如果电影公司掌握了VR，在电影院里度过的每一分钟可能也是在公园度过的一分钟，然而也是戴着头显的一分钟。■



Digital mapping

Car-tography

As mapping systems for autonomous cars emerge, a tangle of startup firms and new alliances vie with Google Maps

IN THE 1940s Jorge Luis Borges, an Argentine writer, wrote a short story about mapping. It imagines an empire which surveys itself in such exhaustive detail that when unfolded, the perfectly complete 1:1 paper map covers the entire kingdom. Because it is unwieldy and thus largely useless, subsequent generations allow it to decay into tatters. Great scraps are left carpeting the deserts.

In their capacity for up-to-the-minute detail, modern maps surpass even Borges's creation. By using networks of sensors, computing power and data-crunching expertise, digital cartographers can produce what are in effect real-time simulations of the physical world, on which both humans and machines can base decisions. These maps show where roadworks are blocking traffic or which street corners are the most polluted. Innovative products will make new demands of them. Drones need to know how to fly through cities; an augmented-reality game might need to know the exact position in London of Nelson's column.

Google is the giant of the consumer-mapping world. More than 1bn people use the Google Maps smartphone app every month. Rivals can still prosper by providing detailed directions in dense cities: CityMapper, for example, tells its users which exit to take in London's warren-like tube stations. But none can match Google's revenues. Local search ads allow firms to place adverts inside the search results of a person who is physically near their premises, along with maps showing their locations. And promoted pins permit businesses to highlight their own positions along routes that Google calculates for navigation—a pin for a Starbucks en route to Central Park in

New York, say. Morgan Stanley, an investment bank, projects that such ads will generate \$1.4bn of revenue for Google in 2017, rising to \$3.3bn by 2020.

Yet the race to develop autonomous cars, which cannot run without guidance from machine-readable maps known as “splines” or “digital rails”, could be a far bigger opportunity. Goldman Sachs, another investment bank, reckons that the market for maps for autonomous cars will grow in value from around \$2.2bn in 2020 to \$24.5bn by 2050 (see chart). Google’s dominance in consumer mapping means it has a strong advantage in this emerging field (which will mainly accrue to Waymo, its autonomous-car spin-off). But it will not have things all its own way. An assortment of other Silicon Valley giants, startups, carmakers and a few old-fashioned mapping firms, are fighting hard.

The inputs for digital mapping are threefold. First comes information about roads, buildings and so on. Such base maps have been commoditised. A British open-data repository called OpenStreetMap (and its cousin organisation, OpenAddresses), that is already widely used and has global data, provides the basics. Many new mapping businesses build on top of OSM data.

Imagery containing close-up detail of streets is the second main ingredient. In May Google said it had used an artificial-intelligence technique known as deep learning to scan 80bn photos, automatically identifying house numbers and the names of streets and businesses. Its photos were gathered from its “StreetView” cars, which have trawled the planet capturing street imagery since 2007, at a vast cost.

This archive is a barrier to entry for other companies, but it may be tumbling. Mapillary, a Swedish startup which also uses deep learning to process imagery, has released a data-set of 25,000 street photos collected through its own sensor network. Its chief executive, Jan Erik Solem, says

that Mapillary's fastest-growing business is providing data mined from those images to companies that are trying to build maps for autonomous cars. (Laser scanners and radar used by autonomous cars to navigate will add to the torrents of data.)

Large quantities of real-time GPS location data from people with smartphones in their pockets are the third important input. Google harvests such data from Google Map users as they move around the world. If it stops seeing data streaming off a street, for example, it is likely to mean that the road has been closed. Here, too, Google's defences are looking less impassable. Mapbox, a young firm based in San Francisco, has found another clever way to compete—a map-specific software-development kit (SDK) which any developer can install and use to present maps to users. When those users call up one of its maps, Mapbox receives anonymised location data. Mapbox's SDK is now in some 250m phones. Marc Prioleau, a mapping guru whom Mapbox poached from Uber, a ride-hailing firm, says the firm is gathering enough data in the Bay Area alone to redraw every road there ten times a day.

Google is also vying with a legacy mapping firm that has sold map data for car-navigation systems since 1985. Germany's three largest car companies, Daimler, Volkswagen and BMW, bought HERE, based in Chicago, for €2.8bn (\$3.1bn) in 2015. In December a Chinese and Singaporean consortium including Tencent, an internet giant, and NavInfo, a mapping firm based in Beijing, took a 10% stake in it. HERE will provide Tencent with digital maps of China. It will get access to location data from WeChat, Tencent's popular chat app, connecting it to a sensor network the scale of which rivals Google's. The firm has also joined forces with Shenzhen-based DJI, the world's biggest drone-maker.

America's big three car companies, General Motors, Ford and Fiat Chrysler, have also invested heavily in digital mapping through AI startups and in

partnerships with ride-hailing firms and with TomTom of the Netherlands, another older mapping firm. Google is hard to avoid, though: Fiat Chrysler has joined Waymo's self-driving programme in Phoenix, Arizona and will use the search giant's mapping data. And whoever ends up winning most sway over cartography, Borges's everything map is no longer imaginary. ■



数字化测绘

汽车地图测绘

随着自动驾驶汽车地图系统的兴起，众多创业公司及新联盟欲与谷歌地图一较高下

二十世纪40年代，阿根廷作家乔治·路易斯·博尔赫斯（Jorge Luis Borges）以绘制地图为主题写了一个短篇小说。故事中的帝国巨细靡遗地测绘国土，得出一份按1:1比例制作的纸质地图，铺展开来可覆盖整个王国。因为笨重，这份地图基本没什么用处，后世的人们听任其腐朽破碎，巨大的残片散落在沙漠上。

现代地图能即时更新细节，这一点连博尔赫斯故事中的地图也无法匹敌。数字化测绘技术利用传感器网络、计算能力及专业的数据处理，实时模拟真实世界，供人们和机器在做决策时参考。这些地图能显示哪里有道路施工阻碍交通、哪些街区污染最严重。创新产品将对这些地图提出新的要求。无人机需要知道飞越城市上空的路线，增强现实游戏可能需要知道纳尔逊纪念柱在伦敦的准确位置。

谷歌是消费地图测绘领域的巨头。每月有超过10亿人在智能手机上使用谷歌地图这款应用。不过，通过在密集城市里提供详细的路线指引，竞争对手仍能蓬勃发展。以CityMapper为例，在错综复杂有如野兔洞穴的伦敦地铁站，该应用能告诉用户该走哪个出口。但论收入，没有一家能与谷歌媲美。谷歌的“本地搜索广告”能把搜索者附近公司的广告置入搜索结果中，并在地图中显示这些公司的具体位置。而“推广图钉”则把谷歌导航路线沿途的商家标注出来，比如，在去往纽约中央公园的路线上以“图钉”标注沿途的星巴克咖啡馆。据投行摩根士丹利的预测，2017年这类广告将为谷歌带来14亿美元的收入，到2020年将升至33亿美元。

然而，研发自动驾驶汽车的竞赛可能是个大得多的机会，这种汽车必须装有被称为“样条”或“数字轨”的可供机器读取的地图指引才能行驶。另一家投行高盛认为，自动驾驶汽车地图市场的价值将从2020年的约22亿美元上升至2050年的245亿美元（见图表）。谷歌在消费地图市场的主导地位意

意味着它在这个新兴领域拥有强大优势，得益的将主要是谷歌分拆成立的自动驾驶汽车业务公司Waymo。但未来，谷歌很难事事如意。硅谷其他巨头、创业公司、汽车厂商及一些传统地图测绘公司也在奋力争夺市场。

数字测绘有三重输入数据。首先是道路及建筑物等信息。这类基础地图已经大众商品化。“开放街道地图”（OpenStreetMap，它还有一家关联机构OpenAddresses）就是英国一家提供这些基础地图的公开数据库，它拥有全球数据，已被广泛使用。许多新的地图测绘公司都以此数据库为基础开发产品。

包含街道特写细节的图像是信息输入的第二大组成。今年5月，谷歌表示已利用名为“深度学习”的人工智能技术扫描了800亿张照片，自动识别门牌号码及街道和商家的名称。照片由谷歌的街景车收集，这些汽车自2007年开始便行走全球，收集街头影像，花费不菲。

这个资料库对其他公司来说是一道进入屏障，但它也许正在瓦解。瑞典一家同样运用深度学习技术来处理图像的创业公司Mapillary已发布一个数据集，内含25,000张街景照片，由该公司自有的传感器网络收集而来。公司首席执行官简·埃里克·索利姆（Jan Erik Solem）表示，Mapillary增长最快的业务是从这些照片中挖掘数据，提供给为自动驾驶汽车打造数字地图的公司。（自动驾驶汽车导航用的激光扫描器及雷达装置也将带来更多的数据。）

第三个重要输入来自于人们口袋里的智能手机所产生的大量实时GPS定位数据。谷歌地图的用户在全球各地出行时，谷歌就可以搜集这类数据。举个例子，假如某一街道不再有数据流出，那么该路段可能已经封闭。在这个领域，谷歌的防线看起来也不那么牢靠了。位于旧金山的新兴公司Mapbox已找到另一个聪明的办法与之竞争：提供一款地图专用的软件开发工具包（SDK），任何开发者都可以安装并使用它来为用户呈现地图。当用户调用这些地图时，Mapbox便会收到匿名的位置数据。Mapbox的这个工具包如今已安装在约2.5亿台手机中。马克·普列奥劳（Marc Prioleau）是Mapbox从网约车公司优步挖来的地图测绘大师，他表示，

Mapbox单在旧金山湾区收集到的数据，就已足够系统对那里的每条道路每天更新十次。

谷歌还正与一家传统地图测绘公司竞争，该公司自1985年就开始销售车用导航系统的地图数据。2015年，德国三大汽车公司戴勒姆、大众和宝马联手以28亿欧元（31亿美元）收购了总部在芝加哥的HERE公司。去年12月，一个中国和新加坡联合财团（包括互联网巨头腾讯和总部在北京的地图测绘公司四维图新）购入了HERE 10%的股权。HERE将为腾讯提供中国的数字地图，并接收从腾讯的热门聊天应用微信获取的位置数据，将这些数据接入一个传感器网络，其规模堪比谷歌的传感器网络。HERE还与全球最大的无人机制造商深圳大疆建立了合作关系。

通用汽车、福特、菲亚特克莱斯勒这三大美国汽车公司已大举投资发展数字地图技术。它们为此扶植了人工智能创业公司、联手各大网约车公司，并与另一家老牌地图测绘公司、荷兰的TomTom展开合作。但要绕开谷歌并不容易：菲亚特克莱斯勒已加入Waymo在亚利桑那州凤凰城的自动驾驶汽车项目，并将使用这家搜索巨头的地图数据。无论最终称霸地图测绘界的会是谁，博尔赫斯小说里那无所不包的地图都已不再是幻想了。





Schumpeter

My car's sexier than yours

Detroit's car firms try to show that anything Silicon Valley can do, they can do better

IT IS fashionable to say that the city of Detroit is on the up after decades of decline. Amid the derelict buildings there are signs of revival; art shops and trendy food trucks abound. But for a truer augury of the city's possible future, consider the rock-bottom stockmarket valuations of Ford and General Motors (GM), Motor City's two big domestic car firms. (A third, Chrysler, is owned by Fiat Chrysler Automobiles, whose chairman is a director of *The Economist's* parent company.) If you put the members of the S&P 500 index in order of their price-earnings ratios, Ford and GM are at the bottom, among the walking dead.

For their investors, creditors and 426,000 staff, about 18% of whom are in Detroit, it is a terrifying signal. A low price-earnings ratio is the stockmarket's way of telling you that business as you know it is over. GM and Ford together made \$18bn of underlying profit last year but have a market value of \$98bn. That ratio implies that their profits will halve or worse, and quickly. Wall Street has got the hots for a younger crowd of firms that investors think will dominate the transport technologies of the 21st century; electric engines, ride-hailing, ride-sharing and driverless cars.

Three Silicon Valley firms—Uber, Tesla and Waymo (Alphabet's driverless-car unit)—are each reckoned to be worth more than GM or Ford. All lose money and bring in no more sales in a year than Ford or GM do in a fortnight. No matter. Expectations are sky high. Morgan Stanley, a bank, expects Waymo's sales to exceed \$200bn by 2030, making it roughly America's fifth-largest firm. Not bad given it does not have any products for sale.

For the people running GM and Ford it is hard to ignore such huge differences in valuation, even if they reflect bubbly thinking about Silicon Valley. Shareholders and directors are becoming restless, and talented staff demoralised. The pressure to act is intense. GM recently had to fend off an activist attack from a hedge fund. In May Ford fired its boss, Mark Fields, replacing him with Jim Hackett, whose experience as a car executive consists of 15 months running Ford's tech incubator. Its chairman, Bill Ford, said new blood was needed to deal with technological change.

Investors are making two mistakes, the car firms argue. First, they underestimate how hard it is to mass-produce cars, and second, they discount the possibility that hidden within them are Detroit's equivalent of a Tesla, an Uber or a Waymo. Certainly, when you see the view from Ford's headquarters, of miles of woods, test tracks and factories owned by the company or by the Ford family, it is easy to believe that there might be some buried treasure there.

Take the point on mass production, first. Detroit's experts sniff that Silicon Valley has no idea how to make millions of vehicles that adhere to the safety and reliability standards of the conventional car firms. Tesla produced the equivalent of 1% of GM's vehicle volumes last year. One Detroit executive reckons it is 10,000 times harder to build an autonomous vehicle that works on real roads rather than on a Californian test track.

Yet he is no Luddite, and expects a revolution. Electric vehicles will be mainstream by 2020, he says. Driverless cars will slash the cost-per-mile of travelling, especially if you count the time saved by freeing people from the hours they waste clutching steering wheels. Ride-sharing will mean that the utilisation rate of cars will go up and therefore that fewer vehicles are sold. But that could be offset by new revenue from services such as charging passengers for rides or selling data that is gathered about them.

The car firms try hard to draw attention to the businesses they own that will benefit from these trends. GM has a 9% stake in Lyft (a rival to Uber that is gaining market share), and in 2016 bought Cruise, an autonomous-vehicle firm based in San Francisco, for \$600m. GM's subsidiary, OnStar, connects 7m drivers to various data services. Its electric-car model, the Chevrolet Bolt, is on the road. Ford owns Chariot, a "crowdsourced" shuttle service, and will have 13 models of electric car on the road by 2020. It is investing \$1bn over the next five years in Argo, an artificial-intelligence firm that is developing software for autonomous vehicles.

Investors do not seem to care. In the past few months they have begun to fret about a new risk, that American car sales may be at a cyclical peak. In previous downturns, profits have slumped. Both GM and Ford want to emphasise that their costs can be more easily cut than before the crisis in 2008-10, when GM went bust and Ford nearly did. They also want to show that they will not waste money abroad. In March GM sold its European arm to France's PSA Group. Ford says that it is prepared to sell some emerging-market operations if they do not produce higher profits soon. But their price-earnings ratios have not budged.

| *Wall Street: the world's most demanding backseat driver*

In their desperation, Ford and GM are toying with a new strategy: putting their tech assets into ring-fenced divisions that can be promoted as "new Ford" and "new GM". These units' accounts will not be pretty, with few sales, and combined investments of \$3bn-4bn a year. But with a speck of the glitter that Tesla's Elon Musk sprinkles on his loss-making firm, they might capture investors' imaginations and resuscitate their parents' share prices.

But by re-engineering their structures, the car companies might start something uncontrollable. Wall Street could get excited and demand that they sell or spin-off the new divisions, robbing Detroit of its best assets. In

the 1990s and early 2000s stodgy telecoms firms such as AT&T spun-off their mobile arms only to be reunited with them years later. Ford and GM may be goaded into unwisely blowing their \$48bn of cash on tech acquisitions.

The underlying shift in the car industry is real: the way in which cars are made and are used is changing. But it is surrounded by a swirl of hyperbole. Detroit's firms face a classic incumbent's dilemma. They must show they can dance with the cool kids, while not losing either their wallets or their dignity. ■



熊比特

我的车比你的拉风

底特律的汽车公司想要证明，硅谷能做的任何事，它们都能做得更好

现在有一种说法很时兴，说底特律衰退了几十年后，又开始走上坡路了。一片废弃的建筑物中显现出了复兴的迹象，艺术品商店和新潮的流动餐车比比皆是。但要想更准确地占卜这座城市可能的未来，人们应该想想这座汽车之城的两大本土汽车公司福特和通用汽车那跌到谷底的市值。（另外还有一家车企克莱斯勒，由菲亚特克莱斯勒汽车公司[Fiat Chrysler Automobiles]拥有，该公司董事长是《经济学人》母公司的董事。）如果将标准普尔500指数的成员公司按市盈率排名，福特和通用汽车就会跟其他一些僵尸企业一样，排在末尾。

对于它们的投资人、债权人和42.6万名员工（约18%在底特律）来说，这是一个可怕的信号。市盈率低是股市在告诉人们，你所知道的这个行业已经玩完了。去年通用汽车和福特一共创造了180亿美元的基本利润，但它们的市值总共只有980亿美元。这一市盈率说明它们的利润会迅速折半甚至降至更低。华尔街已经迷恋上一帮更年轻的公司，投资者们认为这类公司将主导21世纪的交通技术：电动汽车、叫车服务、拼车服务，以及无人驾驶汽车。

三家硅谷的公司——优步、特斯拉和Waymo（Alphabet的无人驾驶汽车公司）——每家都被认为比通用汽车和福特更值钱。它们都在亏损，一年的销售额也比不过福特或通用汽车两周的销售额。不过没关系。人们对它们的期望比天高。摩根士丹利预测，到2030年，Waymo的销售额将超过2000亿美元，差不多能成为美国第五大公司。这样的成绩相当不赖，尤其是考虑到它现在还没有任何产品可以出售。

对于通用汽车和福特的经营者而言，如此巨大的估值差距难以视而不见，即便它反映出人们对硅谷的泡沫思维。股东和董事们开始焦躁不安，优秀员工士气低落。迫使经营者有所行动的压力是巨大的。通用最近先发制

人，避免了一家对冲基金对其采取维权行动。5月，福特炒掉了老板马克·菲尔兹（Mark Fields），接替他的是吉姆·哈克特（Jim Hackett）。后者所具备的汽车公司高管经验便是在福特的科技孵化部门担任了15个月的负责人。福特的董事长比尔·福特（Bill Ford）称，应对科技挑战需要新鲜血液。

汽车公司认为投资者犯了两个错误。第一，他们低估了量产汽车的难度；第二，他们低估了这样的可能性：它们这些公司中隐藏着下一个特斯拉、优步或Waymo。当然，如果你从福特总部向外望去，看到那连绵数英里的森林、试车场，以及福特公司或福特家族拥有的工厂，你很容易相信那里可能埋着什么宝藏。

先来说说量产。底特律的专家们对硅谷不屑一顾，认为硅谷并不知道如何生产出数百万辆符合传统汽车公司的安全性及可靠性标准的汽车。特斯拉去年的产量仅相当于通用汽车的1%。一位底特律的高管认为，比起生产一辆在加州试车道上行驶的无人驾驶汽车，生产一辆能在实际道路上行驶的无人驾驶车要难一万倍。

当然，他不是个卢德分子，也预计会有一场革命。他说电动车将在2020年前成为主流。无人驾驶汽车将大幅降低单位里程的行驶成本，尤其是还帮人们省下了紧握方向盘而浪费的时间。拼车服务能够提高车辆的利用率，汽车销量因而会更少，但这可以由服务带来的新收入弥补，例如向乘客收取车费或出售所收集的乘客数据。

汽车公司努力让人们关注它们拥有的、能从上述趋势中获利的业务。通用汽车持有Lyft（优步的对手，市场份额正在增加）9%的股份，并在2016年以6亿美元收购了旧金山的无人驾驶汽车公司Cruise。通用的子公司安吉星（OnStar）为700万司机提供各种数据服务。它的电动汽车雪佛莱Bolt已经上路。福特拥有一家“众包”班车服务公司Chariot，且在2020年之前将有13款电动汽车上路。未来五年，它将向一家为无人驾驶汽车开发软件的人工智能公司Argo投资10亿美元。

投资者似乎并不在乎。过去几个月里他们开始担心一个新的风险：美国的汽车销售可能正在经历周期性高峰。在过去的低迷期，利润曾经暴跌。2008到2010年的金融危机期间，通用汽车破产，福特也几乎倒闭。但两家公司都想强调，与这场危机之前相比，如今它们削减成本要更容易。它们还想表明自己不会在海外浪费资金。3月，通用汽车把欧洲分部卖给了法国标致雪铁龙集团（PSA Group）。福特称，如果一些新兴市场业务不能尽快产生更高的利润，它已准备好将其出售。但两家公司的市盈率仍纹丝不动。

| 华尔街：世上最苛刻的“后座司机”

绝望之际，福特和通用汽车开始尝试一个新策略：把自己的技术资产放到财务独立、能以“新福特”和“新通用”的名号来推广的部门。这些部门的账面不会好看，只有寥寥无几的销售额和每年总计30到40亿美元的投资。不过看看特斯拉的伊隆·马斯克在他那一直亏损的公司上撒下的闪闪金粉，它们如果也来上一点，说不定能抓住投资者的幻想，从而让母公司的股价复苏。

但是在重建公司架构时，汽车公司可能会开启一些不受控制的因素。华尔街可能会兴奋起来，要求它们出售或分拆这些新部门，抢走底特律最好的资产。在上世纪90年代和本世纪初，像AT&T这样臃肿守旧的电信公司拆分了它们的移动部门，但仅数年后就与之重新合并。也许福特和通用汽车会受到煽动，不明智地将手上480亿美元的现金挥霍一空，用于技术收购。

汽车产业确实在经历根本性的转变：汽车的制造工艺和使用方式正在变化。但这一切都被夸张的漩涡所围绕。底特律的公司面临的正是传统企业的经典困局。它们必须表明自己能和炫酷的新进公司共舞，但同时既不能破财，也不能丢了尊严。 ■



Photography

Wide-eyed and lensless

Cameras are about to get a lot smaller and flatter

THE pill-sized cameras in today's mobile phones may seem miraculously tiny, given that a decade ago the smallest cameras available for retail sale were the size of a pack of cards. But Ali Hajimiri of the California Institute of Technology is unimpressed. In his opinion even these phone cameras are far too thick (witness the optical bump on the back of most mobile phones), so he and his team plan to replace them with truly minuscule devices that spurn every aspect of current photographic technology. Not only do Dr Hajimiri's cameras have no moving parts, they also lack lenses and mirrors—in other words, they have no conventional optics. That does away with the focal depth required by today's cameras, enabling the new devices to be flat. The result, he hopes, will be the future of photography.

Brave words. But, as an inventor, Dr Hajimiri has form to back them up. In 2002 he helped found a firm (now taken over by a bigger one) to build power amplifiers for mobile phones. More than 250m of these have been made. In 2004 he came up with the world's first radar on a chip, which is now being used in prototype self-driving cars. To round things off, in 2012 he created an all-silicon imaging system that uses the terahertz part of the electromagnetic spectrum (which is slightly higher in frequency than radar) to see through objects opaque to light. This system has found employment in everything from medical-diagnostics equipment to security scanners.

The latest venture moves his focus to higher frequencies still than terahertz waves—those of visible light. The new camera, known as an optical phased-array receiver, or OPA, collects the light from which it forms its image using a grid of devices called grating couplers. The prototype (the blue structure

pictured, attached to a thick mounting block to make it easier to handle) has 64 of them. Grating couplers are optical antennae. They collect light and send it to a device called a waveguide. This carries light around in a way analogous to a wire carrying electricity.

| *Flash, bang, wallop. What a picture*

Each grating coupler is tiny—about five by two microns (millionths of a metre)—and so picks up only a minuscule amount of light. That signal has to be amplified. This is done by heterodyning, a process which combines the light in the coupler with a minute laser beam, strengthening the signal at the desired wavelength.

To mimic the image-making role of the optics in conventional cameras, the OPA manipulates incoming light using electrons. Dr Hajimiri compares the technique to peering through a straw while moving the far end swiftly across what is in front of you and recording how much light is in each strawful. In the OPA this scanning effect is created by manipulating the light collected by the grating couplers electronically, using devices called photodiodes. These place varying densities of electrons into the amplified light's path through the OPA, either slowing it down or speeding it up as it travels. That shifts the arrival times of the peaks and troughs of the lightwaves. This “phase shifting” results in constructive interference between waves arriving from the desired direction, which amplifies them. Light coming from other directions, by contrast, is cancelled through destructive interference. Change the pattern of electrons and you change the part of the image field the OPA is looking at. Scanning the entire field in this way takes about ten nanoseconds (billionths of a second).

The photodiodes, then, determine where the camera is pointing without any mechanical movement being needed. They also permit the camera to capture different kinds of images, such as close-ups and fish-eye views. To zoom in for a close-up, the device selects a specific part of the image and

scans it more thoroughly. To zoom out for a fish-eye, it scans the entire optical field, including light from the edges of that field. To change from zoom to fish-eye takes nanoseconds.

The processed optical signal is then passed down the waveguide to further photodiodes. These convert it into an electrical signal, which is used to create the final photo. Crucially, all this can be achieved in a stack of electronics five microns thick—about a fifteenth of the diameter of a human hair.

The exact size of any production version will depend on the job to be done. The prototype can manage fuzzy images of barcodes, but not much else. To achieve the same resolution as the camera in a modern Apple iPhone, Dr Hajimiri reckons an array of about 1m grating couplers will be needed. Allowing for the space between these, the result would, at the moment, have an area of 1cm². This is similar to the area of an iPhone's camera, but that camera is 1,000 times thicker. Dr Hajimiri thinks, moreover, that a production version of the new device would be smaller.

He concedes that there are challenges: improving the optical performance of the elements; suppressing spillover effects between different signals in the device; and honing the algorithms that calibrate the camera's performance. But all these matters, he believes, can be dealt with and he envisages his lensless cameras being commercially available within five years.

Such tiny cameras would have uses far beyond eliminating the optical bumps from mobile phones. They might be deployed, *Fantastic Voyage*-like, to take pictures inside blood vessels. Conversely, they could be combined into massive arrays to create lightweight but extremely large-aperture telescopes able to resolve images from the deepest parts of the universe. They might even be strewn to the winds, photographic dust

particles scavenging the energy they need from stray radio signals, and broadcasting what they see. Or they could be attached, almost invisibly, to walls, to act as spies.

In the “Ringworld” series of science-fiction novels, the books’ author, Larry Niven, envisages spray-on devices called “webeyes” that can be applied to any surface, and used for such espionage. Cameras of the sort Dr Hajimiri is developing are scarily close to making that idea real. ■



摄影技术

广视角，无镜头

相机将变得更小更薄得多

十年前，市面上最小的相机也有一盒扑克牌大小。相比之下，今天手机里那枚药丸大的相机似乎小得不可思议。但加州理工学院的阿里·哈吉米瑞（Ali Hajimiri）仍不满意。在他看来，手机里的相机还是太厚了（大多数手机背后凸起的镜头便是证明），所以他和他的团队计划以真正微型的设备取代这些旧组件，摒弃现有摄影技术的方方面面。哈吉米瑞的相机不但没有活动部件，连镜头和反光镜都没有——换言之，不存在传统的光学元件。这种设计舍弃了现今相机所需要的焦深，使新设备变得扁平。他希望这样的研究成果能成为摄影的未来。

好一番豪言壮语。但作为发明家，哈吉米瑞有实际成绩来支撑。2002年，他协助创办了一家公司（现已被更大的公司收购），制造用于手机的功率放大器，至今已生产超过2.5亿颗。2004年，他发明了世界上首个片上雷达，已应用于自动驾驶的原型车之中。2012年，他发明了全硅成像系统，成就臻至圆满。该系统利用电磁频谱中太赫兹波段（频率略高于雷达）来透视不透光物体，目前已广泛应用于医疗诊断设备和安检扫描仪等诸多领域。

在最新的探索中，他把焦点转向比太赫兹波更高的频率——可见光的频率。这款被称为光学相控阵接收器（OPA）的新相机通过阵列式“光栅耦合器”收集光线形成影像。原型（上图所见的蓝色组件，附在厚基座上方便操作）装有64个这种耦合器。光栅耦合器就是光学天线，负责收集光线并发送到名为“波导”的装置上，波导则像电线导电那样传送光波。

| 预备，就位，笑一个。拍得真好

光栅耦合器尺寸很小，约为 5×2 微米（一微米为百万分之一米），因此只能收集到很少的光线。信号必须通过外差处理来放大，即把耦合器中的光线和细微的激光束结合，加强所需波长上的信号。

为模仿传统相机中光学元件的成像功能，OPA运用电子来操纵入射光线。哈吉米瑞称该技术相当于透过一根吸管窥视前方，同时让吸管的前端对着拍摄对象迅速移动，记录下每“管”内的光量。在OPA内，这种扫描效果是运用光电二极管，通过电子对光栅耦合器收集到的光进行操纵而实现的。这些光电二极管将不同密度的电子置于放大后的光线在OPA中穿行的路径上，使光线在传播中提前或延后相位。这会改变光波波峰和波谷的到达时间。这种“相移”的结果是，从期望方向抵达的光波之间会形成“加和干涉”，从而起到放大作用。相反，来自其他方向的光线则通过破坏性干涉被抵消。改变电子分布便可改变OPA所扫描的像场部分。以这种方式扫描整个像场，大约需要十纳秒（一纳秒为十亿分之一秒）。

然后，光电二极管无需做任何机械运动，就可以让相机指向确定位置。它们还能让相机捕捉不同类型的图像，比如特写和鱼眼视图。要拉近取得特写画面，设备会选取图像中的一部分进行更全面的扫描。要拉远形成鱼眼广角画面，设备会扫描整个光场，包括来自光场边缘的光线。从特写模式切换到鱼眼模式只需几纳秒。

之后，经处理的光信号沿着波导传送到下一级光电二极管，在这里被转换为电信号，用于创建最终的照片。重要的是，这一切仅凭一组五微米厚的电子元件便可完成，大约相当于人类头发直径的十五分之一。

任何量产版相机的确切尺寸都将取决于所需完成的任务。该原型相机能拍到条形码的模糊图像，但仅此而已。要达到最新的苹果iPhone手机的相机那样的分辨率，哈吉米瑞估计需要约含100万个光栅耦合器的阵列。算上耦合器之间的空间，目前看来最终成品将有一平方厘米大小，跟iPhone的相机大小相仿，但iPhone相机的厚度是它的1000倍。而且，哈吉米瑞认为，这款新设备的量产版还会更小。

他承认存在诸多挑战：改善组件的光学性能；抑制设备中不同信号之间的溢出效应；优化校准相机性能算法。但他相信，这一切都可以解决。依他的设想，这种无镜头相机五年内可实现商业化。

这类微型相机的用途远不止消除手机背后的摄像头凸起。它们可以像科幻电影《神奇旅程》（*Fantastic Voyage*）的情节那样，放置到血管内拍照。或者反过来，组合成大型阵列，形成轻量但口径极大的望远镜，拍摄宇宙最深处的图像。这些相机甚至可以作为可拍照的“微尘”散布在空中，从杂散的无线电信号中吸取所需的能量，并传送所见。或者可以几乎无形地附于墙上，用作间谍设备。

在系列科幻小说《环形世界》（*Ringworld*）中，作者拉里·尼文（Larry Niven）想象出了名为“网眼”的可喷涂装置，可喷在任何表面上执行此类间谍活动。哈吉米瑞正在开发的相机已与这种设想惊人地接近。■



Manufacturing technology

The Gemini makers

Millions of things, from factories to cars, will have digital twins

THE factory of the future will be a building stuffed full of robots making robots. A factory in Amberg, a small town in Bavaria, is not quite that, but it gets close. The plant is run by Siemens, a German engineering giant, and it makes industrial computer-control systems, which are essential bits of kit used in a variety of automated systems, including the factory's own production lines.

The Amberg plant is bright, airy and squeaky clean. It produces 15m units a year—a tenfold increase since opening in 1989, and without the building being expanded or any great increase in the 1,200 workers employed in three shifts. (Production is about 75% automated, as Siemens reckons some tasks are still best done by humans.) The defect rate is close to zero, as 99.9988% of units require no adjustment, a remarkable feat considering they come in more than 1,000 different varieties.

Such achievements are largely down to the factory's "digital twin". For there is another factory, a virtual version of the physical facility that resides within a computer system. This digital twin is identical in every respect and is used to design the control units, test them, simulate how to make them and program production machines. Once everything is humming along nicely, the digital twin hands over to the physical factory to begin making things for real.

The digital twin is not a new invention. The concept of pairing traces its roots to the early days of space travel, when NASA built models to help monitor and modify spacecraft that, once launched, were beyond their physical reach. As computer power increased, these analogue models

turned into digital ones.

The powerful systems that have since emerged bring together several elements—software services in computer-aided design and engineering; simulation; process control; and product life cycle management. Some digital twins are gaining artificial intelligence and virtual-reality capabilities, too. They can also help to monitor remotely and provide after-service for products that have been sold. “It is a digital twin of the entire value chain,” says Jan Mrosik, the chief executive of Siemens’s Digital Factory Division.

Siemens is not alone in equipping its factories with digital twins. Its American rival, GE, is doing the same. Both companies also sell their digital-twin software, along with firms such as Dassault Systèmes, a French specialist in the area. Customers come from industries ranging from aerospace and defence to automotive, consumer products, energy, heavy machinery and pharmaceuticals.

One motivation for twinning is to bring products to market faster and at a lower cost. The digital twin allows endless design iterations to be tried in the virtual world without having to stop the production line to see how they can be made, says Mr Mrosik. The twin can also model people working in a factory to improve their ergonomics. In one example, Maserati, which is part of Fiat Chrysler Automobiles (whose chairman is a director of *The Economist’s* parent company), used a digital twin to put its Ghibli sports saloon into production in Grugliasco, Italy, in just 16 months instead of the typical 30 months.

The spread of digital twins could shake up supply chains. For example, suppliers could be asked to submit a digital twin of their product so that it can be tested in a manufacturer’s virtual factory before an order is placed. It is already a requirement at the Amberg plant for suppliers to deliver a

digital twin along with their product to help installation.

Twins will become more responsive still as products are increasingly fitted with sensors that relay data to the internet. Formula 1 cars are full of such sensors; racing teams use these data to create digital twins of their cars so that they can rapidly design, test and manufacture parts needed to make hundreds of changes in the week or two between races. GE creates digital twins of its wind turbines and jet engines to monitor their performance and carry out preventive maintenance. Data transmitted from a jet engine while planes are in the air can provide 15-30 days' advance notice of potential failures.

Even mass-produced goods that are far less complex are likely to end up having digital siblings. This would help with product tracking and verification, which is increasingly important in food manufacturing and pharmaceutical production. Just about any product could have a unique identifier that links to production data, if not a full digital twin, reckons Thomas Körmendi, the chief executive of Kezzler, a Norwegian company that produces secure product codes using an algorithm.

The firm's codes can be scanned with a smartphone, which then connects over the internet so that information can be exchanged with a digital twin on things like a product's location and use. A consumer in London checking the provenance of a bottle of fine wine, for example, could confirm the vintage, or be alerted to the possibility of counterfeiting if the bottle had actually been dispatched to a different country. That's something everyone can raise a glass to. ■



生产技术

双子座生产商

从工厂到汽车，万事万物都将有数字孪生体

未来的工厂大楼中将满是机器人，这些机器人又在制造机器人。巴伐利亚州的小镇安贝格（Amberg）有一座工厂，虽还不至于如此，但也离得不远了。这家工厂由德国工程巨头西门子运营，生产工业计算机控制系统。这种系统是打造各类自动化系统——包括这家工厂自己的生产线——不可或缺的部件。

安贝格的这家工厂明亮，通风，一尘不染。1200名工人三班倒，年产1500万套部件，自1989年开张至今产量已增长了十倍。然而厂房并未扩大，员工人数也没增加多少。（实现了自动化的生产约占75%左右，西门子认为有些任务最好还是由人来完成。）产品缺陷率接近于零，因为99.9988%的产品都无需调整。考虑到工厂有一千多种不同的产品，这着实是一项了不起的壮举。

这样的成绩在很大程度上要归功于工厂的“数字孪生体”。这家实体工厂在计算机系统中还有一个虚拟版本。这个孪生体在各个方面都和实体厂完全相同，用于设计及测试控制部件、模拟生产这些部件的过程以及为生产设备编程。等到一切运转顺利，数字孪生体就把这些都交给实体工厂，真正开始制造产品。

数字孪生体并非新发明。这种建立配对模型的理念可追溯到早期的太空旅行。当时，美国国家航空航天局（NASA）建造了模型来监测和修改航空器，因为一旦发射，就无法再触碰到它们。随着计算机能力的提升，这些模拟模型转变成了数字模型。

从那之后出现的各种强大系统综合了几个因素：计算机辅助设计和工程中的软件服务、模拟、过程控制、产品生命周期管理。有些数字孪生体还增加了人工智能和虚拟现实功能。它们还能帮助实现远程控制，并为已售出

的产品提供售后服务。西门子数字化工厂集团的首席执行官扬·穆浩斯科（Jan Mrosik）称：“这是整个价值链的数字孪生体。”

在为工厂配备数字孪生体方面，西门子并非独一无二。它的美国对手通用电气也有同样的举措。这两家公司也都出售各自的数字孪生体软件。类似的公司还包括这一领域的法国专业公司达索系统（Dassault Systèmes）。购买这类软件的客户则来自各行各业，从航空、防务到汽车、消费品、能源、重型机械和制药等。

打造数字孪生体的动机之一是以更低的成本让产品更快上市。穆浩斯科说，有了数字孪生体，就可以在虚拟世界里试验无数次设计迭代，无需停下生产线来看该如何完成。孪生体还可以模拟工厂里的人力工作，基于人体工学改进工作环境和效率。例如，菲亚特克莱斯勒汽车公司（该公司的董事长是《经济学人》母公司的董事）旗下的玛莎拉蒂（Maserati）运用数字孪生体，仅用16个月的时间就让Ghibli跑车在意大利的格鲁吉亚科（Grugliasco）投产，而这通常需要30个月。

数字孪生体的普及可能会撼动供应链。比方说，生产商也许会要求供应商提交产品的数字孪生体，这样就可以先在它们的虚拟工厂里测试产品，然后再下订单。安贝格的工厂已经要求供应商在提交产品的同时提供一份数字孪生体以便安装。

随着产品越来越多地配备传感器，将数据上传至互联网，数字孪生体还会更迅速积极地做出反应。一级方程式赛车上满是这样的传感器，车队用这些数据为本队的赛车创建数字双胞胎，这样就可以迅速完成所需部件的设计、测试和生产，在两站比赛之间的一或两周内完成成百上千次更改。GE打造了其风力涡轮机和喷气发动机的数字孪生体，用以监测它们的性能并进行预防性维护。利用喷气式发动机在飞机飞行时传出的数据，可以提前15至30天预知潜在故障。

即便是复杂程度低得多的批量生产产品，最终可能也会有数字化的同胞。这将有助于产品的追溯和验证，而这两点在食品生产和制药领域越来越重

要。挪威公司Kezzler使用算法来生成安全产品代码。该公司首席执行官托马斯·珂曼迪（Thomas Körmendi）认为，即便没有完整的数字孪生体，几乎任何产品都可以带有独一无二的标识符，导向详细的生产数据。

该公司的代码可以用智能手机扫描，手机进而连入互联网，和商品的数字孪生体交换商品所在地和用途等信息。例如，如果伦敦的消费者要想确认一瓶好酒的原产地，就可以用这一方法确定酒的产地和年份，而如果发现这瓶酒其实已经送至另一个国家，那么就提醒了消费者这可能是假货。这可是人人都会举杯庆祝的好事。■



Virtual reality

Get real

VR has been more about hype than substance. Will that change?

JUSTIN WILLIAMS takes off a virtual-reality (VR) headset and wobbles away from a demo area at E3, the world's largest gaming convention, in Los Angeles. The bottoms of his feet and calves are "on fire," he says. Mr Williams, a 32-year-old former marine, was playing "Sprint Vector", a VR running game: players swing hand-held controllers to simulate motion. Though he has been standing in one place, his brain believes he has just run for several miles.

This sensation of complete immersion is called "presence". Boosters of VR say it is what will drive the technology's mass adoption, in time. When Facebook bought Oculus, a VR startup, for \$2bn in 2014, and sent interest in the technology rocketing, it was this feeling of being present that Mark Zuckerberg, the social network's boss, described as "incredible".

Yet despite many pronouncements that 2016 was the year of VR, a more apt word for virtual reality might be absence. Of the 6.3m headsets that were shipped last year, most were cheaper, less sophisticated devices, such as the Samsung Gear VR, that rely on smartphones to act as their screens, according to SuperData, a games-market research firm. Only 200,000 high-end Oculus Rift headsets were sold globally (see chart). In the end, SuperData revised its first forecast, made in January last year, that total revenue from VR software and hardware would reach \$5.1bn in 2016, down to \$3.6bn. The actual figure for total worldwide revenue was a meagre \$1.8bn. The expectations set for VR were plainly unrealistic, says George Jijiashvili, an analyst with CCS Insight, a research company. Even in the gaming industry, which has been quick to adopt the technology, people noted that Microsoft's release of its new Xbox gaming console at the

convention made no mention of VR. Oculus did not even set out a stall.

Several obstacles still stand in the way of widespread use. The gear is expensive and clunky, and requires a powerful computer or gaming console to function. Consumers are hesitant to splash out on expensive kit when there isn't a lot to do with it; developers are reluctant to spend resources making games for a tiny market. Developers are also held back by the sheer variety of headsets, which means they need to code content several times for different platforms. The way in which users must wave around handheld controllers such as HTC's "wands" to input movements falls short of the promise of VR, which will eventually use sensors to convey bodily movement.

And yet signs of progress are also visible. Despite the lack of splashy announcements at E3, there were plenty of smaller companies eager to show off their wares. More than 120 of the 293 exhibitors, mostly gaming-related companies, had some sort of VR product, up from 53 last year, 27 in 2015, six in 2014 and none in 2013. Their offerings included everything from "haptic" feedback (giving VR users a sensation of touch) to advertising inside VR content.

Some tech giants still see VR as integral to their future. Despite its underwhelming sales of Oculus Rift, Facebook is convinced that VR is "the next major computing platform". It recently hired Hugo Barra, a well-known former Google and Xiaomi executive, to head up its VR division. It has a new offering, "Spaces", which is a place to socialise with friends in VR that allows users to create avatars, to express some emotion through facial expressions, answer video calls, share photos and take selfies. As a first go, it is surprisingly compelling.

Other tech firms reckon VR may be a stepping stone to a bigger prize: augmented reality (AR), which allows users to overlay the digital world

onto the real one. AR has more everyday applications, such as navigation, than VR, which is expected to be used chiefly for leisure activities and in industry. Apple believes that AR will become a bigger phenomenon than VR.

Google is trying both. It had a salutary experience with its “Glass” headsets, a much-maligned set of primitive AR spectacles that it launched in 2013 only to withdraw them from sale two years later. It has now developed and started selling “Daydream” mobile headsets, a cheap smartphone-based VR kit, and has invested in several VR and AR companies, such as Magic Leap, an AR startup. It has bought Owlchemy Labs, the creator of “Job Simulator”, a VR game set in a future in which humans no longer need to work thanks to machines. Microsoft is betting on what it calls “mixed reality”, arguing that it is pointless to draw a line between AR and VR. Although it did not emphasise VR at E3, it is enthusiastic about its potential on the Windows 10 operating system.

If VR is to take off at last, tech-industry executives agree that avid gamers will be crucial. Such people tend to be early adopters of expensive new equipment, so they subsidise innovation. Games developers know how to engage players and keep them interested, and how to tell stories in a non-linear fashion. And they have for years created content in three dimensions, a basic requirement for VR. Indeed, virtual reality is integrating games and the broader technology industry as never before. “It’s like two continents that were apart, and continental drift is bringing them together,” says Neil Trevett of the Khronos Group, a non-profit industry group.

HTC developed its Vive headset in collaboration with Valve, a games developer and distributor. Google is funding independent games developers to boost the creation of content. When Apple introduced new virtual-reality and augmented-reality features at a conference for software

developers in June, its emphasis was on games. Members of the Khronos Group, including Google and Apple as well as games firms such as Epic and Nintendo, are working on industry-wide standards.

New headsets from a variety of hardware firms—Acer, Asus, Dell, Lenovo and Hewlett-Packard—all running on Windows, are expected later this year. Many new games and entertainment products using VR (see next article) are poised to go on sale. Better technology and more content will encourage gamers who were on the fence to join in, expanding the market and setting off a virtuous cycle, argues Dan O'Brien, head of VR at HTC. As part of that cycle, headsets will become smaller, cheaper and wireless. Some of those advances will come from China, which leads the world in the adoption of VR. Chinese firms have been quick to invest, and its hardware industry is churning out new products. Xi Jinping, the president, has mentioned VR as important for economic growth.

Virtual reality also has new functions in business and beyond. Mr O'Brien says he receives many inquiries from carmakers, for example, which are using VR as a way quickly and cheaply to prototype and collaborate on new models of vehicles. Hospitals in America are experimenting with 3D models in VR as a way for doctors to get a closer look at tricky bits of bodies or to prep for surgery. The Pentagon is eyeing new VR technologies aimed at consumers as a cheap addition to its existing use of VR for training. The lessons from making shoot-'em-up games for bored teenagers could one day be applied to real training programmes for soldiers—as well as being useful for the doctors who come after. The VR industry has not yet fulfilled the hype. But the believers have not lost their faith. ■



虚拟现实

动真格

VR一直雷声大雨点小，情况会发生变化吗？

贾思汀·威廉姆斯（Justin Williams）脱下VR头显，摇摇晃晃地从E3游戏展的一个演示区走出来。他说自己的脚底板和小腿“像着了火一样”。在这场洛杉矶举办的全球最大游戏展上，这位32岁的海军陆战队退役士兵刚刚玩了“矢量冲刺”(Sprint Vector)——一款VR跑酷游戏，玩家可以通过挥动手柄来模拟动作。虽然他一直站在原地，他的大脑却觉得自己已经跑了几英里。

这种完全沉浸其中的感觉被称为“临场感”。VR的支持者称临场感最终会推动VR的大规模应用。Facebook在2014年以20亿美元收购VR创业公司Oculus，令人们对这一技术兴趣飙升。当时，该社交网络的老板马克·扎克伯格称这种临场感“不可思议”。

尽管许多人宣称2016年是VR元年，但形容虚拟现实更恰当的词也许是“缺位”。据游戏市场研究公司SuperData的数据，去年销售的630万台VR头显中，大部分是不那么高端的廉价设备，需要靠智能手机来做显示屏，比如三星Gear VR。高端头显Oculus Rift在全球只售出20万台（见图表）。SuperData在去年1月预测，2016年VR软件及硬件销售总收入能达到51亿美元，但最终将预测下调至36亿美元。而全球实际收入只有区区18亿美元。研究公司CCS Insight的分析师乔治·吉吉亚什维利（George Jijashvili）说，人们对VR的期待显然是不切实际的。即便在迅速采用VR技术的游戏界，人们也发现，微软在这次E3展上发布新款Xbox游戏机时并没有提及VR技术。Oculus甚至都没有参展。

VR要得到广泛使用，仍有几个障碍。设备昂贵笨重，且需强大的电脑或游戏机配合才能运作。功能不多的话，消费者是不愿花大价钱购入这些装备的。开发人员也不愿耗费资源为狭小的市场制作游戏。头显五花八门，也令开发人员为之却步，因为这意味着他们需要就内容为不同平台分别编程。玩家需要挥舞游戏手柄（如HTC的“魔杖”）来输入动作，并没达到VR

最终运用传感器来传递身体动作的预期效果。

但进步的迹象也已显现。尽管在E3展会上缺乏大张声势的新品发布，但还是有很多小公司迫不及待地展示自己的产品。293家参展商中，120多家（大部分是游戏方面的公司）拥有和VR多少有些关联的产品，数量多过以往：去年为53家，2015年为27家，2014年六家，2013年则是零。他们带来的新东西包括“触觉”反馈（给VR用户传递触摸感）、在VR内容中投放广告等等。

一些科技巨头仍将VR视为自身未来发展的重要一步。尽管Oculus Rift的销量不尽人意，Facebook仍深信VR是“下一个重要计算平台”，并在最近聘请了谷歌和小米的前知名高管雨果·巴拉（Hugo Barra）来主管公司的VR部门。其新产品“空间”（Spaces）是个让用户通过VR与朋友社交的平台，他们可以创建虚拟形象、通过面部表情表达情绪、接听视频通话、分享照片、自拍。作为第一次尝试，该产品出人意料地引人注目。

其他科技公司认为，VR也许是一块垫脚石，可借用它达成一个更大的目标：增强现实（AR），即让用户把数字世界叠加到现实世界之上。AR的日常应用比VR多，例如导航，而VR被认为主要用于休闲活动和工业用途。苹果相信AR将比VR更成气候。

谷歌正双管齐下。它在2013年推出了名为谷歌眼镜的头戴设备，这款较为原始的AR眼镜遭受大量非议，发布两年后便下架停售，谷歌从中汲取了有益的经验。如今谷歌开发了名为“白日梦”（Daydream）的移动头显，并已开始销售，这是一款基于智能手机的廉价VR套件。谷歌还投资了多家VR及AR公司，如AR创业公司Magic Leap。它还收购了VR游戏《工作模拟》（Job Simulator）的开发商Owlchemy Labs。这款游戏的场景设在未来世界，由于有机器代劳，人类已无需工作。微软则在押注所谓的“混合现实”（mixed reality）领域，认为在AR和VR之间作严格区分毫无意义。在E3展会上，微软尽管没有强调VR，但谈起该技术在Windows 10操作系统上的潜力时还是热情洋溢。

高科技行业的高管们一致认为，VR要最终流行起来，狂热的游戏玩家是关键所在。这些人会抢先购置昂贵的新设备，为创新提供资金。游戏开发人员知道怎样吸引玩家、保持他们的兴趣，也知道怎样不平铺直叙地讲故事。他们还有多年制作三维内容的经验，而这是VR的基本要求。事实上，虚拟现实正在前所未有地整合游戏和范围更大的科技行业。“就像大陆漂移把分离的两块大陆聚合到一起。”非营利性行业机构科纳斯组织（Khronos Group）的尼尔·特里维特（Neil Trevett）说道。

HTC与游戏开发商兼分销商维尔福（Valve）合作开发了Vive头显。谷歌正在资助独立游戏开发人员来推动内容制作。6月，苹果在一场软件开发大会上介绍了VR和AR新功能，重点就在游戏方面。科纳斯组织的成员，包括谷歌和苹果，还有Epic和任天堂等游戏公司，正在制定行业标准。

宏碁、华硕、戴尔、联想和惠普等各大硬件公司预计今年晚些时候将推出新款头显，全部基于Windows操作系统。许多运用VR的新游戏和娱乐产品已准备好投放市场。HTC的VR部门主管丹·奥布莱恩（Dan O'Brien）认为，更好的技术和更丰富的内容将促使原本犹豫不决的游戏玩家出手购入VR设备，进而拓展市场，启动良性循环。作为良性循环的一部分，头显的尺寸会变小，价格会降低，而且会采用无线形式。这其中的一些进步将来自在VR的采纳上引领全球的中国。中国企业投资行动迅速，其硬件行业正大量推出新产品。国家主席习近平曾提到VR对经济增长有重要作用。

虚拟现实对商界及其他行业也有新功用。比如，奥布莱恩说他收到很多汽车制造商的问询，它们正运用VR制造原型及合作研发新车型，速度快且成本低。美国的医院正试验VR三维模型，让医生能更仔细地检查身体的复杂组织或为手术做准备。美国国防部正在关注消费级的VR新技术，将其视为现有训练用VR的廉价补充。也许有一天，为百无聊赖的青少年制作射击游戏的经验可用于训练士兵的真实项目上；再往后，医生们也能得益。目前，VR行业依然雷声大雨点小，但VR信徒并未丧失信心。■



Fighting ageing

Youthful spirits

Blood transfusions from young animals can revitalise old ones. Trials are now running to see if that is true for people, too

IT WAS one of the oddest experiments in the history of dentistry. In the early 1950s a researcher called Benjamin Kamrin was looking into the causes of tooth decay. To do so, he turned to that scientific stalwart, the lab rat. Specifically, he cut small patches of skin from pairs of rats and then sutured the animals together at the site of the wound. After about a week of being joined in this way, the animals' blood vessels began to merge. The result was two rats whose hearts pumped blood around a shared circulatory system. This state of affairs is called parabiosis.

Parabiosis works best on animals that are closely related genetically. By getting his rats to share blood, as well as genes, and then feeding the animals a variety of diets, Kamrin hoped to prove (which he did) that it was sugar in food, and not some inherent deficiency in individuals, that was responsible for rotting their teeth.

Other people, though, have used the technique to find more striking results. For example, mammalian bone density usually drops with age. Three years after Kamrin's work, however, a gerontologist called Clive McCay showed that linking an old rat to a young one boosted the density of the oldster's bones. In 1972 another paper reported, even more spectacularly, that elderly rats which shared blood with young ones lived four to five months longer than similarly old rats which did not.

The rats themselves, unsurprisingly, were not always keen on the procedure. Early papers describe the dangers of "parabiotic disease", in which one animal's immune system rebels against the foreign blood, and

also explain how rats must be socialised carefully before being joined, to stop them biting each other to death.

“The technique itself is kind of gross and crude,” admits Michael Conboy, a biologist and parabiosis researcher at the University of California, Berkeley. Perhaps for that reason, research had more or less died out by the late 1970s. These days, though, it is back in the news—for a string of recent discoveries have suggested that previous generations of researchers were on to something. The blood of young animals, it seems, may indeed be able to ameliorate at least some of the effects of ageing. And the technique is promising enough to have spawned human clinical trials.

| *No jokes about vampires, please*

This modern interest in parabiosis dates back to 2005, when Dr Conboy (who was then at Stanford University), his wife Irina, and a group of other Stanford researchers published a paper in *Nature*. In it they described joining mice aged between two and three months with members of the same strain that were 19-26 months old. That is roughly equivalent to hooking a 20-year-old human up to a septuagenarian. After five weeks, the Conboys and their colleagues deliberately injured the older mice’s muscles. Usually, old animals heal far less effectively from such injuries than young ones do. But these mice healed almost as well as a set of young control animals. The young blood had a similar effect on liver cells, too, doubling or tripling their proliferation rate in older animals.

Since then, a torrent of papers have shown matching improvements elsewhere in the body. No one has yet replicated the finding that young blood makes superannuated mice live longer. But it can help repair damaged spinal cords. It can encourage the formation of new neurons in mouse brains. It can help rejuvenate their pancreases. The walls of mouse hearts get thicker as the animals age; young blood can reverse that process as well.

The effects work backwards, too. Old blood can impair neuron growth in young brains and decrepify youthful muscles. Intriguingly, the phenomenon even seems to operate across species. In April Tony Wyss-Coray, also at Stanford, showed that infusing old mice with blood from the umbilical cords of infant humans improved their performance on memory tests.

There have been enough results, says Janet Lord, who runs the Institute of Inflammation and Ageing at Birmingham University, in Britain, to remove any doubt that something impressive is happening. But finding out exactly what is trickier. The working theory is that chemical signals in young blood are doing something to stem cells in older animals. Stem cells are special cells kept in reserve as means to repair and regrow damaged tissue. Like every other part of the body, they wear out as an animal ages. But something in the youngsters' blood seems to restore their ability to proliferate and encourages them to repair damage with the same vigour as those belonging to a younger animal would.

Nobody yet knows exactly what that something is, but people are looking hard. In all probability, says Dr Lord, it is not one thing at all, but dozens or hundreds of hormones, signalling proteins and the like, working together. Researchers have been comparing the chemical composition of old and young blood, searching for those chemicals that show the biggest changes in level between the two. These include oxytocin (a hormone better known for its role as a transmitter of signals between neurons); two proteins called GDF-11 and TGF beta-1, both of which are already known to affect cell behaviour; and B2M, another protein which, among other things, affects the body's ability to absorb iron from food.

Even with a list of targets, working out what is going on is hard, says Richard Lee, a cardiologist at Brigham and Women's Hospital in Boston, Massachusetts. Blood is complicated stuff, and the tools available to

analyse it are far from perfect. Dr Lee's own work is a good example. In 2014 his group suggested GDF-11 as a possible rejuvenating factor. The following year a team at Novartis, a big pharmaceutical company, said that they were unable to replicate those results. The trouble, said the group from Novartis, was that the test used by Dr Lee's team was sensitive to proteins besides GDF-11, messing up the results. Dr Lee's team replied within months that, no, it was in fact the Novartis test that was flawed, because it was itself picking up extra proteins. And there, at the moment, the matter stands.

There are further possible explanations for parabiotic rejuvenation besides blood chemistry. One is that older animals may also benefit from having their blood scrubbed by young kidneys and livers, which mere blood transfusion would not offer. A paper published by the Conboys and their team in 2016, which described blood exchanges that were done in short bursts (thus eliminating the possibility of such scrubbing) reported rejuvenating effects, but ones that were not as widespread as those obtained by full-on parabiosis.

Another idea is that cells from the young animal, rather than chemicals in its blood, could be doing some of the work. By modifying the genes of a mouse so that its cells glow under ultraviolet light, researchers can track where those cells end up when the mouse in question is linked to another. They have found that only a few cells from a younger mouse take root in an older animal it is linked to. This does not quite rule the theory out, says Irina Conboy, for the number of cells may not reflect their importance. Immune-system cells, for instance, multiply rapidly when needed. And they are precisely the sorts of cells that might help an older animal.

The mechanisms by which parabiosis operates, then, are foggy. But that has not dissuaded some companies from setting up trials to see if young blood can work its magic in people as well as rodents. Persuading patients to have themselves stitched to another person so they can share circulatory

systems might be tricky. So instead of full-on parabiosis, these trials are using donated blood plasma.

| *Blood simples*

One such firm, based in California, is called Ambrosia. It has attracted plenty of raised eyebrows for charging its participants, who must be at least 35 years old, \$8,000 to join. For that, they get an infusion of blood plasma from a donor under 25. Most clinical trials work by comparing the treatment under investigation either with another, established treatment, or with a placebo. Ambrosia's trial will not do this. Jesse Karmazin, Ambrosia's founder, says it would be hard to persuade people to pay if there were a chance they might not get the real thing. Instead, he says, patients will serve as their own controls. This will be done by comparing their blood chemistries before and after the treatment.

The unusual trial design, the charge for participation and the sheer amount of hype surrounding anti-ageing research has led some to accuse Dr Karmazin of being more interested in money than science. Not so, he says. Because blood plasma is a natural product, he says, it is not patentable. Without the prospect of a profitable new drug, no drug companies are interested in sponsoring his work. "If I could run this trial for free, I would," he says. "But the reality is I can't." Indeed, Dr Karmazin would not be drawn on how—or if—he plans to turn an eventual profit. But he argues that, with plenty of blood plasma already being collected, both for transfusion and to extract important biochemicals such as clotting factors from it, checking to see if it might have other useful properties is only sensible. Although Ambrosia is not yet ready to publish its results, its initial findings, he says, are encouraging.

Another firm, called Alkahest, which was spun out of work done at Stanford, has had less trouble attracting money. It began its life in JLABS, a biotechnology "incubator" run by Johnson & Johnson, a big drug firm, and

has secured \$50m from Grifols, a Spanish company that processes blood plasma into various products. It has commissioned a trial in which 18 people with Alzheimer's disease will be given four infusions of plasma taken from young donors, over four weeks. The main goal, says Karoly Nickolich, Alkahest's boss, is to see if the treatment is safe. That should, he says, be fairly straightforward. Blood transfusions are, after all, routine procedures. The study will also, though, check whether the blood used can reverse some of the effects of Alzheimer's, as seems to happen in mice in analogous circumstances.

Alkahest plans to present the results of its study at a conference in November. Because the trial is being run by researchers at Stanford, rather than by the firm itself, Mr Nickolich does not yet know what they are likely to show. But if the treatment is safe, he says, and if it proves effective, then the next step will be to identify and isolate the responsible compounds. Unlike blood plasma, such compounds would be patentable—particularly if they were then made synthetically. And such synthesis would be needed. As Mr Nickolich observes, even if things go well, there is simply not enough donated blood around to treat the world's 44m Alzheimer's patients with plasma extracts.

Some researchers are more wary than Mr Nickolich about the wisdom of such trials. Michael Conboy points out that transfusions are risky. "You can occasionally get immune reactions even with well-matched donors," he says. "In the worst cases you can get full-on anaphylaxis [an extreme allergic reaction that can be fatal]."

For his part, Dr Lee worries about the hype that inevitably attaches itself to "anti-ageing" treatments. "I never use terms like 'anti-ageing' or 'rejuvenation' when I talk about laboratory science," he says. "It conveys a false sense of hope." Dr Lord agrees that talk of reversing ageing is premature. But, she says, there are reasons for cautious optimism.

Improving the ability of old muscles to repair themselves, for instance, might not be enough to fend off the Reaper for ever. But frailty, and the falls it causes, are a problem for the elderly. Mitigating the damage from Alzheimer's, even if it cannot be cured, would also be a boon. Rather than lengthening lifespan, says Dr Lord, it is better to think about lengthening "healthspan". That is not immortality. But it would still be quite something. ■



对抗衰老

青春血液

输入年轻动物的血液可助年老动物重现活力。在人类身上是否亦是如此？试验正在进行中

这是牙科史上最怪异的试验之一。20世纪50年代初，一位名叫本杰明·卡姆林（Benjamin Kamrin）的研究人员为研究蛀牙的成因，求助于科学试验的忠实伙伴——大鼠。具体来说，就是从好几对大鼠身上分别切下小块的皮肤组织，然后在切口处把这些大鼠两两缝合在一起。如此合体约一周后，它们的血管开始融合。结果是两只大鼠的心脏会向共享的循环系统供血。这种情况被称为联体共生（parabiosis）。

在基因密切相关的动物身上，联体共生的效果最佳。卡姆林让这些大鼠共享血液和基因，然后向它们投喂各种食物，希望以此证明导致龋齿的是食物中的糖分，而非个体的某种先天不足。他最终成功证明了这一点。

其他人则利用该技术获得了更惊人的发现。例如，哺乳类动物的骨密度通常随年龄增长而下降。然而，卡姆林的研究过了三年后，老年病学家克莱夫·麦凯（Clive McCay）证明了把老年大鼠和幼年大鼠联体能提升老年大鼠的骨密度。1972年，另一篇论文更令人咋舌地指出，相比同类老年大鼠，分享了幼年大鼠血液的老年大鼠能多生存四至五个月。

当然，大鼠们本身并不太喜欢这个过程。早期就有论文描述过“共生病”的危害——发病时动物的免疫系统排斥外来血液。论文也解释了在把这些试验鼠联体之前，必须先小心地让它们熟络起来，防止互相撕咬致死。

加州大学伯克利分校的生物学家和联体共生研究员迈克尔·康博伊（Michael Conboy）承认，“这种技术本身有些野蛮和倒人胃口。”也许是这个原因，到了20世纪70年代后期，这方面的研究已差不多销声匿迹。不过，最近这种技术又重新回到人们的视线里，因为近期有一连串发现显示，前几代研究人员其实已经摸索到了一些重要的东西。看起来，年轻动

物的血液好像确实能够缓解至少一部分的衰老的影响。以该技术的前景，足以催生这方面的人体临床试验。

| 拜托，别拿吸血鬼开玩笑

联体共生的现代研究始自2005年。当时在斯坦福大学工作的康博伊（Conboy）和妻子伊琳娜（Irina）以及斯坦福的其他几位研究人员在《自然》杂志上发表了一篇论文。文章描述了对两至三个月大的小鼠和19至26个月大的同种小鼠所做的联体试验。这大致相当于把20岁的年轻人与七旬老人联体。五周后，康博伊夫妇和同事故意损伤了受试老年鼠的肌肉。通常，老年动物受到这类损伤后的恢复速度远不及年轻动物。但这些老年小鼠的痊愈效果堪比对照组的年轻小鼠。年轻血液对肝细胞也有类似效果，使老年小鼠体内肝细胞的增殖速度提高了一或两倍。

自此，有大量论文显示动物体内其他方面也存在类似的改善。但至今尚未有研究重复出年轻血液延长老年鼠寿命这一结果。但研究证明年轻血液有助修复受损的脊髓，还可促进小鼠的大脑形成新神经元，帮助它们的胰腺恢复活力。小鼠的心脏壁会随年龄增长而变厚，年轻的血液还可逆转这一过程。

其中也存在逆向效果。老年血液会损害年轻大脑中的神经元生长，并使年轻的肌肉衰老。有趣的是，这种现象似乎甚至可以跨物种显现。今年4月，同为斯坦福大学研究人员的托尼·魏斯-克雷（Tony Wyss-Coray）表示，老年小鼠输入人类婴儿的脐带血后，在记忆测试中的表现有所提升。

英国伯明翰大学炎症和老化研究所（Institute of Inflammation and Ageing）的负责人珍妮特·洛德（Janet Lord）说，现有研究结果足以让人消除怀疑，确信有一些非同一般的因素在起作用。但要确切说明到底是什么就不那么容易了。初步的理论是，年轻血液中的化学信号对年老动物中的干细胞施加了某种影响。干细胞是储备在体内的特殊细胞，用于修复和再生受损组织。就像身体其他各部分一样，干细胞也会随动物的年龄增长而老化。但年轻血液中的某些成分似乎能令干细胞恢复增殖能力，并促进它们像年轻动物的干细胞那样有效地修复受损组织。

还没有人确切知道到底是什么在起作用，但人们正在仔细分辨。洛德表示，很有可能不止一种，而是数十或数百种激素、信号蛋白及类似物质在共同作用。研究人员比较了年老及年轻血液的化学成分，寻找两者间含量水平差异最大的化学物质。这其中包括催产素，这种激素更为人熟知的作用是在神经元之间传递信号；还有名为GDF-11和TGF beta-1的两种蛋白质，已知两者均会影响细胞的行为；另外还有一种名为B2M的蛋白质，它的作用之一是影响身体从食物中吸收铁的能力。

即便有了目标清单，要弄清楚发生作用的过程还是很难，马萨诸塞州波士顿市布列根和妇女医院（Brigham and Women's Hospital）的心脏病专家理查德·李（Richard Lee）说道。血液是很复杂的东西，现有的分析血液的工具也远非完美。李博士自己的研究便是个好例子。2014年，他的团队发现GDF-11有可能是一种“返老还童”因子。第二年，大型制药公司诺华（Novartis）的一个团队称无法重复该结果。诺华团队表示，问题在于李博士团队的测量方法对GDF-11以外的蛋白质也有敏感性，影响了测量结果。几个月后，李博士的团队予以否认，称有问题的其实是诺华团队的测试，因为正是该团队的测试在过程中混入了其他蛋白质。目前此事件尚无进一步发展。

除了血液化学方面的因素，联体共生的“返老还童”现象还有其他可能的解释。其一是，老年动物可能也同时受益于年轻肾脏和肝脏对血液的净化作用，而这单靠输血是无法实现的。康博伊及其团队在2016年发表的一篇论文称，在短时间内完成的血液交换（因而消除了上述净化过程的可能性）具有复壮的效果，但不如全面联体共生后那样全面。

另一个想法是，也许是来自年轻动物的细胞发挥了些许作用，而非血液中的化学物质。研究人员改造了一只小鼠的基因，使其细胞能在紫外线下发光，从而在这只小鼠跟其他小鼠联体时跟踪这些细胞的去向。他们发现，在与老年鼠联体时，只有少数幼鼠的细胞转移到老年鼠体内。但这并不能完全推翻上述理论，伊琳娜·康博伊（Irina Conboy）说，因为细胞数量不一定反映其重要性。举个例子，免疫系统细胞在必要时可迅速繁殖。它们正是那种可能会对老年动物有所帮助的细胞。

如此说来，联体共生的作用机制仍是个谜。但这并没有阻止一些公司展开试验，探究除了啮齿类动物之外，年轻血液是否也会在人类身上发挥神奇的效应。说服患者与他人缝合成一体以共享循环系统可能不大容易。因此，这些试验运用了捐献血浆，而非采取全面的联体共生。

| 输血蠢行

这类公司中有一家位于美国加州，名为Ambrosia（“长生珍馐”）。该公司要求参与试验者必须年满35岁，并收取8000美元的费用——这一价格令不少人感到惊讶。付钱后，参与者被输入来自25岁以下捐献者的血浆。大部分临床试验要么是将所研究的疗法与另一种已经证实的疗法作对照，要么是与安慰剂组作比较，Ambrosia的试验则不然。其创始人杰西·卡马辛（Jesse Karmazin）表示，如果受试者有可能被分到对照组，那么就很难说服他们付这笔钱来参与试验。他说，患者将充当自己的对照组，通过比较接受治疗前后的血液化学成分来进行临床试验。

由于不寻常的试验设计，加上参与费用和围绕抗衰老研究的大量炒作，已有一些人指责卡马辛意在赚钱甚于科研。他否认了这一点。他说，血浆是一种天然产品，因此不能申请专利。如果没有希望研发出有利可图的新药，制药公司就不会有兴趣赞助他的研究。“我要是能免费做这个试验，我会免费的，”他说道，“但现实是我不能。”的确，卡马辛不愿意透露他是否或者如何计划籍此最终获利。但他认为，已有大量血浆被收集起来，既为输血之用，也为抽取凝血因子等重要生化物质，测试血浆是否有其他有用特性恰是明智的做法。尽管Ambrosia公司还未准备好发表研究成果，但他说初步结果令人鼓舞。

另一家名为Alkahest（“万能溶剂”）的公司源于斯坦福大学的研究项目，在吸引投资上阻力较小。它最初成形于大型制药公司强生设立的生物科技“孵化器”JLABS，并从生产各类血浆制品的西班牙公司Grifols获得了5000万美元的投资。Alkahest已经委托开展一项试验——在四周内，向18名阿尔茨海默症患者分四次输入年轻献血者的血浆。Alkahest公司的老板卡罗伊·尼克里奇（Karoly Nikolich）表示，试验的主要目标是了解疗法是否安全。他说，结果应该会相当明确，毕竟输血是常规医疗手段。不过，该

研究也将检验所用的血液能否逆转阿尔茨海默氏病的某些影响，这对处于类似情况下的小鼠似乎是有效的。

Alkahest公司计划在11月的一次会议上介绍其研究成果。由于试验是由斯坦福大学的研究人员而非公司自己进行的，尼克里奇还不清楚可能会展示怎样的内容。不过他说，如果疗法是安全的且被证明有效，那么下一步便会是识别及分离发挥效力的化合物。不同于血浆，这类化合物是可以申请专利的，尤其是以后需要人工合成的话。而且也的确需要合成制造。正如尼克里奇认为的那样，即便试验一切顺利，献血量也不足以提取血浆物质来治疗全球4400万名阿尔茨海默症患者。

对于这类试验是否明智，一些研究人员比尼克里奇更为谨慎。迈克尔·康博伊指出，输血是有风险的。“即便血浆来自配对得当的献血者，也可能出现免疫排斥反应，”他说，“最糟糕的情况是出现全身过敏反应（一种可能致命的极端过敏反应）。”

而李博士则担心对这类试验的大肆宣传难免会使其与“抗衰老”疗法挂钩。“在谈论实验室研究时，我从来不用‘抗衰老’或‘返老还童’这些词，”他说，“这会产生误导，让人空欢喜。”洛德也认同现在谈论逆转衰老还为时尚早。不过她说确有理由持审慎乐观态度。例如，改善老化肌肉的自我修复能力也许不足以长久对抗死神，但年老体衰以及由此导致的跌倒对老年人来说的确是个问题；即便无法治愈阿尔茨海默症，能减轻其损害也是一个福音。洛德说，与其追求延年益寿，还不如考虑怎样延长“健康期”。这不是长生不老，但仍会是件了不得的事。■



If blockchains ran the world

The long arm of the list

The trust business is little noticed but huge. Startups deploying blockchain technology threaten to disrupt it, and much else besides

“WE LIKE lists because we don’t want to die.” What Umberto Eco, an Italian writer, said about human beings applies even more to the institutions they create. Without lists that keep track of people and things, most big organisations would collapse.

Lists range from simple checklists to complex databases, but they all have one major drawback: we must trust their keepers. Administrators hold the power. They can doctor corporate accounts, delete titles from land registries or add names to party rolls. To stop the keepers from going rogue, and catch them if they do, society has come to rely on all sorts of tools, from audits to supervisory boards. Together, list-keepers and those who watch them form one of the world’s biggest and least noticed industries, the trust business.

Now imagine a parallel universe in which lists have declared independence: they maintain themselves. This, broadly, is the promise of the “blockchain”, the system which underlies bitcoin, a digital currency, and similar “distributed-ledger” technologies. If blockchains take over, as fans are sure they will, what are the implications of the trust business migrating into the ether?

It would not be the first time a novel form of list-making changed the world. More than 500 years ago a new accounting technique, later known as double-entry book-keeping, emerged in northern Italy. It was a big step in the development of the modern company and economy. Werner Sombart, a German sociologist who died in 1941, argued that double-entry

book-keeping marked the birth of capitalism. It allowed people other than the owner of a business to keep track of its finances.

If double-entry book-keeping freed accounting from the merchant's head, the blockchain frees it from the confines of an organisation. That is probably not what Satoshi Nakamoto, the still-elusive creator of bitcoin, had in mind when he set out on his endeavour. His aim was to create a "purely peer-to-peer version of electronic cash", as he put it in a "white paper" published in 2008. To do so, he created a new type of database, the blockchain. It provides proof of who owns what at any given moment. It contains the payment history of each bitcoin in circulation; heavy-duty encryption makes it theoretically impossible to alter it once a transaction is registered; copies are spread around the computers, or "nodes", that form the bitcoin network, so that anybody can check whether something is wrong. A "consensus mechanism", a complex cryptographic process which replaces the list-keeper, turns the blockchain into an independent entity.

Clever minds quickly saw that such a set-up can be used for things other than money. Different sorts of self-sufficient lists now abound. Prominent among them is Ethereum. Like bitcoin, it boasts its own crypto-currency, called "ether", but it also allows users to add "smart contracts", code that encapsulates the terms of a business agreement and is executed automatically.

When Luca Pacioli, a Franciscan friar, wrote the first textbook on double-entry book-keeping in the late 15th century, he could not have foretold what the accounting technique would bring about. But today plenty of startups suggest ways that blockchains could change the world.

Everledger, for example, keeps track of valuable assets. The firm has registered the ID of more than 1m diamonds, making it easier to check whether gems were stolen or mined in war zones.

Other firms want to help keep track of people. One of the first things done for a baby could be to give the newborn an entry in a blockchain, the crypto-equivalent of a birth certificate. This sounds Orwellian, but it does not have to be. On the contrary, if people's identity is anchored in one or several blockchains, this would give them more control over it and their personal data. If a potential tenant, for example, wants to prove to a landlord that his income is high enough to pay the rent, he need only disclose that bit of information, instead of allowing access to his entire credit history, as is often the case today.

In a blockchain world, having such a "self-sovereign identity" may well be a fundamental human right. Moxie Marlinspike, an anarchist entrepreneur, and others have already called for the abolition of the "ID-slavery" imposed by current national registration systems. A slew of startups, including Evernym, Jolocom and uPort, are working on services that will allow people to register identities.

Once people are able to manage their identity, other possibilities open up, says Kevin Werbach of the University of Pennsylvania's Wharton business school. People will be able to band together in virtual countries and set their own rules. One such already exists: BITNATION. Anyone can become a citizen by accepting its constitution. To do business in BITNATION, people have to build up reputation, for instance by trading on the platform.

| *Chain reaction*

This is also an example of the other big function of such ledgers: they can serve as a source of truth. All kinds of information could be attached to an entry in a blockchain. In the case of a car, say, that could be where it came from, the history of repairs and even where it was driven. Taken together, these data would form the "truth" about a given vehicle.

Many people are already working on "truth services". Researchers have

proposed creating unique cryptographic identifiers, or “hashes”, of the descriptions of clinical trials and registering them in a blockchain, so they cannot be changed to fit desired results. Georgia, Sweden and Ukraine are testing the technology as a way of digitising parts of their land registries. And Delaware, the American state which has made a big business out of registering companies from all over the world, is gearing up to allow blockchains for corporate record-keeping.

Transactions on a blockchain could also serve as input for smart contracts. Slock.it, another startup, is developing physical locks which have a digital existence on Ethereum. When it is sent some ether, this smart rental contract opens the lock. This could enable new ways of sharing things. If somebody wanted to rent a car, say, he could simply transfer money to its smart contract and drive away.

Smart contracts promise to change the economy more than any other feature of the blockchain. They could take over most routine business processes. Some companies could be no more than a bundle of smart contracts, forming true virtual firms that live only on a blockchain. Predictably, the first attempt to create such a “decentralised autonomous organisation” ended in disaster. Named “The DAO”, the entity was set up a year ago as a sort of virtual venture-capital fund. It raised more than \$160m, but then hackers siphoned off \$60m, leading to its demise.

Yet simpler versions of such structures, called initial coin offerings (ICOs), have since taken off—and created the first bubble of the blockchain economy. In an automated form of crowdfunding, startups set up a smart contract on Ethereum and publish a “white paper”, or prospectus. Investors can then send ether to the smart contract, which automatically creates “tokens” that can be traded like shares. More than \$550m has already been invested in ICOs.

Some of these projects are scams. And many honest ones leave outsiders baffled. EcoBit aims to build a market for carbon credits. Aragon wants to use blockchain tools to manage entire organisations, complete with decentralised arbitration courts. SONM is “a decentralised fog supercomputer”: users can either buy computing power with the project’s tokens or earn them by adding their machines to the pool.

| *Will the centre hold?*

These efforts give a taste of what will be possible, says Albert Wenger of Union Square Ventures (USV), a venture-capital firm. He thinks that such decentralised organisations could one day disrupt the tech giants. At their heart, he argues, those tech titans are gigantic centralised databases, keeping track of products and purchase histories (Amazon), users and their friends (Facebook), and web content and past search queries (Google). “Their value derives from the fact that they control the entire database and get to decide who sees which part of it and when,” he says.

USV has invested in decentralised alternatives, such as OpenBazaar, an e-commerce marketplace. Instead of visiting a website, users download a program that directly connects them to other people wanting to buy and sell goods and services. Others have started to build blockchain-based social networks that pay users who contribute content. Steemit is a blogging-site that allows authors to earn tokens. Synereo lets users tip individual content-providers.

In a world run by blockchains, decentralisation could be pushed even further, to include objects. Once they have their own identity and can be controlled via a blockchain, it is possible to imagine them becoming, in a way, self-determining. A few years back, Mike Hearn, a former bitcoin developer who now works for R3, a blockchain consortium, suggested the idea of self-driving cars which are also financially autonomous. Guided by smart contracts, they would stash away some of the digital money they

make by ferrying people around, so as to pay for repairs or to replace themselves when repairs are no longer worthwhile. They would put themselves in long-term parking if not enough rides are to be had—or emigrate to another city. They could issue tokens to raise funds and to allow owners to get part of their profits.

If even objects control their own destiny, what is left for governments and the nation state to do? Plenty, it turns out. Despite libertarian dreams of complete decentralisation, in many cases somebody still has to make sure that the information baked into a blockchain is actually true. In China, for example, regulators are part of a pilot project run by IBM and Walmart to make the retailer's supply network more transparent, for instance by tracing the provenance of pork and organic food.

In some areas the blockchain may even make life easier for governments. Last year Dubai announced that it wants all government documents secured on a blockchain by 2020, a prerequisite for agencies to become completely paperless. The technology could also be used as a cheap platform to generate what poor countries lack most: more efficient government and trust in contracts. And some hope that the blockchain could make the United Nations work better by helping it keep track of all its programmes, creating transparency and reducing waste.

Another example, counter-intuitively, is money. Although the blockchain was created to replace them, central bankers have been interested in the technology from the beginning. When banks share a ledger, rather than keeping their information in separate databases, it will be simpler for regulators to observe financial flows. Several central banks are toying with the idea of issuing their own crypto-currency; the Bank of Canada and the People's Bank of China are running tests. If digital coins were to replace cash, this would open up new possibilities for monetary policy. To increase demand in an economic crisis, for instance, the coins could be

programmed to lose some of their value if they are not spent within a certain time.

| *Warning: blockchains ahead*

The technology today is nowhere near being able to support many of these applications. Such ledgers may not be as immutable as they seem, and blockchains have yet to show that they can scale up sufficiently (the bitcoin system manages seven transactions per second, compared with thousands in a typical credit-card network). But if the history of digital technology is any guide, these barriers will be overcome.

A bigger issue is institutional resistance, as many blockchain enthusiasts are discovering the hard way. Corporate departments are not willing to give up control of their lists because it means a loss of power. In many cases it is also not clear how much value blockchains actually add. Some centralised systems seem to be doing just fine. For now, conventional payment services appear more efficient than their decentralised counterparts.

Politics will also be a hurdle. The reason many champions of the technology display an almost religious excitement about blockchains is because they believe these replace messy decision-making with clean cryptographic code. But bitcoin itself shows that even simple technical questions can turn into interminable fights between potential winners and losers. Even after years of discussion, those involved in bitcoin have yet to agree on how to increase the system's capacity.

This points to the biggest question of all. Should blockchains run the world? Warning voices are starting to be heard. If distributed ledgers indeed disrupt the trust business, then a lot of administrative jobs will be lost, perhaps even more than through artificial intelligence. Some have called blockchains a libertarian conspiracy. Others fret about a dismantling of institutions humans have painstakingly built. "Each time we use a

distributed ledger we participate in a shift of power from central authorities to non-hierarchical and peer-to-peer structures,” researchers at the European Parliament wrote recently. Then there is the concern that hard, cold blockchains and contracts too smart for their own good will ossify society—or make it run amok.

As decentralised list-keeping grows stronger, the list of worries about it is sure to grow longer. ■



假如世界由区块链来运行

扩张的清单

信用业务不起眼却规模庞大。部署区块链技术的创业公司威胁要颠覆它以及其他许多事

“我们喜欢列清单，因为我们不想死。”意大利作家翁贝托·艾柯（Umberto Eco）描述人类的这句话更适用于人类创造的机构。假如没有清单来追踪记录人和事，大部分大机构都会崩溃。

从简单的列表到复杂的数据库，清单各式各样。但它们都有一个重大缺点：我们必须信任管理清单的人。行政管理人员拥有权力，可以篡改企业账户、删除土地登记里的产权、往党派名单上添加名字。为防范他们胡作非为，并抓获犯事者，社会开始依赖从审计到监事会等各种机制。清单管理者和监督他们的人一起构成了世界上最庞大却又最不起眼的产业之一：信用业务。

现在，想象存在一个平行宇宙，在那里，清单已经宣布独立——它们自我维护。这大体上就是“区块链”的承诺。这种系统构成了数字货币比特币以及其他类似的“分类账”技术的基础。假如这种系统真如区块链的拥趸们所笃信的那样，将接管清单的管理，那么迁徙到以太空间的信用业务将会带来怎样的影响？

这不是创建清单的全新模式头一次改变世界。五百多年前，一种新的记账方式——后来被称为复式记账法——在意大利北部出现。这是现代企业和经济发展迈出的一大步。1941年去世的德国社会学家维尔纳·桑巴特（Werner Sombart）称复式记账法标志着资本主义的诞生。它让企业主之外的人也能追踪企业的财务状况。

假如说复式记账法让商人不用再自己费心思管账目，区块链则使得会计这一职能突破了机构的限制。这可能是至今行踪神秘的中本聪在创造比特币时未曾想到的。他在2008年发布的“白皮书”中说，他的目标是创造一种

“纯粹P2P版本的电子现金”。为此他创造了一个新型数据库——区块链。它可提供证据，显示在任何特定时刻谁拥有什么。它包含所有流通中的比特币的支付历史记录。繁复的加密，使得一项交易一旦登记在册，理论上就再也无法修改。交易的拷贝在构成比特币网络的计算机即“节点”间传播，因此任何人都能查看是否存在问题。“共识机制”，即复杂的加密过程取代了管账簿的人，让区块链变成了一个独立主体。

聪明的人很快认识到这种设置的用途不止于管钱。现在，五花八门的自洽清单层出不穷。以太坊是其中著名的一个。和比特币一样，它也拥有自己的加密货币，名为“以太币”。但它还同时允许用户添加“智能合约”——一种“封存”商业协议条款并自动执行的编码。

当圣方济各会教师卢卡·帕乔利（Luca Pacioli）在15世纪末写出史上第一本复式记账教科书时，他不可能预料到这种会计方法会带来的影响。但今天，许多创业公司都提出了可能用区块链改变世界的方式。

比如，Everledger追踪高价资产。该公司已为一百多万颗钻石登记编号，方便追查钻石是偷来的还是从战区开采来的。

其他公司想要帮助追踪人。为新生儿最先做的事可以包括这一件：在区块链上登记一条信息，相当于出生证的加密版。这让人想到奥威尔的小说，但实情不必非得如此。相反，假如人们的身份信息被固定在一个或几个区块链中，他们将获得对这些信息及其他个人信息更多的控制权。例如，假设一个找租房的人想向房东证明自己的收入足够支付房租，那么他只需要透露这部分信息，而不用再像如今常发生的那样，让别人查看自己完整的信用记录。

在区块链的世界里，拥有这类“自我主权身份”很可能会成为一种基本人权。无政府主义企业家莫克西·马林斯巴克（Moxie Marlinspike）等人已经呼吁废除目前国家登记系统强加给人们的“身份奴役”。包括Evernym、Jolocom和uPort在内的一大批创业公司正在研发能让人们登记身份的服务。

一旦人们得以管理自己的身份，其他的可能性也随之打开，宾夕法尼亚大学沃顿商学院的凯文·韦尔巴赫（Kevin Werbach）说。人们将能在虚拟的国度里联合起来并设立自己的规则。已经出现了这样一个系统：比特国（BITNATION）。只要接受比特国的宪法，任何人都能成为它的公民。要在比特国内做生意，人们需要通过在该平台上做交易等方式建立起声誉。

| 连锁反应

身份登记也显现了这类账本的另一大用处：作为真相来源。各种各样的信息都可以被附加在区块链的一个条目上。以一辆车为例，这些信息可以包括它的生产厂家、维修历史，甚至它曾被开去哪里。这类数据汇聚在一起就形成了关于某一件交通工具的“真相”。

已经有许多人在经营“真相服务”。研究人员已提议就临床试验描述创造加密标识符，即“哈希”（hashes），并将它们登记在区块链中，这样它们就无法被篡改以符合理想结果。格鲁吉亚、瑞典和乌克兰正在测试用区块链技术来将土地登记部分数字化。美国的特拉华州是全球各地大量企业的注册地——这已成为该州的一大业务，它正在积极准备让区块链来进行企业记录保存。

区块链上的交易也可以为智能合约服务。另一家创业公司Slock.it正在研发一种在以太坊上存有数字版本的实体锁。当有人转入一些以太币时，智能租赁合同就会将锁打开。这将开辟共享事物的新方法。例如，如果有人想要租一辆车，他只要往这辆车的智能合约上转一些钱，就可以把车开走了。

相比区块链的其他功能，智能合约应该会给经济带来更大的改变。它们可以接管大部分日常业务程序。一些企业将仅由一批智能合约构成，成为只存在于区块链空间的虚拟企业。正如所料，首个创立“去中央化的自主机构”的尝试以灾难收场。一年前成立的The DAO公司是某种虚拟风投基金，融资超过1.6亿美元，但被黑客盗走6千万，导致公司灭亡。

不过，自那以后，这类构造更简单的版本——“首次公开售币”（ICOs）开

始流行，创造了区块链经济的首次泡沫。在一个自动化的众筹形式中，创业公司在以太坊上创建智能合约，并发布“白皮书”，即招股书。投资者而后可以向这个智能合约发送以太币，这会自动生成“代币”，它们可以像股票那样交易。至今已有超过5.5亿美元投入这些ICO中。

有些项目是骗局。而不少诚实的项目又让外行看不懂。EcoBit旨在建立一个碳信用额度市场。Aragon想用区块链工具管理整个机构，加之以去中央化的仲裁法庭。SONM是一台“去中心化雾超级计算机”，用户可以用该项目的代币来购买运算能力，也可以把自己的计算设备添加到这个超级计算机网络上赚取代币。

| 中心不稳？

风险资本公司合广投资（Union Square Ventures，简称USV）的艾伯特·温格尔（Albert Wenger）说，这些努力让人一窥未来的可能性。他认为这类去中心化组织某天可能会颠覆科技巨头。这类巨头的本质是庞大的中央集权数据库，他说，它们追踪产品和购物历史（亚马逊）、用户及其朋友圈（Facebook）、网络内容和搜索历史（谷歌）。“它们的价值源于它们控制着整个数据库并能决定谁在何时看到数据库的哪一部分。”他说。

合广投资已经投资了一些去中央化的替代方案，比如电子商务市场OpenBazaar。这个市场的用户并不访问某个网站，而是下载一个程序，这个程序让他们直接联系上其他想要买卖商品和服务的人。其他人已经开始创建基于区块链的社交网络，向提供内容的用户支付报酬。Steemit是一个博客平台，作者们可以在上面赚取代币。Synereo的用户可以给作者打赏。

在一个由区块链运行的世界里，去中央化可以进一步扩大，将实物也包含在内。一旦这些物品拥有了自己的身份，能通过区块链被控制，那就可以想象它们在某种程度上已经自主了。迈克尔·赫恩（Mike Hearn）曾是比特币的开发者，现在为R3区块链联盟工作。他在几年前构思了财务自主的自动驾驶汽车。这些汽车受智能合约的指引，会把自己载人赚来的数字货币囤一些下来，用来支付维修费用，或者在不值得再修的时候给自己来个

更新换代。如果乘车需求不足，它们会长时间停泊，或移居另一个城市。它们可以发行代币来筹资，并让自己的主人获得部分利润。

假如连物品都掌控了自己的命运，那么政府和国家还剩啥事可干？其实还有很多。尽管自由主义者梦想彻底的去中央化，在很多情况下还是需要某个人来确保被“烙上”区块链的信息是真实的。比如，在中国，监管官员就参与了IBM和沃尔玛联合开展的一个试点项目，通过追踪猪肉和有机食物的原产地，让沃尔玛的供货网络变得更加透明。

在某些领域，区块链甚至可能会让政府日子更好过。去年，迪拜宣称希望在2020年前将所有政府文件保存在区块链中，这是让政府机构实现完全无纸作业的先决条件。区块链技术也可被用作一个廉价的平台，生成贫困国家最缺少的东西：更高效的政府和更可信的合约。有些人希望区块链能帮助联合国追踪记录其全部项目议程，提升透明度，减少浪费，从而让联合国的工作变得更富成效。

一个让人意想不到的领域是金钱。虽然区块链的产生就是为了取代央行，各大央行却从一开始就对这项技术很感兴趣。当银行共用一本分类账，而不是把各自的信息保存在独立的数据库里，监管者就能更容易地观察到财务的流动情况。有几家央行正在探讨发行自己的加密货币。加拿大银行和中国人民银行正在开展测试。如果数字货币将取代现金，这将为货币政策提供新的可能性。比如，在一场经济危机中，为提振需求，这类货币可被设定为若在特定时间段里没有花出去就会自行贬值。

| 警告：前方有枷锁

今天的技术水平还远不足以支持这类应用中的大部分。这些分类账可能不像它们看上去那么不可更改，区块链也还需证明它们的规模可以扩张到足够大（比特币系统每秒可管理七宗交易，而一般的信用卡网络要做几千宗）。但如果说数字技术的历史有任何参考价值的话，那么这类障碍终将被克服。

一个更大的问题是体制阻力，这是众多区块链狂热分子在经历了一番艰辛

后才发现的一点。企业部门不愿放弃对其清单的控制，因为这意味着失去权力。在很多情况下，区块链实际上能创造多少价值也说不太清楚。一些中央化系统看起来运行得还不错。就目前而言，传统支付服务似乎要比其去中央化的对手来得更高效。

政治也会是个阻碍。许多区块链技术的倡导者之所以会对这项技术表现出近乎宗教信仰般的狂热，是因为他们认为它用清晰的加密编码取代了混乱的决策。但比特币本身的历史已经显示，即便是简单的技术问题，也可能转变成潜在的赢家和输家之间无休止的战争。经过多年争论，比特币相关人士仍然未能就如何增加这个系统的容量达成一致。

这就引出了最大的一个问题。应该让区块链掌管这个世界吗？警告声开始响起。如果分布式分类账真的颠覆了信用业务，那么许多行政岗位将不复存在，数量甚至可能会超过被人工智能取代的岗位。一些人已经把区块链叫做自由主义阴谋。另一些人对于把人类千辛万苦建立起来的机构组织拆解掉忧心忡忡。“每一次我们使用分布式分类账，我们就参与了把权力从中央权威部门转移到无阶层、P2P结构的过程中。”欧洲议会的研究人员近日这样写道。还有一种担忧是怕生硬而冷冰冰的区块链及协议过于聪明，会让社会变得僵化保守，抑或被用于为非作歹而导致混乱失控。

随着去中央化的清单管理日渐强大，对其担忧的清单也势必越来越长。 ■



If borders were open

The \$78 trillion free lunch

Yes, it would be disruptive. But the potential gains are so vast that objectors could be bribed to let it happen

A HUNDRED-DOLLAR BILL is lying on the ground. An economist walks past it. A friend asks the economist: “Didn’t you see the money there?” The economist replies: “I thought I saw something, but I must have imagined it. If there had been \$100 on the ground, someone would have picked it up.”

If something seems too good to be true, it probably is not actually true. But occasionally it is. Michael Clemens, an economist at the Centre for Global Development, an anti-poverty think-tank in Washington, DC, argues that there are “trillion-dollar bills on the sidewalk”. One seemingly simple policy could make the world twice as rich as it is: open borders.

Workers become far more productive when they move from a poor country to a rich one. Suddenly, they can join a labour market with ample capital, efficient firms and a predictable legal system. Those who used to scrape a living from the soil with a wooden hoe start driving tractors. Those who once made mud bricks by hand start working with cranes and mechanical diggers. Those who cut hair find richer clients who tip better.

“Labour is the world’s most valuable commodity—yet thanks to strict immigration regulation, most of it goes to waste,” argue Bryan Caplan and Vipul Naik in “A radical case for open borders”. Mexican labourers who migrate to the United States can expect to earn 150% more. Unskilled Nigerians make 1,000% more.

“Making Nigerians stay in Nigeria is as economically senseless as making farmers plant in Antarctica,” argue Mr Caplan and Mr Naik. And the non-

economic benefits are hardly trivial, either. A Nigerian in the United States cannot be enslaved by the Islamists of Boko Haram.

The potential gains from open borders dwarf those of, say, completely free trade, let alone foreign aid. Yet the idea is everywhere treated as a fantasy. In most countries fewer than 10% of people favour it. In the era of Brexit and Donald Trump, it is a political non-starter. Nonetheless, it is worth asking what might happen if borders were, indeed, open.

To clarify, “open borders” means that people are free to move to find work. It does not mean “no borders” or “the abolition of the nation-state”. On the contrary, the reason why migration is so attractive is that some countries are well-run and others, abysmally so.

Workers in rich countries earn more than those in poor countries partly because they are better educated but mostly because they live in societies that have, over many years, developed institutions that foster prosperity and peace. It is very hard to transfer Canadian institutions to Cambodia, but quite straightforward for a Cambodian family to fly to Canada. The quickest way to eliminate absolute poverty would be to allow people to leave the places where it persists. Their poverty would thus become more visible to citizens of the rich world—who would see many more Liberians and Bangladeshis waiting tables and stacking shelves—but much less severe.

If borders were open, how many people would up sticks? Gallup, a pollster, estimated in 2013 that 630m people—about 13% of the world’s population—would migrate permanently if they could, and even more would move temporarily. Some 138m would settle in the United States, 42m in Britain and 29m in Saudi Arabia.

Gallup’s numbers could be an overestimate. People do not always do what they say they will. Leaving one’s homeland requires courage and resilience.

Migrants must wave goodbye to familiar people, familiar customs and grandma's cooking. Many people would rather not make that sacrifice, even for the prospect of large material rewards.

Wages are twice as high in Germany as in Greece, and under European Union rules Greeks are free to move to Germany, but only 150,000 have done so since the beginning of the economic crisis in 2010, out of a population of 11m. The weather is awful in Frankfurt, and hardly anyone speaks Greek. Even very large disparities combined with open borders do not necessarily lead to a mass exodus. Since 1986 the citizens of Micronesia have been allowed to live and work without a visa in the United States, where income per person is roughly 20 times higher. Yet two-thirds remain in Micronesia.

Despite these caveats, it is a fair bet that open borders would lead to very large flows of people. The gap between rich and poor countries globally is much wider than the gap between the richest and less-rich countries within Europe, and most poor countries are not Pacific-island paradises. Many are violent as well as poor, or have oppressive governments.

Also, migration is, in the jargon, "path-dependent". It starts with a trickle: the first person to move from country A to country B typically arrives in a place where no one speaks his language or knows the right way to cook noodles. But the second migrant—who may be his brother or cousin—has someone to show him around. As word spreads on the diaspora grapevine that country B is a good place to live, more people set off from country A. When the 1,000th migrant arrives, he finds a whole neighbourhood of his compatriots.

So the Gallup numbers could just as well be too low. Today there are 1.4bn people in rich countries and 6bn in not-so-rich ones. It is hardly far-fetched to imagine that, over a few decades, a billion or more of those people might

emigrate if there were no legal obstacle to doing so. Clearly, this would transform rich countries in unpredictable ways.

Voters in destination states typically do not mind a bit of immigration, but fret that truly open borders would lead to them being “swamped” by foreigners. This, they fear, would make life worse, and perhaps threaten the political system that made their country worth moving to in the first place. Mass migration, they worry, would bring more crime and terrorism, lower wages for locals, an impossible strain on welfare states, horrific overcrowding and traumatic cultural disruption.

| *Open questions*

If lots of people migrated from war-torn Syria, gangster-plagued Guatemala or chaotic Congo, would they bring mayhem with them? It is an understandable fear (and one that anti-immigrant politicians play on), but there is little besides conjecture and anecdotal evidence to support it. Granted, some immigrants commit crimes, or even headline-grabbing acts of terrorism. But in America the foreign-born are only a fifth as likely to be incarcerated as the native-born. In some European countries, such as Sweden, migrants are more likely to get into trouble than locals, but this is mostly because they are more likely to be young and male. A study of migration flows among 145 countries between 1970 and 2000 by researchers at the University of Warwick found that migration was more likely to reduce terrorism than increase it, largely because migration fosters economic growth.

Would large-scale immigration make locals worse off economically? So far, it has not. Immigrants are more likely than the native-born to bring new ideas and start their own businesses, many of which hire locals. Overall, migrants are less likely than the native-born to be a drain on public finances, unless local laws make it impossible for them to work, as is the case for asylum-seekers in Britain. A large influx of foreign workers may

slightly depress the wages of locals with similar skills. But most immigrants have different skills. Foreign doctors and engineers ease skills shortages. Unskilled migrants care for babies or the elderly, thus freeing the native-born to do more lucrative work.

Would open borders cause overcrowding? Perhaps, in popular cities like London. But most Western cities could build much higher than they do, creating more space. And mass migration would make the world as a whole less crowded, since fertility among migrants quickly plunges until it is much closer to the norm of their host country than their country of origin.

Would mass immigration change the culture and politics of rich countries? Undoubtedly. Look at the way America has changed, mostly for the better, as its population soared from 5m mainly white folks in 1800 to 320m many-hued ones today. Still, that does not prove that future waves of immigration will be benign. Newcomers from illiberal lands might bring unwelcome customs, such as political corruption or intolerance for gay people. If enough of them came, they might vote for an Islamist government, or one that raises taxes on the native-born to pamper the newcomers.

| *Eyes on the prize*

There are certainly risks if borders are opened suddenly and without the right policies to help absorb the inflow. But nearly all these risks could be mitigated, and many of the most common objections overcome, with a bit of creative thinking.

If the worry is that immigrants will outvote the locals and impose an uncongenial government on them, one solution would be not to let immigrants vote—for five years, ten years or even a lifetime. This may seem harsh, but it is far kinder than not letting them in. If the worry is that future migrants might not pay their way, why not charge them more for visas, or make them pay extra taxes, or restrict their access to welfare benefits? Such

levies could also be used to regulate the flow of migrants, thus avoiding big, sudden surges.

This sounds horribly discriminatory, and it is. But it is better for the migrants than the status quo, in which they are excluded from rich-world labour markets unless they pay tens of thousands of dollars to people-smugglers—and even then they must work in the shadows and are subject to sudden deportation. Today, millions of migrants work in the Gulf, where they have no political rights at all. Despite this, they keep coming. No one is forcing them to.

“Open borders would make foreigners trillions of dollars richer,” observes Mr Caplan. A thoughtful voter, even if he does not care about the welfare of foreigners, “should not say...‘So what?’ Instead, he should say, ‘Trillions of dollars of wealth are on the table. How can my countrymen get a hefty piece of the action?’ Modern governments routinely use taxes and transfers to redistribute from young to old and rich to poor. Why not use the same policy tools to redistribute from foreign to native?” If a world of free movement would be \$78trn richer, should not liberals be prepared to make big political compromises to bring it about? ■



如果边界开放

78万亿美元免费午餐

是的，这将是颠覆性的。但潜在的收益如此巨大，可以“贿赂”反对者让它成真

地上有一张一百美元的钞票。经济学家走过去，视若无睹。一位朋友问：“你没看到钱吗？”经济学家回答说：“我觉得我是看到了什么东西，但这肯定是我的错觉。如果地上真的有100美元，肯定已经有人把它捡起来了。”

如果有什么东西看起来好到不真实，那很可能它确实不真实。但偶尔也可能是真的。华盛顿特区反贫困智囊团全球发展中心（Centre for Global Development）的经济学家迈克尔·克莱门斯（Michael Clemens）认为，人行道上有“万亿美元的钞票”。一个看似简单的政策可能让世界上的财富翻一番：开放边界。

当工人从贫穷国家迁至富裕国家时，他们的生产力会大幅提高。转瞬间他们就可以加入一个资金充足、公司高效、法律体系可预见的劳动力市场。拿着锄头从土里刨食的人开上了拖拉机。手工制作土坯的人用起了起重机和挖掘机。理发师则找到了支付小费时更慷慨的客户。

“劳动力是世界上最有价值的商品，但由于严格的移民法规，大部分都被浪费掉了。”布莱恩·卡普兰（Bryan Caplan）和维普尔·奈克（Vipul Naik）在《对开放边界的激进辩护》（A radical case for open borders）一文中写道。移民到美国的墨西哥劳工收入可望提高150%。非技术性尼日利亚工人收入则可增加1000%。

卡普兰和奈克说：“从经济上来说，让尼日利亚人留在尼日利亚，就像让农民在南极种地一样没道理。”经济层面之外的好处也不容忽视。身处美国的尼日利亚人不会被博科·哈拉姆的伊斯兰教徒奴役。

开放边界的潜在收益让完全自由贸易都相形见绌，更别说外国援助了。然而，不论在何地，这个想法无不被视为幻想。在大多数国家，只有不到

10%的人赞成。在英国脱欧和特朗普的时代，这在政治上毫无机会。不过，我们值得问一下，如果边界真的开放，可能会发生什么。

先澄清一下，“开放边界”是指人们可以自由迁徙来找工作。它并不意味着“没有边界”或“废除民族国家”。恰恰相反，移民如此有吸引力的原因就是有些国家运转良好，其他国家却一塌糊涂。

富裕国家的工人比贫穷国家的工人收入要高得多，部分原因是受教育程度较高，但主要还是因为他们所处的社会用许多年发展出了一套促进繁荣与和平的体制。把加拿大的体制移植到柬埔寨非常困难，但让一个柬埔寨家庭飞往加拿大却很简单。要消除绝对贫困，最快捷的办法就是让人们离开持续贫困的地方。他们的贫困会更直接地摆在富国公民的面前——后者会看到，端盘子或码货的利比里亚人和孟加拉人多出好多——但其贫困程度会变低很多。

如果边界开放，有多少人会迁居？盖洛普民意调查在2013年的估计是6.3亿人（约占全球人口的13%）在有可能的情况下会永久移民，选择暂时移民的人则更多。愿意在美国定居的约有1.38亿人，愿意定居英国的有4200万，沙特阿拉伯则是2900万。

盖洛普的数字可能高估了。人们并不总是说到做到。离开自己的家园需要勇气和韧性。移民必须告别熟悉的人、熟悉的习俗和奶奶做的菜。哪怕有获得大量物质回报的前景，许多人也不愿意做出这样的牺牲。

德国的工资是希腊的两倍，根据欧盟的规则，希腊人可以自由地搬到德国，但自从2010年希腊债务危机开始以来，1100万希腊人中只有15万人这样做了。法兰克福的天气很糟糕，几乎没有人会说希腊语。即使非常大的经济差距与开放边界相结合也不一定导致大规模的出走。自1986年以来，密克罗尼西亚的公民无需签证即可在美国生活和工作，而美国人均收入要高出该国约20倍。然而，三分之二的人仍留在密克罗尼西亚。

尽管有这些因素，开放边界仍然很可能导致大规模的人员流动。全球贫富差距远大于欧洲内部最富国和不那么富裕的国家之间的差距。大多数穷国

并非太平洋海岛上的乐土，许多国家不但穷，还充斥暴力，或有压迫的政府。

再者，用行话说，移民是“依赖路径的”。它始于涓涓细流：第一个从A国搬到B国的人通常会发现，这个地方没有人说他的语言，也没人知道烹饪面条的正确方法。但第二个移民——可能是他的兄弟或表亲——就有了一个可以带他四处转转的人。随着B国是个好地方的消息在A国移民社区传开来，会有更多的A国人动身移民。当第一千名移民到达时，他找到了一整个同胞社区。

所以盖洛普的数字同样有可能太低了。今天，富裕国家有14亿人，不那么富裕的国家有60亿。在几十年的时间里，如果没有法律上的障碍，这些人中可能有十几亿要移民，这种想象并不离谱。显然，这将会给富裕国家带来不可预测的转变。

目的地国家的选民通常不会在意有少量移民，但担心真正开放的边界会导致自己被外国人“淹没”。他们担心这会让生活变得更糟，也许会威胁到当初让他们的国家值得移民的政治制度。他们担心大量移民会导致更多的犯罪和恐怖主义、本地人工资下降、让福利国家难以承受的负荷、可怕的过度拥挤，以及创伤性的文化破坏。

| 开放问题

如果许多移民来自遭受战争蹂躏的叙利亚、匪帮横行的危地马拉或混乱的刚果，他们会带来骚乱吗？这是一个可以理解的恐惧（也是为反移民政客们所利用的），但除了猜测和传闻之外并没有多少证据支持。有些移民确实犯下罪行，甚至是登上头条的恐怖主义行为。但在美国，外国出生者入狱的可能性只有本国出生者的五分之一。在一些欧洲国家，如瑞典，移民比当地人更容易惹上麻烦，但这主要是因为他们更有可能是年轻男性。华威大学（University of Warwick）的研究人员对1970年至2000年间145个国家的移民流动情况进行了研究，发现迁徙更有可能减少而非增加恐怖主义，主要是因为它促进了经济增长。

大规模移民会使本地人在经济上变得更糟吗？到目前为止，还没有。比起本地人，移民更有可能带来新的想法，开创自己的企业，其中很多企业会雇用本地人。总的来说，移民比本地人成为公共财政负担的可能性更小，除非当地的法律使他们无法工作，就像在英国寻求庇护的人那样。大量涌入的外国工人可能会稍微降低具有类似技能的本地人的工资水平。但大多数移民都有不同的技能。外国医生和工程师可缓解技能短缺。非技术性移民可照顾婴儿或老人，从而让本地人腾出手去做利润更高的工作。

开放边界会导致过度拥挤吗？在伦敦等人口众多的城市也许会。但是，大多数西方城市都可以把建筑建得比现在高得多，创造出更多的空间。大规模移民将使整个世界整体上不那么拥挤，因为移民的生育率很快就会下降，直到接近其东道国而非原籍国的普遍水平。

大规模移民是否会改变富裕国家的文化和政治？这一点毫无疑问。看看美国发生的变化，从1800年主要由白人构成的500万人，到如今包含各种肤色人口的3.2亿人，主要都是朝着好的方向变化。不过，这并不能证明未来的移民潮也会是良性的。来自非自由地区的新移民可能会带来不受欢迎的习俗，如政治腐败或不宽容同性恋者。如果这样的移民足够多，他们可能会投票选举出一个伊斯兰政府，或者一个向本土出生的人征税以娇惯新来者的政府。

| 盯住好处

如果边界突然打开而没有正确的政策来帮助吸收流入的人口，肯定会有风险。但只要有一点创造性思维，就几乎可以减轻所有这些风险，并克服许多最常见的反对意见。

如果担心移民会在投票上击败本地人，从而把一个对其不友好的政府强加给他们，一个解决办法就是不让移民投票——五年、十年甚至终身。这可能看起来很苛刻，但这比不让他们来要友善多了。如果担心未来的移民不能自食其力，为什么不向他们收取更多的签证费、缴纳额外的税款或是限制他们获得福利？这样的税负也可以用来调节移民的流动，从而避免突然大规模的涌入。

这听起来是严重的歧视，确实如此。但对于移民而言，这也强过现状——被排除在富裕世界的劳动力市场之外，除非向蛇头支付数万美元；即便到了目的国也必须工作在阴影地带，并随时可能被驱逐出境。今天，数百万移民在海湾地区工作却根本没有政治权利。尽管如此，来的人还是越来越多。并没有人强迫他们。

卡普兰认为：“开放边界将使外国人的财富比现在多几十万亿美元。”一个思维缜密的选民，即使他不在乎外国人的福利，“也不应该说……‘那又怎么样？’而是应该说，‘眼下讨论的可是几十万亿美元的财富。我的同胞怎么才能从中分得一大杯羹呢？’现代政府惯常使用税收和转移支付来重新分配财富，由年轻人分给老人，由富人分给穷人。为什么不使用相同的政策工具，从外国人手中再分配给本地人呢？”如果一个人口自由迁徙的世界能增加78万亿美元的财富，自由主义者难道不应该做出大的政治妥协来实现它吗？ ■



Testing basic incomes in Finland

Northern pilot

An experiment offers some early lessons

JUHA JARVINEN, an unemployed young father in a village near Jurva, in western Finland, brims with ideas for earning a living. He has just agreed to paint the roofs of two neighbours' houses. His old business, making decorative window frames, went bust a few years ago. Having paid off debts, he recently registered another, to produce videos for clients.

Mr Jarvinen says that for six years he hoped to start a new business but it was impossible. The family got by on his wife's wages as a nurse, plus unemployment and child benefits. He had a few job offers from local businesses, which are mainly in forestry, furniture and metalwork. But anything less than a permanent, well-paid post made no sense, since it would jeopardise his welfare payments. To re-enroll for benefits later would be painfully slow.

Mr Jarvinen's luck turned in January, when he was picked at random from Finland's unemployed (10% of the workforce) to take part in a two-year pilot study to see how getting a basic income, rather than jobless benefits, might affect incentives in the labour market. He gets €560 (\$624) a month unconditionally, so he can add to his earnings without losing any of it.

If Mr Jarvinen is making progress, it is too soon to draw overall conclusions. Kela, Finland's national welfare body, which runs the pilot, will not contact participants directly before 2019, lest that influences outcomes. Instead it monitors remotely, using national registers of family incomes, taxes paid and more. (Anonymised data will be made available to researchers.)

Some lessons are emerging. Olli Kangas, who helped to design the study and now runs it for Kela, says the process is far harder to implement than expected: “a nightmare”. He decries politicians who blow hot and cold, yet insist the study must be wrapped up before an election in 2019. He calls them “small boys with toy cars, who become bored and move on”. Finnish politics is intricate: the Centre party, Greens and a far-left party back the study. So does a libertarian wing of the conservatives, hoping to pare the welfare state. Sceptics include traditional conservatives, many Social Democrats and big unions.

Such unions, with (mostly male) members in permanent jobs in heavy industry, manage unemployment funds and do not want to lose control, so they dislike the idea of a basic income, says Mr Kangas. In contrast the idea appeals to those who represent part-time service staff, such as (mostly female) cleaners or retail workers. He says surveys show the wider public wavering: 70% like the idea of the grant in theory, but that drops to 35% when respondents are told that income taxes—already high—would have to rise to pay for it.

The study’s design faced constraints. The constitution ordains equality for all, so getting permission to afford some welfare recipients special treatment was difficult. That limitation, and a budget of only €20m (plus diverted welfare funds that would have otherwise gone to the recipients), restricted the sample size to just 2,000 people. Mr Kangas frets that might prove too small to be statistically robust. And it limits the questions the study can investigate.

He would like to try similar grants on those with low-income jobs, to see if such recipients choose to work less, for example. It would also have been instructive—if expensive and politically difficult—to give grants to residents of entire towns to see how local economies are affected. The timescale is another limitation. Kate McFarland, of the Basic Income Earth

Network, which has promoted the idea of basic incomes since the 1980s, says a two-year study is too short to learn how the psychology of beneficiaries changes.

Whatever its flaws, the pilot is a good example of the Finnish penchant for social experiments. Participants will be followed for ten years to identify long-term effects. International interest in the pilot programme has been intense. In June television crews from South Korea and Sweden have been queuing up to see Mr Kangas; he regularly lectures abroad and advises others on similar studies. Just getting started counts as a success, he says. “This is trial and error, and the door is now open for better experiments.” ■



芬兰试行“基本收入”

北方试点

一场实验已经带来了一些发现

在芬兰西部尤瓦市（Jurva）附近的一个村庄里，失业的年轻父亲尤哈·查维伦（Juha Jarvinen）满脑子都是怎么赚钱谋生。他刚答应给两户邻居粉刷屋顶。之前他开过一家做装饰窗框的公司，几年前破产了。还清债务后，最近他注册了另一家公司，为客户制作视频。

查维伦说，六年了，他一直想开一家新公司，但没办法做到。一家人仅靠妻子做护士的工资加上失业救济和育儿补贴度日。也曾有本地企业给他工作机会，主要是林业、家具及金属制品行业的公司。但如果不是长期的高薪职位，他根本没必要做，因为那样就拿不到救济金了。而重新申请救济金又要等上很久。

今年1月，查维伦转运了。他从芬兰的失业人群（占劳动人口的10%）中被随机选中，参加一个为期两年的试点研究。这项研究探讨以“基本收入”代替失业救济金会如何影响找工作的动力。查维伦每月可无条件领取560欧元（624美元），他尽可以去赚取其他收入而不会影响拿这笔钱。

查维伦的新生活还在推进中，现在要下总体的结论还为时尚早。执行该试点研究的芬兰国家福利机构芬兰社会保障局（Kela）在2019年之前不会直接联系参与者，以免影响研究结果。但它会用家庭收入、缴税等全国登记数据进行远程监控。（研究人员将获得经匿名处理的数据。）

有一些经验已经浮现出来。帮助芬兰社保局设计并执行该研究的奥利·康格斯（Olli Kangas）表示，实施的过程远比预想的难，可以说是“一场噩梦”。他批评政客们态度忽冷忽热却又坚持要求在2019年大选前结束这个项目。他形容他们是“小男孩玩玩具车，腻了就换别的”。芬兰的政治局面复杂：中间党、绿党及一个极左党派支持该研究。保守党中的自由派也表示支持，希望削减国家的福利支出。持怀疑态度的包括传统保守派、众多

社会民主党人士及大型工会。

大型工会（成员主要为男性，在重工业企业有稳定的工作）负责管理失业基金，不想失去控制权，所以不喜欢“基本收入”这种新形式，康格斯说。相反，代表兼职服务业劳工（比如多为女性的清洁工或零售人员）的工会则欢迎这一做法。他说，调查显示广大民众摇摆不定：70%的受访者理论上支持派发这一补助，但当得知政府必须提高业已高昂的所得税来支付这一补助时，赞成者的比例下降至35%。

该研究的设计受到一些制约。芬兰宪法规定人人平等，所以向部分接受救济者提供特殊待遇难以获得许可，再加上只有2000万欧元的预算（以及原本会作为失业救济派发给参与者的那笔钱），令研究的样本规模受限，只有2000人。康格斯担心样本太小，会导致统计不够有代表性。而且研究可调查的问题也因此受限。

例如，他还希望能向从事低收入工作的人提供类似的补助，看看这类受助人是否会减少工作量。另外，如果能向整个城镇的居民提供补助，以此了解它对地方经济的影响，也会具有指导意义，不过这成本高昂，还有政治阻力。时间跨度是另一个限制。基本收入地球网络（Basic Income Earth Network）自上世纪80年代起便开始提倡基本收入这一概念，该组织的凯特·麦克法兰（Kate McFarland）表示，两年的研究时间太短，难以了解受益者的心理变化。

无论有何缺陷，该试点项目是芬兰人热衷社会实验的好例子。参与者将被持续追踪十年，以观察长期影响。国际上对这个试点项目兴趣浓厚。6月，来自韩国和瑞典的电视摄制组排队访问康格斯；他定期到国外作报告，给类似的研究提供建议。能启动就是成功，他说。“这是一个试错的过程，我们已经打开了大门，准备迎接更好的实验。”■



World's biggest banks

ICBC was the world's biggest bank for the fifth year running

At the end of 2016, and for the fifth year running, Industrial and Commercial Bank of China (ICBC) was the world's biggest bank as measured by tier-1 capital (mostly retained earnings and common stock), according to the *Banker*. Chinese and American banks again dominate the top ten: in the only change from last year's ranking, Bank of America reclaimed the fifth place it lost to Agricultural Bank of China in 2015. China's banking market remains the world's biggest by assets and tier-1 capital; last year it further strengthened its lead over America. Growth in both countries, however, was driven by second-tier banks; China's big-four lenders may be reaching their size limit. ■



世界上最大的银行

中国工商银行连续第五年成为世界上最大的银行

根据英国《银行家》（The Banker）杂志的数据，2016年底，按一级资本（主要是留存收益和普通股）计算，中国工商银行连续第五年成为世界上最大的银行。中国和美国的银行再次称霸前十。与去年公布的排名相比，唯一的变化是美国银行（Bank of America）夺回了它在2015年输给中国农业银行的第五位的位置。按资产和一级资本计算，中国金融市场的规模仍然称冠全球——去年中国对美国的领先优势进一步扩大。然而，这两个国家的增长都由二线银行驱动；中国四大国有银行的规模也许正在逼近上限。■



Online hot-food delivery

We can be heroes

Food-ordering firms such as Delivery Hero are thriving

NIKLAS OSTBERG spent much of his youth as a competitive cross-country skier in Sweden. Then he ditched his skis for a less healthy cause. A decade ago he founded a firm that matched online pizza orders to restaurants. It grew into Delivery Hero, a Berlin-based service that last year dispatched nearly 200m takeaway dinners to customers around the world. It is in over 40 countries and claims to be the local leader in 35, including Germany.

The recipe has delivered in financial terms. The company's initial public offering (IPO) on June 30th proved popular with investors and its share price has climbed since. Delivery Hero is now valued above \$5bn, a handy premium over a valuation of \$3.1bn in May, when Naspers, a South African online giant, invested in it.

It is not alone; shares in similar businesses have performed well after going public in recent years. Shares in Just Eat, a British company with a market value of £4.5bn (\$5.8bn), have more than doubled since its IPO in 2014. The value of Grubhub, a food-delivery company based in Chicago, has risen by a third in the same period to around \$4bn. The market capitalisation of Takeaway.com, a Dutch firm, is up by a third since it listed in September; it is now worth €1.6bn (\$1.8bn).

What matters in food-ordering is gaining dominance in what analysts and Mr Ostberg agree are "winner takes most" individual markets. In any given country, consumers are unlikely to have more than one food-ordering app on their phones. For second- or third-placed competitors a reverse "network effect" occurs, says Mr Ostberg, in which they must constantly struggle to avoid losing restaurants and customers and margins tend to fall.

Firms that dominate can enjoy profit margins of up to 20% per order, although Delivery Hero's are only half that level.

Those margins are drawing online giants, Amazon and Uber, into the business. Their bulk and expertise in digital platforms and deliveries threaten the independent operators. Mr Ostberg puts a brave face on it and notes that the potential market for hot food globally could be worth \$72bn, which leaves room for various firms to flourish in different parts of the world. He vows to take much of the capital raised from the firm's IPO to invest in new technology.

Prospects for Delivery Hero depend on how smart Mr Ostberg's team proves to be in this regard. The firm, which is part-owned by Rocket Internet, a Berlin-based company-incubator, is not a pure tech startup. It expanded partly through acquisitions and a merger late in 2016 with a rival, Food Panda (also controlled by Rocket). It organises deliveries through its digital platform, but managing fleets of cycle couriers is a complex business to scale up. Its wide exposure to emerging markets, from Saudi Arabia to Hong Kong, although offering growth, also brings lots of potential headaches because of local regulations and cultural quirks.

Mr Ostberg talks up the focus on tech, citing the firm's experimental deliveries by drones and robots, plus its efforts on data-gathering and analysis to anticipate customer desires or resolve problems with logistics. But the firm is not as advanced as, for example, Zalando, an online fashion firm that grew out of Rocket Internet and floated in 2014. Florian Heinemann, who founded Project-A, a venture-capital firm, in Berlin and spent years at Rocket, praises Zalando's team of 2,000 tech engineers for their skill in using data from customers. He does not see the equivalent, yet, at Delivery Hero.

The IPO should nonetheless boost Berlin's profile as a startup hub, making

it easier for other entrepreneurs to raise more capital in turn. It should also help Rocket Internet, shares in which have fallen in recent years as other firms it backed have failed to take off. “Opting for an IPO is a very hard route and there are very few positive examples in Germany,” says Ulrich Schmitz of Axel Springer, who oversees the media firm’s incubator of tech startups in the city. Later-stage funding can be especially hard for firms to raise, so anything that encourages investors to see clear exit routes is helpful, he says.

Mr Ostberg agrees, saying he dreams that his firm can grow to become a “category leader” and “inspire others” in the European tech scene. That is still an uphill task—but cross-country skiers, at least, are good at those. ■



互联网外卖

我们都能成为超人

外卖超人一类的订餐公司方兴未艾

尼可拉斯·奥斯特伯格（Niklas Ostberg）曾是瑞典的一名竞技越野滑雪运动员，在滑雪场度过了大部分青年时光。之后他扔下滑雪板，去做了件和体育关系不大的事。十年前，他创办了一家公司，接收网上披萨订单，然后派给餐厅，这就是现在总部位于柏林的外卖超人（Delivery Hero）的前身。去年，该公司向全世界顾客送出了近两亿份外卖。如今外卖超人遍布40多个国家，并声称在德国等35个国家都是行业领头羊。

外卖超人在财务上取得了成功。公司6月30日的首次公开募股（IPO）大受投资者欢迎，此后股价一路上扬。5月，南非互联网巨头Naspers向该公司投资时，其估值为31亿美元，眼下估值则超过50亿美元，轻松实现溢价。

外卖超人的成功不是个例。近年来同类企业上市后股价都表现良好。市值45亿英镑（58亿美元）的英国公司Just Eat自2014年的IPO后股价翻了一番还多；同一时期，总部位于芝加哥的外卖公司Grubhub市值增加了三分之一，约达40亿美元；荷兰公司Takeaway.com自去年9月上市以来市值增加了三分之一，目前为16亿欧元（18亿美元）。

订餐业务发展的关键是赢得各国市场的主导权，分析师和奥斯特伯格一致认为这些市场是“赢者多得”。无论哪个国家的消费者都不大可能在手机上安装一个以上的订餐应用。奥斯特伯格说，对于那些位处第二、第三名的竞争者来说，“网络效应”对它们呈现出反向作用，它们必须不断奋力避免餐馆和顾客的流失，其利润也趋于下滑。占据主导地位的公司每单可以获得最高达20%的利润，不过外卖超人目前只有这一半的水平。

可观的利润正吸引亚马逊和优步这两大互联网巨头涉足该行业。它们的巨大体量和在数字化平台及配送方面的专业能力对一些独立经营者构成了威胁。对此，奥斯特伯格有点故作沉着。他指出，全球餐饮配送的潜在市场

价值可达720亿美元，这让各种类型的公司在世界不同地区都有大展拳脚的机会。他承诺要从公司的IPO融资中拿出大部分投资新技术。

外卖超人的前景将取决于奥斯特伯格团队在运用新技术方面的才智。外卖超人的部分所有权属于总部位于柏林的企业孵化器Rocket Internet，它本身并不是一家纯技术创业公司。它进行了多项收购，并在2016年底兼并了（同样也由Rocket Internet控股的）竞争对手Food Panda，从而完成了部分扩张。公司通过自身的数字化平台组织配送，但管理送餐的单车大军相当复杂，要扩大规模并非易事。从沙特阿拉伯到香港，公司大举进军新兴市场，虽然拉动了增长，但同时也因地方监管和文化习性而面临不少潜在的麻烦。

奥斯特伯格大谈外卖超人对科技的重视，称公司在测试用无人机和机器人送餐，还在大数据收集和分析上下功夫，以预测顾客的需求，解决物流方面的问题。但是外卖超人不比Zalando公司先进。这家时尚电商由Rocket Internet孵化，并于2014年上市。柏林风险投资公司Project A的创始人弗洛里安·海涅曼（Florian Heinemann）曾在Rocket Internet供职数年，他对Zalando公司2000人的技术工程师团队在运用顾客数据方面的技能赞赏有加，但他尚未在外卖超人那里看到这样的能力。

尽管如此，这次IPO应该能提升柏林作为创业中心的形象，进而令其他创业者更容易募集到更多资金。它应该也会有利于Rocket Internet——近年来Rocket Internet的股价也在下跌，因为它投资的其他一些公司未能一飞冲天。“选择IPO是一条非常艰辛的道路，在德国，成事者寥寥无几。”在柏林媒体公司Axel Springer负责科技创业公司孵化业务的乌利希·施密茨（Ulrich Schmitz）说道。对于公司来说后期融资尤为困难，因此他认为，只要是有助于投资者看到清晰的退出机制的事，都是有益之举。

奥斯特伯格认同这一点，称他梦想着自己的公司能够成为欧洲科技界的“行业领导者”并且“激励他人”。这仍是一项艰难的任务，但至少对越野滑雪运动员来说，迎难而上是他们的强项。■



Schumpeter

Time for Plan C

Fresh from visiting the Oval Office, an American CEO sends an e-mail to his top lieutenants

TO OUR management team: When I left the White House yesterday, after another two-hour round-table with the president, I knew in my gut that it was time to put in place “plan C” for this great company. The boxer, Mike Tyson, had a point when he said “everyone has a plan until they get punched in the mouth.” But so did Winston Churchill when he observed that “plans are of little importance, but planning is essential.” We owe it to our investors, customers and 131,000 employees globally, to have a reset.

A year ago we were pursuing plan A. We expected that Hillary Clinton would win the election and that American business would continue as it has since the subprime crisis, meaning slow growth and lots of red tape but open borders and record profits that we could return to shareholders as dividends and buy-backs. Together, our firm and fellow members of the S&P 500 index have been paying out \$1trn a year, far more than we invest.

After November 8th, we switched to plan B. For a few months it seemed a Republican-run Congress and White House might deliver sweeping deregulation and tax reforms to set the economy free, just as in the Reagan era. We dusted off plans to raise investment by a fifth and boost hiring at home. Like most firms we loaded the gun but didn’t pull the trigger. That was a hell of a great call.

It is now clear that dysfunction at the White House and in Congress means plan B is off the table. The markets agree. Sure, equity prices are still up. But after the election, bond yields soared in anticipation of an economic boom, only to give up half of their gains. The “Trump Bump” has faded. Yet life

won't return to normal. Our firm faces many risks. We have to fight back.

That calls for plan C, which has three elements: winning, tackling and the future. I like to use the acronym "WTF". For a start we have to win profits from our proximity to power. I sit on the president's CEO advisory board and he has me on speed dial to talk about trade deals and his regulatory appointments. We toasted with Diet Coke on Air Force One after we visited Saudi Arabia in May. Our firm secured a contract worth \$6bn for a desalination plant in Jeddah and a licence to operate a bank in the kingdom. These two wins will lift our profits by 14% a year by 2020.

A bonfire of obsolete laws by Congress is unlikely. But as one of my friends in the White House texted me yesterday, "people are policy". We can still win in other ways. Business-friendly folk are newly in charge of the regulatory bodies for telecoms, the environment and the stockmarket. Candidate Trump grumbled about monopolies such as AT&T and Amazon, but now he is in office he has lost interest. I like it when that happens.

But plan C also requires us to recognise new dangers coming at us hard and fast. They need to be tackled—stopped and brought down. One of the Wall Street bankers I know likes to say that the president has three personalities: chairman, showman and con man. It is the last two we need to worry about.

Our PR team is ready to tackle any 4am presidential Twitter tirade about betraying American workers. We will avoid responding directly on Twitter, but will rebut him on Facebook and in e-mails to staff and the media. Our executives must have patriotic sound-bites on the tips of their tongues: for example, 52% of our staff are in America and we invest \$5bn each year here. Repeat it.

We must also confront the risk of getting entangled in the investigations

surrounding the White House. Today I am imposing a ban on any commercial interaction between our firm and the president's business or the entrepreneurial folks in his entourage. This includes lending cash to the Trump Organisation, which has at least five loans and bonds maturing in the next four years.

We must be ready to tackle any consequences of a trade war breaking out with China or Germany, or a collapse of NAFTA, with contingency plans for our global supply chains. We have secured facilities in Pennsylvania (a swing state for the president so he would like this), where some Mexican production can be moved. Any spare capacity would go to growing Asian economies. The one-off cost would be \$500m—high but manageable.

Having POTUS-proofed our company, that leaves the last letter of the WTF acronym: the future of our business in America. Corporate taxes may fall, but not by much. The president is targeting a rate of 15% but most of us on the CEO advisory council think 28% is as low as it will go, based on the fiscal outlook and the president's weakness in Congress. Since our firm, like the aggregate of the S&P 500, pays a cash tax rate of 23%, this won't make a difference.

We expect the taxation of foreign profits to be simplified under the administration, so we can repatriate the \$51bn we parked abroad without paying a large levy (by the way we are not alone—the total for S&P 500 firms is over \$1trn). But with a slow economy, politics unpredictable and digital predators such as Amazon breathing down our necks in some product areas, I have zero appetite to spend it on new American factories. We'll use it for more buy-backs, new software or foreign expansion.

| *West-winging it*

I'll be frank. Plan C envisions three and a half years of America going nowhere. The odds of recession are one in three. If the economy stalls, it

will be hard for President Trump to be re-elected. Which brings me to my final point. America has broken a taboo by electing a business figure to the White House. By 2020, perhaps voters will be hungry for a “competence candidate”. Someone who really has run a big empire. Someone like me.

Mark Zuckerberg and Howard Schultz from Starbucks are already touring the country, running exploratory campaigns. Jamie Dimon at JPMorgan Chase tells me he won't run, but I don't believe him. None of them can match my leadership record. By 2020 one of you deserves a chance to run this great company and I will seek the chance to serve America, the greatest turnaround opportunity on Earth. Keep it to yourselves for now—but the C in our new plan stands for candidate. ■



熊彼特

该实行C计划了

刚访问了椭圆办公室，一位美国CEO就给他的高级助手们发去了电子邮件

致我们的管理团队：昨天，我又一次参加了与总统的两小时圆桌会谈。离开白宫的时候，直觉告诉我，该为我们这个伟大的公司实行“C计划”了。拳王泰森说的对，“在被人狠狠修理一顿之前，每个人都是有自己的计划的”。但丘吉尔也说过，“计划本身无关紧要，制定计划却必不可少”，这也有道理。我们应该给我们的投资人、客户和全球13.1万名雇员一个从头开始的机会。

一年前我们在努力实现A计划。我们料想希拉里会赢得大选，美国商业将继续次贷危机之后的局面——增长缓慢、监管重重，但边界开放、利润创纪录，我们也可将利润以股息和回购的形式回报给股东。我们公司和标准普尔500指数的其他公司一年总共付出了一万亿美元，远超我们的投资。

11月8号以后，我们转向B计划。有那么几个月，共和党掌控下的国会和白宫看似会全面放松管制、实行税收改革，以实现经济自由，就像里根时期那样。我们又搬出了老一套，准备把投资提升五分之一，并且在国内增聘人手。像大部分公司一样，我们给枪上了膛，却并没有扣下扳机。这可真是个伟大的决定。

现在清楚了，白宫和国会运转不良意味着B计划已经没戏了。市场也赞同这一点。没错，股价仍在上涨。选举之后，出于对经济繁荣的预期，债券收益率飙升，结果又跌去了一半的增幅。“特朗普冲击”已声势渐消。然而生活却不会恢复正常。我们公司面临很多风险。我们必须反击。

这就要求有C计划，其中包含三个要素：赢取，应对和未来。我想用这三个词的首字母来指代这一计划：“WTF”（winning, tackling and the future）。首先，我们必须通过接近权力来赢取利润。我是总统的CEO顾问委员会成员，在讨论贸易协议和他的监管任命时，他会首先找到我。5

月访问沙特阿拉伯之后，我们在空军一号上以健怡可乐举杯相祝。我们公司签下了价值60亿美元的合同，得以在吉达（Jeddah）建设一个海水淡化厂，还获得了在沙特王国经营银行的许可。有了这两项胜利，2020年之前我们的利润将每年提升14%。

要国会一把火烧掉过时的旧法规是不可能的。但就像我一位白宫的朋友昨天发给我的短信所说，“人就是政策”。我们还可通过其他方式赢取利益。对商业友好的人士最近掌管了电信、环境和股市的监管机构。特朗普还是候选人时，曾对AT&T和亚马逊这样的垄断企业颇有微词，但如今既已就任，便对此失去了兴趣。我喜欢这样的局面。

但是C计划也要求我们识别出将迅猛来袭的新危险。它们必须被解决——拦下来、平息掉。我认识的一位华尔街银行家总喜欢说总统特朗普有三重人格：董事长、演员和骗子。我们要担心的是后两个。

我们的公关团队已经做好准备，随时应付总统的推文，哪怕他在凌晨4点喋喋不休地声讨美国工人遭到的背叛。我们会避免直接在推特上回应，但会在Facebook和给员工及媒体的电子邮件中反驳他。我们的高管必须把爱国宣言挂在嘴边，比如说我们52%的员工在美国，我们每年在这里投资50亿美元。不断重复。

我们也必须正视一项风险：被卷入围绕白宫开展的调查。今天，我在此下达禁令，严禁我们公司与总统的生意或是他随员中的任何企业人士有商业往来，包括不能借钱给特朗普集团（Trump Organisation）。该集团在未来四年内至少有五笔贷款和债券到期。

我们必须为我们的全球供应链制定应急计划，以应对美国与中国或德国爆发贸易战或《北美自由贸易协定》（NAFTA）崩溃的后果。我们已经在宾夕法尼亚州建厂（这个州在大选时是个摇摆州，所以总统会喜欢这一举动），墨西哥的部分生产可以搬去那里。任何剩余的产能都将流向亚洲的发展中经济体。一次性成本将有5亿美元，虽高昂但尚可应付。

解决了让公司免受美国总统影响这个问题，就剩下WTF的最后一个字母：

我们的业务在美国的未来。公司税可能会下降，但不会降太多。总统的目标税率是15%，但考虑到财政前景和总统在国会的弱势，我们CEO顾问委员会的大多数人都认为，税率最低也就能降到28%。我们公司和标准普尔500中的所有公司一样，支付23%的现金税，所以没有什么差别。

我们期望这届政府能够简化对海外盈利的税收，这样我们便可将囤放在国外的510亿美元汇回国内，而不用支付高额税金——顺便说一句，我们不是独此一家，标普500指数公司总共有一万多亿美元放在国外。不过，由于经济增长缓慢，政治局面不可预测，亚马逊这样的数字掠夺者在某些产品领域又紧盯着我们，我对用这笔钱在美国建设新厂毫无兴趣。我们会用这些钱来增加回购、购买新软件或在国外扩张。

| 西翼包抄，拿下白宫

坦白说，C计划预计美国三年半内会毫无建树。发生经济衰退的可能性为三分之一。如果经济停滞不前，特朗普总统将难以获得连任。这就到了我要说的最后一点。美国选择了一位商界人物执掌白宫，打破了禁忌。到2020年，也许选民会渴望出现一位“有能力的候选人”、真正掌控过一个大帝国的人。就像我这样的。

马克·扎克伯格和星巴克的霍华德·舒尔茨（Howard Schultz）已经在全国各地巡访，进行选举考察。摩根大通的杰米·戴蒙（Jamie Dimon）跟我说他不会参加竞选，但我不信。论担任领袖的履历，他们谁也没法跟我比。到2020年，你们中的某个人应该得到机会来经营这个伟大的公司，而我将寻求服务美国的机会，这也是令我们这个世界获得最大转变的机会。先不要声张——其实我们C计划中的“C”指的就是候选人（candidate）。■



Shipbuilding in China

Cruising for a bruising

China may waste money trying to build its own cruise ships

AT FIRST glance the balcony-lined silhouette of the *Norwegian Joy*, a new cruise ship, looks like any other Western liner moored in Shanghai. But a 333-metre-long Chinese artwork of a phoenix on its topsides signals its distinctive status as the first ship designed especially for China's expanding cruise market. A pop star, Wang Leehom, christened it on June 27th.

Norwegian Joy was built by Meyer Werft in Germany, in response to a booming Chinese market for cruises. Over the past year the number of Chinese holidaying at sea has more than doubled, to 2.1m, according to the Cruise Lines International Association, a trade group. These numbers are likely to encourage other lines to build ships just for China, instead of using cast-offs from America and Europe. The *Norwegian Joy* has a much bigger casino than usual, to cater for the Chinese love of gambling. The shops are also twice as large as on Norwegian Cruise Line's other ships, notes Andy Stuart, its CEO.

But China itself wants a slice of the cruise-ship market, which is dominated by European firms. China State Shipbuilding Corporation, a firm that usually builds bulk carriers, tankers and the like, in February entered a joint venture with Fincantieri, an Italian rival, to construct two cruise vessels for the Chinese operations of Carnival, America's largest cruise line. In March SunStone Ships, a smaller Miami-based cruise outfit, ordered four more from China Merchants Heavy Industry, another state-owned yard near Shanghai.

It is a case of when, not if, Chinese yards break into the industry, admits Bernard Meyer, managing partner of Meyer Werft. China's government

declared in a five-year plan in 2015 that it aimed to build its own cruise ships as part of its strategy of shifting the economy towards advanced manufacturing.

It will not be easy for Chinese yards to build such ships, however. Europe's dominance came from developing clusters of niche suppliers, notes Martin Stopford of Clarksons, a shipbroker; these will be hard to replicate. When Mitsubishi Heavy Industries, a Japanese conglomerate, recently tried to enter the industry with an order worth \$1.3bn from a German line for two cruise ships, it lost \$2.3bn. Last October, to stop its share price plunging further, it had to promise it would never try to build another.

Nor is it clear whether mastering cruise-ship construction will really help China with other industries. Cruise ships may look like hotels at sea, but the materials and even the plumbing that are required to meet maritime regulations are very different to anything of use on land. Even so, the state is ready to hand Chinese shipbuilders the billions of dollars required. The real beneficiaries may well be Western cruise lines, who can play the newcomers off against incumbent European suppliers. ■



中国造船业 自讨苦吃

中国试图打造自己的邮轮。也许是白费钱

一排排阳台构成了新邮轮诺唯真喜悦号的侧影。乍看起来，它与任何一艘停泊在上海的西方邮轮都没什么两样。但它那333米长的中国风船体画——一只凤凰——显示了它的独特地位：这是第一艘专门为扩张中的中国邮轮市场设计的船只。6月27日，担任喜悦号“邮轮教父”的流行歌手王力宏为该船的首航祈福。

诺唯真喜悦号由德国的迈尔船厂（Meyer Werft）建造，为的是顺应中国蓬勃发展的邮轮市场。行业组织国际邮轮协会（Cruise Lines International Association）的数据表明，过去一年里，在海上度假的中国游客数量翻了一番还多，达到210万。这些数字可能会鼓励其他航运公司建造专供中国使用的船只，而不是使用美国和欧洲的淘汰品。诺唯真喜悦号的赌场比一般邮轮的要大得多，以迎合中国人对赌博的喜好。诺唯真游轮（Norwegian Cruise Line）的CEO安迪·斯图尔特（Andy Stuart）指出，喜悦号里的商店面积也是该公司其他船只的两倍。

不过中国自己也想从欧洲企业主导的邮轮市场分得一杯羹。中国船舶工业集团公司建造的通常都是散货船、运油船之类，但今年2月，它与竞争对手意大利芬坎蒂尼船厂（Fincantieri）组建了合资企业，为美国最大的邮轮公司嘉年华（Carnival）的中国业务建造两艘邮轮。3月，迈阿密一家较小的邮轮公司SunStone Ships从另一家上海附近的国有船厂招商局重工订购了四艘邮轮。

迈尔船厂的管理合伙人伯纳德·迈尔（Bernard Meyer）承认，现在的问题不是中国的船厂是否会打入这个行业，而是什么时候的问题。中国政府在2015年宣布了新的五年规划，提出要建造自己的邮轮，作为经济向先进制造业转型战略的一部分。

然而，中国船厂要建造邮轮并不容易。船运经纪公司克拉克森（Clarksons）的马丁·斯托普福德（Martin Stopford）指出，欧洲的主导地位缘于它发展出了利基供应商集群，这很难复制。日本企业集团三菱重工近年从一家德国公司接到了一份价值13亿美元、建造两艘邮轮的订单。它希望能借此进入这个行业，结果却亏损了23亿美元。去年10月，为了阻止股价进一步下跌，三菱重工不得不保证再也不会尝试建造邮轮。

掌握邮轮制造技术能否真正帮助中国的其他行业，这一点也不好说。邮轮可能看起来像海上宾馆，但它的材料甚至水暖设备都要求符合海事法规，与陆地上使用的所有东西都大不相同。即便如此，中国政府还是准备为中国造船企业提供所需的数十亿美元资金。真正的受益者很可能是西方的邮轮公司，它们可以让新进企业与欧洲现有的供应商互相抗衡。 ■



Fake news

Creation stories

It is becoming easier to create convincing audio and video of things that have never happened

EARLIER this year Françoise Hardy, a French musician, appeared in a YouTube video. She is asked, by a presenter off-screen, why President Donald Trump sent his press secretary, Sean Spicer, to lie about the size of the inauguration crowd. First, Ms Hardy argues. Then she says Mr Spicer “gave alternative facts to that”. It’s all a little odd, not least because Françoise Hardy (pictured), who is now 73, looks only 20, and the voice coming out of her mouth belongs to Kellyanne Conway, an adviser to Mr Trump.

The video, called “Alternative Face v1.1”, is the work of Mario Klingemann, a German artist. It plays audio from an NBC interview with Ms Conway through the mouth of Ms Hardy’s digital ghost. The video is wobbly and pixelated; a competent visual-effects shop could do much better. But Mr Klingemann did not fiddle with editing software to make it. Instead, he took only a few days to create the clip on a desktop computer using a generative adversarial network (GAN), a type of machine-learning algorithm. His computer spat it out automatically after being force fed old music videos of Ms Hardy. It is a recording of something that never happened.

Mr Klingemann’s experiment foreshadows a new battlefield between falsehood and veracity. Faith in written information is under attack in some quarters by the spread of what is loosely known as “fake news”. But images and sound recordings retain for many an inherent trustworthiness. GANs are part of a technological wave that threatens this credibility.

Audio is easier to fake. Normally, computers generate speech by linking lots of short recorded speech fragments to create a sentence. That is how the voice of Siri, Apple's digital assistant, is generated. But digital voices like this are limited by the range of fragments they have memorised. They only sound truly realistic when speaking a specific batch of phrases.

Generative audio works differently, using neural networks to learn the statistical properties of the audio source in question, then reproducing those properties directly in any context, modelling how speech changes not just second-by-second, but millisecond-by-millisecond. Putting words into the mouth of Mr Trump, say, or of any other public figure, is a matter of feeding recordings of his speeches into the algorithmic hopper and then telling the trained software what you want that person to say. Alphabet's DeepMind in Britain, Baidu's Institute of Deep Learning in Silicon Valley and the Montreal Institute for Learning Algorithms (MILA) have all published highly realistic text-to-speech algorithms along these lines in the past year. Currently, these algorithms require levels of computing power only available to large technology companies, but that will change.

Generating images is harder. GANs were introduced in 2014 by Ian Goodfellow, then a student at MILA under Yoshua Bengio, one of the founding fathers of the machine-learning technique known as deep learning. Mr Goodfellow observed that, although deep learning allowed machines to discriminate marvellously well between different sorts of data (a picture of a cat v one of a dog, say), software that tried to generate pictures of dogs or cats was nothing like as good. It was hard for a computer to work through a large number of training images in a database and then create a meaningful picture from them.

Mr Goodfellow turned to a familiar concept: competition. Instead of asking the software to generate something useful in a vacuum, he gave it another piece of software—an adversary—to push against. The adversary would

look at the generated images and judge whether they were “real”, meaning similar to those that already existed in the generative software’s training database. By trying to fool the adversary, the generative software would learn to create images that look real, but are not. The adversarial software, knowing what the real world looked like, provides meaning and boundaries for its generative kin.

Today, GANs can produce small, postage-stamp-sized images of birds from a sentence of instruction. Tell the GAN that “this bird is white with some black on its head and wings, and has a long orange beak”, and it will draw that for you. It is not perfect, but at a glance the machine’s imaginings pass as real.

Although images of birds the size of postage stamps are not going to rattle society, things are moving fast. In the past five years, software powered by similar algorithms has reduced error rates in classifying photos from 25% to just a few percent. Image generation is expected to make similar progress. Mike Tyka, a machine-learning artist at Google, has already generated images of imagined faces with a resolution of 768 pixels a side, more than twice as big as anything previously achieved.

Mr Goodfellow now works for Google Brain, the search giant’s in-house AI research division (he spoke to *The Economist* while at OpenAI, a non-profit research organisation). When pressed for an estimate, he suggests that the generation of YouTube fakes that are very plausible may be possible within three years. Others think it might take longer. But all agree that it is a question of when, not if. “We think that AI is going to change the kinds of evidence that we can trust,” says Mr Goodfellow.

Yet even as technology drives new forms of artifice, it also offers new ways to combat it. One form of verification is to demand that recordings come with their metadata, which show when, where and how they were

captured. Knowing such things makes it possible to eliminate a photograph as a fake on the basis, for example, of a mismatch with known local conditions at the time. A rather *recherché* example comes from work done in 2014 by NVIDIA, a chip-making company whose devices power a lot of AI. It used its chips to analyse photos from the *Apollo 11* Moon landing. By simulating the way light rays bounce around, NVIDIA showed that the odd-looking lighting of Buzz Aldrin's space suit—taken by some nitwits as evidence of fakery—really is reflected lunar sunlight and not the lights of a Hollywood film rig.

Amnesty International is already grappling with some of these issues. Its Citizen Evidence Lab verifies videos and images of alleged human-rights abuses. It uses Google Earth to examine background landscapes and to test whether a video or image was captured when and where it claims. It uses Wolfram Alpha, a search engine, to cross-reference historical weather conditions against those claimed in the video. Amnesty's work mostly catches old videos that are being labelled as a new atrocity, but it will have to watch out for generated video, too. Cryptography could also help to verify that content has come from a trusted organisation. Media could be signed with a unique key that only the signing organisation—or the originating device—possesses.

Some have always understood the fragility of recorded media as evidence. “Despite the presumption of veracity that gives all photographs authority, interest, seductiveness, the work that photographers do is no generic exception to the usually shady commerce between art and truth,” Susan Sontag wrote in “On Photography”. Generated media go much further, however. They bypass the tedious business of pointing cameras and microphones at the real world altogether. ■



虚假新闻

无中生有

将从未发生过的事生成令人信服的音像内容变得更容易了

今年早些时候，法国音乐家弗朗索瓦丝·哈迪（Françoise Hardy）出现在一则YouTube视频中。画面外的主持人问她，特朗普为什么会让新闻秘书肖恩·斯派塞（Sean Spicer）在参加其就职典礼的人数这个问题上撒谎。哈迪先是辩驳了一番，然后说斯派塞“给出的是另类事实”。这事有点怪，尤其是因为现年73岁的哈迪看上去只有20岁（如图），而且她发出的声音实际来自特朗普的顾问凯莉安娜·康威（Kellyanne Conway）。

这段叫做“另类面孔v1.1”（Alternative Face v1.1）的视频是德国艺术家马里奥·克林格曼（Mario Klingemann）的作品。视频利用数字技术创建了哈迪的形象，借“哈迪”之口播放的却是全美广播公司（NBC）采访康威时的录音。视频中的影像摇晃不定，画质粗糙——一个合格的视觉特效工作室做出的东西要比这好得多。不过，克林格曼并没有使用编辑软件。相反，他只花了几天时间，在台式机上用一种名为生成对抗网络（generative adversarial network，简称GAN）的机器学习算法创作出了这段视频。克林格曼给他的电脑输入哈迪过去的音乐短片之后，视频就自动生成了。因此，这段视频所记录的是一件从未发生过的事情。

克林格曼的实验预示着虚假与真实之间将出现一个新战场。在某些领域，人们对书面信息的笃信因所谓“假新闻”的传播而受到冲击。但图像和录音对很多人来说仍天然带有可信度。一波技术浪潮正在威胁这种信赖，GAN就是其中之一。

音频更容易伪造。计算机一般是通过连接许多短小的语音片段来合成句子，从而生成话语。苹果的数字助理Siri的语音就是这么来的。但这样的数字声音受制于计算机存储的语音片段的范围。只有在说出某些特定的短语时，它们听起来才真实。

“生成式音频”有所不同，它是利用神经网络来学习所用音频源的统计特征，然后在任何场景中直接再现这些特征，对语音变化的建模不是以秒而是毫秒为单位。比如说想让某些话从特朗普或任何一个公众人物的嘴里说出来，只需将这个人的演讲录音输入算法，然后告诉训练好的软件你想让他说什么就行了。过去一年中，Alphabet公司在英国的公司DeepMind、百度在硅谷的深度学习研究院、还有蒙特利尔学习算法研究所（MILA）都发布了类似的文本转换语音算法，真实度极高。目前，只有大型技术公司才具备这些算法所需的计算能力，但这一点将会发生改变。

生成图像要更难一些。GAN在2014年由伊恩·古德费洛（Ian Goodfellow）发明，当时他还是蒙特利尔学习算法研究所的学生，他的导师约书亚·本吉奥（Yoshua Bengio）是深度学习这种机器学习技术的创立人之一。古德费洛指出，尽管深度学习让机器能够非常准确地区分不同类型的数据（比如区分一只猫和一只狗的照片），但软件在试图生成狗或猫的图片时表现就远没有那么好了。计算机很难利用数据库中大量的训练图像创建出有意义的图片。

古德费洛转而采用一个人们熟悉的概念：竞争。他不再让软件在封闭的状态下生成有用的东西，而是提供了一个对手软件来与之对抗。对手软件会判断生成的图像是否“真实”，即与生成式软件的培训数据库中已存在的图片是否相似。为了骗过对手，生成式软件就会学习创建看似真实的图像。对手软件了解真实世界是什么样子，因而能为生成式软件提供意义、树立界限。

今天，GAN可以根据一句指令生成邮票大小的鸟类图像。只要告诉GAN“这只鸟是白色的，头部和翅膀上有一些黑色羽毛，还有一个橙色的长喙”，它就会为你画出这只鸟的图像。尽管不完美，但乍看之下，机器生成的图像足以乱真。

虽然邮票大小的鸟类图像还不至于扰乱社会，但技术在快速发展。过去五年中，相似算法所驱动的软件在为照片分类时，错误率已从25%降低到只有几个百分点。图像生成软件预计也将取得类似程度的进展。谷歌的机器

学习专家兼艺术家迈克·泰卡（Mike Tyka）已为一些想象出来的面孔创造了图像，分辨率达到768×768像素，是以往最大生成图像的两倍有余。

古德费洛现在就职于谷歌的内部AI研究部门Google Brain（接受《经济学人》采访时，他在非营利研究机构OpenAI工作）。当被追问预期时，他估计三年内就可能会生成相当可信的YouTube虚假视频。其他人认为这可能需要更长的时间。但所有人都同意这终将实现，只是早晚问题。古德费洛说：“我们认为人工智能将改变那些我们可信赖的证据。”

不过，技术推动了新造假方式的产生，同时也提供了打假的新方法。其中一种验证方式是要求录制的内容必须提供元数据，元数据能显示录制内容是何时何地以及如何被收集的。了解了这些信息，如果发现图片里某个细节与当时当地的情况不吻合，就可以据此判断这是虚假图片并加以剔除。一个相当“显眼”的例子来自芯片制造公司英伟达（NVIDIA，其设备支持了大量AI）在2014年的一项工作。英伟达用其芯片分析了“阿波罗11号”登月的照片，通过模拟光线反射的情况，英伟达证明，被一些笨蛋视为作假证据的宇航员巴兹·奥尔德林（Buzz Aldrin）太空服上奇怪的亮光其实是月球表面反射的太阳光，而不是好莱坞电影棚的灯光。

大赦国际（Amnesty International）已经在努力应对一些作假问题。它的公民证据实验室（Citizen Evidence Lab）核实涉嫌侵犯人权的视频和图像证据的真伪。它利用谷歌地球来检查背景景观，检验视频或图像是否如其拍摄者所说是是在某时某处拍摄的。该实验室利用搜索引擎Wolfram Alpha将视频中呈现的天气状况与历史天气状况进行交叉对比。大赦国际抓到的造假案例多数都是将旧视频标识为新暴行，但它也必须开始防范生成式视频了。加密技术也可以帮助验证视频或图像是否来自受信任的组织。可以对这些内容签名从而令其带有唯一的密钥，只有签名机构或初始拍摄设备才拥有这一密钥。

有些人一直都明白影音记录媒介并非可靠的证据。苏珊·桑塔格（Susan Sontag）在《论摄影》（On Photography）一书中写道：“由于人们认定照片是对事物的真实再现，所有照片都被赋予了权威性、吸引力和诱惑力。

但说到艺术和真相之间常有的黑幕，摄影师的工作也不例外。”然而，生成式媒体更进一步，连把相机和麦克风指向真实世界的麻烦过程都省去了。■



The Big Mac index

Meat reversion

The dollar has slipped over the past six months, but still looks dear

THIRTY-ONE years ago, *The Economist* created the Big Mac index as a way of gauging how different currencies stacked up against the dollar. The index is based on the theory of purchasing-power parity, the idea that in the long run, exchange rates should adjust so that the price of an identical basket of tradable goods is the same. Our basket contains one item, a Big Mac.

The latest version of the index shows, for example, that a Big Mac costs \$5.30 in America, but just ¥380 (\$3.36) in Japan. The Japanese yen is thus, by our meaty logic, 37% undervalued against the dollar.

In that, the yen is not alone. The greenback has strengthened considerably in recent years: of the 34 currencies we track in the full index, 31 are currently undervalued against the dollar. Only the Swiss franc, Norwegian krone and Swedish krona are overvalued. That said, plenty of currencies have clawed back some ground against the dollar in the past six months.

Take, for example, the Egyptian pound, which burgeronomics holds to be the most undervalued currency. In November, the Egyptian government decided to allow its currency to float freely. By December the pound had fallen to its current value of around 18 per dollar. Inflation has soared as a consequence, averaging 30% over the past six months. Big Mac prices have increased accordingly, from 27.5 pounds (\$1.53) to 31.4. The net result, according to our index, is that the Egyptian pound has gone from 71% undervalued against the dollar in January to 67% today.

The euro has also gained ground in the same period. The single currency

buys \$1.14 today, up from \$1.05 at the start of the year; the euro has gone from being 20% undervalued against the dollar in our index, to 16% undercooked. That reflects a mixture of politics and economics.

Eurosceptic parties were beaten back at the polls in both the Netherlands and France, muting fears that populists would find success. The euro zone grew substantially faster than the American economy in the first quarter, and the European Central Bank has started to signal that its policy of extraordinary monetary stimulus will not last for ever. If Europe's recovery continues to strengthen, American tourists to the continent may end up getting less burger for their buck.

One of the best-performing currencies over the past six months has been the Mexican peso. In January, the peso had fallen to a record low of 22 to the dollar, thanks in no small part to fears of a possible trade war with Mexico's northern neighbour. But markets have become increasingly sceptical that Donald Trump will follow through on his most blood-curdling trade threats. The peso has recovered ground and hovers at around 18 per dollar. The Mexican currency is now only 48% undervalued against the greenback, compared with 56% in January.

Markets are also losing faith in Mr Trump's ability to pass domestic economic reforms. On the campaign trail, the president-to-be promised expansionary fiscal policies, including tax cuts and increased infrastructure spending. Traders believed that the Federal Reserve would be forced to increase interest rates in response. The dollar surged, reaching a 15-year high in January. Since then, the dollar has slipped by 5% on a trade-weighted basis. That not only vindicates those sceptical of Mr Trump's legislative prowess. It's also a partial vindication for believers in burgeronomics. If our index has any fact content, the dollar may have further to fall. ■



巨无霸指数

汉堡价格回升

过去六个月美元下滑，但看起来仍然昂贵

31年前，《经济学人》创造了巨无霸指数（the Big Mac index），用来衡量不同货币相对于美元的估值程度。该指数基于购买力平价理论，即从长远来看，汇率应该会自行调整，使相同的一篮子可交易商品价格趋于一致。我们的篮子里就一件商品：一个巨无霸汉堡。

例如，最新的指数显示，一个巨无霸在美国的售价为5.30美元，而在日本仅售380日元（3.36美元）。因此，按照我们的汉堡逻辑，日元兑美元汇率被低估了37%。

日元并非孤例。近年来美元大幅升值：我们的完整指数所跟踪的34种货币中，有31种兑美元的汇率目前被低估。只有瑞士法郎、挪威克朗和瑞典克朗被高估。不过，过去六个月来，许多货币兑美元的汇率都已有所回升。

以埃及镑为例，汉堡经济学认为它是最被低估的货币。去年11月，埃及政府决定允许其货币自由浮动。到12月，埃及镑已经下降到现在1美元兑换18磅左右的水平。通胀随之飙升，过去六个月里平均每月升幅为30%。巨无霸价格也相应上涨，从27.5镑（1.53美元）升至31.4镑。根据我们的指数，汇率下跌和通胀上升相抵后，埃及镑兑美元从1月的低估71%变成现在的低估67%。

欧元在同一时期也有所回升。这个欧洲单一货币如今1元可兑换1.14美元，高于年初的1.05美元。我们的指数显示，欧元兑美元一度被低估了20%，现在则是16%。这反映了政治和经济的共同作用。荷兰和法国的民意调查显示，疑欧党派气焰受到压制，消减了人们对民粹主义者将会取得成功的恐惧。今年第一季度，欧元区经济增长速度远超美国，欧洲央行也已开始发出信号，表示大力度的货币刺激政策不会永远持续。如果欧洲的复苏继续加强，到欧洲大陆的美国游客用美元能买到的汉堡可能会变少。

过去六个月表现最好的货币之一是墨西哥比索。今年1月，比索兑美元的汇率跌至22: 1的创纪录低点，这在很大程度上是缘于该国可能会与北边邻国发生贸易战的担忧。然而市场越来越怀疑特朗普是否会兑现他那些最吓人的贸易威胁。比索兑美元汇率已经回升至18: 1左右，兑美元现在只被低估48%，而1月份为56%。

市场对特朗普通过国内经济改革的能力也正失去信心。在竞选过程中，这位待选总统承诺将采取扩张性财政政策，包括减税和增加基础设施支出。交易者认为美联储将因此被迫加息。此后美元飙升，在1月达到15年来的最高点。但从那时起至今，美元按贸易加权计算已经下滑了5%。这不仅证实了那些怀疑特朗普推动立法能力的人的看法，也部分证明了相信汉堡经济学的人没错。如果说我们的指数还算靠得住，美元可能还得进一步下跌。 ■



Education technology

Brain gains

Together, technology and teachers can revamp schools

IN 1953 B.F. Skinner visited his daughter's maths class. The Harvard psychologist found every pupil learning the same topic in the same way at the same speed. A few days later he built his first "teaching machine", which let children tackle questions at their own pace. By the mid-1960s similar gizmos were being flogged by door-to-door salesmen. Within a few years, though, enthusiasm for them had fizzled out.

Since then education technology (edtech) has repeated the cycle of hype and flop, even as computers have reshaped almost every other part of life. One reason is the conservatism of teachers and their unions. But another is that the brain-stretching potential of edtech has remained unproven.

Today, however, Skinner's heirs are forcing the sceptics to think again. Backed by billionaire techies such as Mark Zuckerberg and Bill Gates, schools around the world are using new software to "personalise" learning. This could help hundreds of millions of children stuck in dismal classes—but only if edtech boosters can resist the temptation to revive harmful ideas about how children learn. To succeed, edtech must be at the service of teaching, not the other way around.

| *Pencils down*

The conventional model of schooling emerged in Prussia in the 18th century. Alternatives have so far failed to teach as many children as efficiently. Classrooms, hierarchical year-groups, standardised curriculums and fixed timetables are still the norm for most of the world's nearly 1.5bn schoolchildren.

Too many do not reach their potential. In poor countries only a quarter of secondary schoolchildren acquire at least a basic knowledge of maths, reading and science. Even in the mostly rich countries of the OECD about 30% of teenagers fail to reach proficiency in at least one of these subjects.

That share has remained almost unchanged over the past 15 years, during which billions have been spent on IT in schools. By 2012 there was one computer for every two pupils in several rich countries. Australia had more computers than pupils. Handled poorly, devices can distract. A Portuguese study from 2010 found that schools with slow broadband and a ban on sites such as YouTube had better results than high-tech ones.

What matters is how edtech is used. One way it can help is through bespoke instruction. Ever since Philip II of Macedon hired Aristotle to prepare his son Alexander for Greatness, rich parents have paid for tutors. Reformers from São Paulo to Stockholm think that edtech can put individual attention within reach of all pupils. American schools are embracing the model most readily. A third of pupils are in a school district that has pledged to introduce “personalised, digital learning”. The methods of groups like Summit Public Schools, whose software was written for nothing by Facebook engineers, are being copied by hundreds of schools.

In India, where about half of children leave primary school unable to read a simple text, the curriculum goes over many pupils’ heads. “Adaptive” software such as Mindspark can work out what a child knows and pose questions accordingly. A recent paper found that Indian children using Mindspark after school made some of the largest gains in maths and reading of any education study in poor countries.

The other way edtech can aid learning is by making schools more productive. In California schools are using software to overhaul the conventional model. Instead of textbooks, pupils have “playlists”, which

they use to access online lessons and take tests. The software assesses children's progress, lightening teachers' marking load and giving them insight on their pupils. Saved teachers' time is allocated to other tasks, such as fostering pupils' social skills or one-on-one tuition. A study in 2015 suggested that children in early adopters of this model score better in tests than their peers at other schools.

| *Pay attention at the back*

Such innovation is welcome. But making the best of edtech means getting several things right. First, "personalised learning" must follow the evidence on how children learn. It must not be an excuse to revive pseudoscientific ideas such as "learning styles": the theory that each child has a particular way of taking in information. Such nonsense leads to schemes like Brain Gym, an "educational kinesiology" programme once backed by the British government, which claimed that some pupils should stretch, bend and emit an "energy yawn" while doing their sums.

A less consequential falsehood is that technology means children do not need to learn facts or learn from a teacher—instead they can just use Google. Some educationalists go further, arguing that facts get in the way of skills such as creativity and critical thinking. The opposite is true. A memory crammed with knowledge enables these talents. William Shakespeare was drilled in Latin phrases and grammatical rules and yet he penned a few decent plays. In 2015 a vast study of 1,200 education meta-analyses found that, of the 20 most effective ways of boosting learning, nearly all relied on the craft of a teacher.

The second imperative is to make sure that edtech narrows, rather than widens, inequalities in education. Here there are grounds for optimism. Some of the pioneering schools are private ones in Silicon Valley. But many more are run by charter-school groups teaching mostly poor pupils, such as Rocketship and Achievement First—or Summit, where 99% of graduating

pupils go on to university and laggards make the most progress relative to their peers in normal classes. A similar pattern can be observed outside America. In studies of edtech in India by J-PAL, a research group, the biggest beneficiaries are children using software to receive remedial education.

Third, the potential for edtech will be realised only if teachers embrace it. They are right to ask for evidence that products work. But scepticism should not turn into Luddism. A good model is São Paulo, where teachers have welcomed Geekie, an adaptive-software company, into public schools.

In 1984 Skinner called opposition to technology the “shame” of education. Given what edtech promises today, closed-mindedness has no place in the classroom. ■



教育技术

增长才智

技术和教师联手可以改进学校教育

1953年，斯金纳（B.F. Skinner）旁听了女儿的数学课。这位哈佛心理学家发现，所有的学生都在用相同的方式以相同的速度学习相同的内容。几天后，他发明了他的第一件“教学机器”，让孩子们按自己的节奏解答问题。到了60年代中期，推销员开始上门兜售类似的小玩意。不过没过几年，人们对这些产品的热情就已消失殆尽。

此后，教育技术就一直在重复这种从大热到沉寂的循环，尽管与此同时电脑已经几乎重塑了生活所有其他方面。原因之一是教师及其工会因循守旧，但还有一个原因是教育技术提升才智的潜力尚未得到证实。

然而，今天斯金纳的后继者正迫使怀疑者重新思考这个问题。在马克·扎克伯格和比尔·盖茨等技术派亿万富豪的支持下，全球各地的学校正在使用新的软件将学习“个性化”。这能帮助到被困在沉闷课堂中的亿万孩子，但前提是教育技术的推动者能够抵挡住诱惑，不让那些有关儿童如何学习的有害见解卷土重来。教育技术要成功，必须要服务于教学，而不是支配教学。

| 放下铅笔

传统的学校教育模式始于18世纪的普鲁士。迄今为止，各种替代方案都未能达到学校教育那样的规模和效率。对全球近15亿学童中的大多数而言，课堂教学、年级分段、标准化课程和固定的课程时间表仍是常态。

有太多学生没有充分实现他们的潜力。在贫穷国家，只有四分之一的中学生掌握了最基础的数学、阅读和科学知识。即使在大多为富裕国家的经合组织成员国中，也有大约30%的青少年未能熟练掌握其中至少一门科目。

过去15年里，这一百分比几乎没有变化。而在此期间，数十亿美元已被投

入到学校的信息技术上。2012年，在少数几个富国中，每两名学生就配有一台电脑。在澳大利亚，电脑的数量比学生还多。但如果利用不善，技术设备反而会分散学生的注意力。2010年葡萄牙的一项研究发现，相比IT条件优越的学校，在宽带速度慢且禁止访问YouTube等网站的学校里，学生的成绩更好。

关键在于如何使用教育技术。让它发挥作用的一种方式是因材施教。马其顿王国的腓力二世（Philip II）聘请亚里士多德培养儿子亚历山大，助他日后开创伟业。这之后，有钱的父母便开始聘请家庭教师。从圣保罗到斯德哥尔摩，全球各地有很多改革者认为，教育技术可以让所有学生都获得个体化的关注。美国学校最热衷采用这一模式，有三分之一的学生所在的学区都已承诺引进“个性化、数字化学习”。Facebook的工程师为Summit Public Schools【译注：美国一家特许学校集团】免费编写了学习软件，成百上千的学校正在复制这类机构的教学方式。

在印度，约半数小学毕业生无法读懂一段简单的文字，很多学生听不懂上课内容。Mindspark之类的“自适应”软件可以推断出一个孩子的知识范围，并提出相应的问题。最近有一篇论文发现，在对穷国进行的各类教育研究中，在课余使用Mindspark学习的印度孩子在数学和阅读方面取得的进步最大。

教育技术辅助学习的另一个途径是让学校教育变得更有成效。在加州，一些学校正在利用软件来改革传统教育模式。学生不用教科书，而是使用“播放列表”访问在线课程并接受测试。软件可以评估学童的进步，减轻教师阅卷打分的工作量，加深老师对学生的了解。教师可将节省出来的时间花在其他任务上，如培养学生的社交技能，或提供一对一的辅导。2015年的一项研究表明，在率先采纳这种教育模式的学校，学生比其他学校的同龄学生成绩更好。

| 留心负面因素

这样的创新是受欢迎的。但是，要最有效地利用教育技术，就要做好以下几件事情。首先，“个性化学习”必须依据学童的实际学习方式，而不能成

为重启某些伪科学理念的借口。“学习风格”（learning styles）就是这样一种伪科学理论，声称每个孩子都有自己接受信息的独特方式。这样的无稽之谈催生了一些无益之举，比如英国政府曾经支持过的一个“教育运动学”项目——健脑操（Brain Gym）。该项目称有些学生在做算术练习时应该做做拉伸弯弯腰，再打个“提神呵欠”。

另一种影响较小的错误论调声称，技术发展意味着儿童不再需要学知识或向教师学习——上Google搜一搜就可以了。一些教育学家更进一步，认为知识妨碍了创造力和批判性思维等能力的发展。但实际情况恰恰相反，一个装满知识的头脑才能促进这些能力的发展。莎士比亚从小接受的是拉丁语短语和语法规则训练，但却写出了几部像样的戏剧。2015年，一项包含1200项教育元分析的大型研究发现，最能有效促进学习的20种方法几乎全部依赖老师的教导。

第二个必行之举是确保教育技术会缩小而不是扩大教育不平等。在这方面有些值得乐观的理由。先行引入教育技术的学校中，有一些是硅谷的私立学校，但更多的是特许教育机构开办的学校，招收的也主要是贫困学生，例如Rocketship和Achievement First，或是Summit。Summit毕业生的大学升学率高达99%，成绩落后的学生与普通学校的后进生相比，取得的进步也最大。在美国之外也可以看到类似的情形。研究机构J-PAL在印度开展的针对教育技术的研究发现，教育技术最大的受益者是利用软件接受补习的儿童。

第三，只有被教师接受，教育科技才能实现其潜力。教师要求提供教育技术类产品发挥作用的证据，他们是对的，但怀疑态度不应转变成卢德主义。圣保罗是个不错的范例，那里的教师欢迎自适应软件公司Geekie进入公立学校。

1984年，斯金纳称反对技术是教育的“耻辱”。鉴于今天教育技术显现出的潜力，课堂中已容不得固守成见了。■



Finance

Your money and your life

As lives get longer, financial models will have to change

IN 1965 ANDRÉ-FRANÇOIS RAFFRAY, a 47-year-old lawyer in southern France, made the deal of a lifetime. Charmed by an apartment in Arles, he persuaded the widow living there that if he paid her 2,500 francs (then about \$500) a month until she died, she would leave it to him in her will. Since she was already 90, it seemed like a safe bet. Thirty years later Mr Raffray was dead and the widow, Jeanne Louise Calment, was still going strong. When she eventually passed away at 122, having become the world's oldest person, the Raffray family had paid her more than twice the value of the house.

Underestimating how long someone will live can be costly, as overgenerous governments and indebted private pension schemes have been discovering. They are struggling to meet promises made in easier times. Public pensions are still the main source of income for the over-65s across the OECD, but there are big differences between countries (see chart). In both America and Britain public provision replaces around 40% of previous earnings, but in some European countries it can be 80% or more. Where it makes up a big share of total pension income, as in Italy, Portugal and Greece, a shrinking workforce will increasingly struggle to finance a bulging group of pensioners.

Private pension schemes, which supplement state provision, have been shifting from defined-benefit plans, where workers are promised a fixed amount of income in retirement, to defined-contribution plans, where workers themselves take on the risk. Such schemes are good for employers but tricky for individuals, who become personally responsible for ensuring they do not outlive their savings. The new stage of life now emerging

between work and old age adds a further complication. To accommodate these changes, the financial industry needs an overhaul.

First, it has to update the rigid three-stage life-cycle model on which most of its products are based. Second, it needs to resolve two opposite but equally troubling problems: undersaving during working life and oversaving during retirement. The first puts pressure on public provision, the second leads to underconsumption as cash is left under the mattress. Third, a more creative approach is needed to the range of assets that pensioners can draw on, including their homes, which have so far played little part in provision for old age.

“In a multi-stage life, the idea of hitting a cliff-edge retirement at 65 and then living off an annuity is outdated,” says Alistair Byrne, from State Street Global Advisors, a money manager. His clients, many of whom intend to work past normal retirement age, are asking for more flexibility to get at their savings at a younger age. They also want a secure income for the last phase of life. “It’s not at all obvious that the traditional pension industry, which still sees life as a three-stage event, will survive this transition,” says Andrew Scott of the London Business School.

| *Nothing in the kitty*

Many people simply do not save enough. Roughly 40% of Americans approach retirement with no savings at all in widely used retirement accounts such as IRAs or 401(k)s. In Britain 20% of women and 12% of men between 55 and 65 have no retirement savings, according to Aegon. Yet with the demise of defined-benefit schemes, the increase in the retirement age and the steady rise in life expectancy, most of today’s workers will need to save more than their parents did. Some of them do not earn enough to put money aside, but for many the problem is in the mind: they consistently underestimate how long they will live and overestimate how long their money will last. As more people become self-employed, getting them to

save for their old age becomes ever more important.

One solution is to allow retirement funds to be used more flexibly, which may encourage people to save more. But nudges are unlikely to be enough. “People need a push,” says Myungki Cho, from Samsung Life’s Retirement Research Centre in Seoul. Some countries, such as Denmark and the Netherlands, provide such a push by making enrolment in pension schemes more or less mandatory. Short of that, auto-enrolment, recently introduced in Britain, and auto-escalation (increasing contributions over time) can also make a difference.

At the same time many pensioners spend less than they can afford, which creates its own problems. Ronald Lee and Andrew Mason have found that in most rich countries the elderly are net savers. Since they cannot be sure how long they will live and what their state of health will be, and have no way of predicting inflation, interest rates and markets, some caution is clearly in order. But Chip Castille, from BlackRock, an asset manager, thinks oversaving is often unintentional. “It would be an extraordinary coincidence if you saved exactly enough for retirement,” he says.

This gets to the heart of why some economists are pessimistic about greying societies. In a phase when older people should be spending freely, many are accumulating wealth, says David Sinclair, of the ILC UK. He thinks the greater pension freedoms granted in Britain in 2015 are more likely to lead to frugality rather than spending sprees.

Such “accidental” oversaving will increase in a world of defined-contribution plans, predicts Tony Webb, an economist at the New School, in New York City. Given a choice, people will assemble their own kitties rather than buy annuities that provide an agreed lifetime income in exchange for a lump sum. If they die young, the money will be a windfall for their heirs. Similarly, since money locked up in homes is difficult to get

at during the owner's lifetime, much of this too will be passed on, Mr Webb adds. Raising inheritance-tax rates could make a difference, but better insurance is equally important. This dormant wealth, which is often neither invested nor spent, is stopping many of the younger old from realising their full economic potential. "Often people just need the confidence that we've run the numbers and that they really can afford to make that donation to a charity, or spend a little more on themselves," says Kai Stinchcombe, from True Link, a financial-advice firm for pensioners.

| *Take care*

Depending on where people live, how much they earn and whether they have family willing to care for them, one of the greatest financial risks of ageing can be end-of-life care expenditure. A 50-year-old American has a better-than-even chance of ending up in a nursing home, estimate Michael Hurd and colleagues from RAND, a research organisation in America. In Britain an official review in 2011 of long-term care reckoned that a quarter of older people in Britain needed very little care towards the end of life but 10% faced care costs in excess of £100,000.

Most countries will need to find a mix of public and private provision to pay for long-term care costs. A well-functioning insurance market should be an important part of this, but care insurance has mostly failed to take off. American providers who piled in too enthusiastically in the 1990s got burnt when customers needed more care than expected, and are still haunted by the experience. Low rates of return on bonds have not helped.

Every country has its own peculiarities, but four common factors help explain the market failures. First, the future of public care is uncertain. Second, despite or because of this, many people think they do not need insurance because the state or their family will look after them. Third, the market is subject to "adverse selection"—the likelihood that insurance will appeal only to those most at risk of needing care. And fourth, care costs are

unpredictable and could spin out of control in the future. As a result, insurers either avoid the care market altogether, or charge exorbitant premiums and add lots of restrictions.

As with any big risk, pools need to be large to make protection products work. The easiest way to achieve this is to make insurance compulsory, as in Germany. One alternative is auto-enrolment in a public-private scheme with an opt-out, a method with which Singapore is experimenting. At a minimum, some government intervention—such as providing a backstop for the most catastrophic risks—seems to be required for the market to establish itself. But perhaps the biggest problem is that government policies chop and change far too often.

Insurers could help, not least by offering more hybrid products such as life insurance with the option of an advance on the payout if customers need care, or annuities that pay a lower-than-usual income but convert to a higher-than-usual rate if pre-agreed care levels become necessary. And there is a need for clearer guarantees against unexpected premium hikes. Most importantly, though, insurers will need to persuade people to enroll long before they are likely to require any care.

By far the most common reason for someone needing long-term care is that they are suffering from Alzheimer's or some other form of dementia. Globally around 47m people have dementia. Without a medical breakthrough this number could grow to 132m by 2050, according to the World Alzheimer's Report. One study found that people suffering from dementia accounted for four-fifths of all those in care homes worldwide.

In the absence of other options, for many people the ultimate insurance is their home, though few homeowners see it that way. In the rich world much of the wealth of lower and middle-income households is tucked away in bricks and mortar. With house prices soaring in many countries,

releasing some of this equity could greatly benefit asset-rich but cash-poor pensioners, as well as the wider economy.

The most obvious tool for this is a reverse mortgage, which lets homeowners exchange some of their home's equity for a lump sum or a stream of income in retirement. But it is not widely used. In America fewer than 49,000 reverse mortgages were sold last year, most of them provided by only about ten banks. Mis-selling scandals in the early days now seem to have been resolved, says Jamie Hopkins, of the American College of Financial Services, but people find such mortgages scary and worry that they might lose their home. Because of the lack of competition, the products also remain expensive. Mainstream financiers could help expand the market.

In the meantime, entrepreneurial empty-nesters have found another way to sweat their assets: Airbnb. The over-60s are the fastest-growing group of hosts on the home-sharing site and receive the highest ratings. Almost half of older hosts in Europe say the additional income helps them stay in their home.

The longer that people live, the more varied their life cycle will become. Workers will take breaks to look after children or go back to school; pensioners will take up a new job or start a business. Financial providers need to recognise these changing needs and cater for them. That includes helping to fund technology that could vastly improve the final stage of life. ■



金融

你的钱与你的人生

寿命越来越长，金融模型不得不变

1965年，法国南部一名47岁的律师安德雷-弗朗索瓦·拉弗雷（André-François Raffray）做了一笔一辈子的交易。他钟情于阿尔勒的一间公寓，并说服了住在那里的寡妇：如果他每个月支付2,500法郎（约合500美元）直到她去世，她将会在遗嘱中把公寓留给他。由于她已经90岁了，这似乎是一个稳赢的赌注。30年后，拉弗雷先生去世，而寡妇让·路易斯·卡尔芒（Jeanne Louise Calment）依然生气勃勃。当她最终于122岁去世时，她是世界上年纪最大的人，而拉弗雷家族向她支付的金额超过了公寓价值的两倍。

低估一个人能活多久可能要付出高昂的代价——过度大方的政府和负债累累的私人养老金计划已经发现了这一点。日子好过时做出的承诺，如今履行起来却痛苦不堪。在所有的经合组织国家，公共养老金仍然是65岁以上老人的主要收入来源，但各国之间存在着很大的差异（见图表）。在美国和英国，公共经费能够替代工作时收入的40%左右，但在一些欧洲国家这个比例可以达到80%甚至更高。在意大利、葡萄牙和希腊这样的国家，公共经费占到了养老金总收入中很大一部分，不断萎缩的劳动力将越来越难以支撑日益膨胀的退休群体。

作为国家发放养老金的补充，私人养老金计划已经从保证员工退休后获得固定收入的固定收益计划，逐渐转向员工自行承担风险的固定缴款计划。这样的计划有利于雇主，但对个人而言则比较棘手，因为他们要自行承担确保积蓄足够花销的责任。如今，在工作年龄与老年之间出现的新的生命周期阶段让情况变得愈发复杂。为了适应这些变化，金融业需要一场彻底的改革。

首先，大多数产品背后死板的三阶段人生周期模型必须修订。其次，两个相反但同样令人不安的问题需要解决：工作时储蓄不足，退休后储蓄过

多。前者让公共经费吃紧，后者则因为把现金贮藏起来而导致消费不足。第三，需要更创新的手段来扩展养老金领取者可以利用的资产范围，比如利用其房屋——迄今房屋在供养老年人方面还没有起到什么作用。

来自道富环球投资管理公司（State Street Global Advisors）的阿利斯泰尔·拜恩（Alistair Byrne）表示：“在被划分成多个阶段的人生中，在65岁时搞一刀切退休，然后靠年金生活的想法已经过时了。”他的客户中有很多人打算到了正常退休年龄仍继续工作，也对在较年轻时提取存款有更多的灵活性要求。他们还希望在人生的最后阶段能获得稳定的收入。“传统养老金产业仍把人生看作一个三阶段的活动，它能否挺得过这种转变还说不准。”伦敦商学院的安德鲁·斯科特（Andrew Scott）说道。

| 一文不名

许多人根本就没有足够的储蓄。约有40%的美国人快到退休时在IRA或401(k)等常用的退休账户中毫无积蓄。根据荷兰全球保险集团（Aegon）的说法，55岁至65岁的英国人中，20%的女性和12%的男性没有退休储蓄。然而，随着固定收益计划的消亡、退休年龄的提高和预期寿命的稳步上升，今天的大多数雇员需要比他们的父母存更多的钱。有些人是因为挣钱不多而存不下来，但很多人的问题出在认知上：他们总是低估了自己能活多久，而高估了钱能花多久。随着越来越多的人成为个体经营者，让他们为了养老而储蓄变得越来越重要。

一个解决办法是允许人们更灵活地使用退休资金，这可能会鼓励人们存下更多的钱。不过光是“轻推”一下不大可能解决问题。“人们需要被重推一把。”位于首尔的三星人寿退休研究中心的赵明基（Myungki Cho，音译）这样表示。丹麦和荷兰等国通过多少有些强制性的退休计划来推动储蓄。英国比较温和一些，它最近推出的自动加入和自动升级（随着时间推移提高缴费）也可能产生效果。

与此同时，许多养老金领取者的花销低于其负担能力，这也带来了问题。罗纳德·李（Ronald Lee）和安德鲁·梅森（Andrew Mason）发现，在大多数富裕国家，老年人都是净储蓄者。既然他们不能肯定自己会活多久、

健康状况会如何，而且无法预测通货膨胀、利率和市场状况，谨慎点肯定是有好处的。不过，资产管理公司贝莱德的奇普·卡斯迪尔（Chip Castille）认为过度储蓄往往并非有意为之。他说：“得是极度的巧合才能让存的钱刚好够退休后使用。”

这就是为什么一些经济学家对于银发社会如此悲观的核心原因。在老年人应该潇洒消费的阶段，许多人却在积累财富，英国国际人均寿命研究中心（ILC UK）的大卫·辛克莱（David Sinclair）说道。他认为，英国在2015年给予养老金的自由度可能导致人们更加节俭而不是大肆挥霍。

纽约新学院的经济学家托尼·韦伯（Tony Webb）预测，在这个固定缴费计划的世界里，这种“意外”的过度储蓄将会增加。如果有选择的话，人们会自行积累资金池，而不是花上一笔钱去购买年金来获得约定的终身收入。韦伯补充说，如果他们英年早逝，这笔钱将是继承人的意外之财。同样，由于锁定在房产中的钱很难在屋主在世时拿到，这些钱中的大部分也都会被继承。提高继承税率可能会有些作用，但更好的保险同样重要。这些休眠的财富常常既未被投资也未被消费，让许多年纪不太大的老年人未能实现自己的全部经济潜力。养老金融咨询公司True Link的卡伊·斯丁奇康布（Kai Stinchcombe）表示：“人们常常只是需要一点信心，相信我们已经帮他们算过了，他们确实能够承担给慈善机构捐款，或是多花点钱在自己身上。”

| 保重

取决于人们居住的地方、收入多少以及是否有家人愿意照顾他们，老龄化最大的财务风险之一可能是临终护理开支。据美国研究机构兰德的迈克尔·赫德（Michael Hurd）及其同事们估计，如今50岁的美国人在疗养院终老的可能性超过一半。在英国，2011年对长期护理的一项官方调查发现，英国四分之一的老人临终时基本不需要什么照顾，但10%的人面临超过10万英镑的护理费用。

大多数国家将需要把公共和私人经费搭配起来以支付长期护理费用。运作良好的保险市场应该是其中的重要组成部分，但护理保险大多没能做大。

20世纪90年代时，美国保险商过分积极地涌入这个领域，却发现投保人对护理的需要比预期更多，结果吃了大亏，这番经历令他们至今心有余悸。债券的低回报率也对局面没有帮助。

每个国家都有自己的特殊之处，但有四个常见因素有助于解释市场失灵。首先，公共护理的未来不确定。第二，虽然如此，或是正因为如此，很多人认为他们不需要保险，因为国家或他们的家人会照顾他们。第三，市场受“逆向选择”的影响——保险可能只会吸引那些最有可能需要照顾的人。第四，护理成本是不可预知的，在未来可能失控。因此，保险公司要么完全避开护理市场，要么收取高昂保费再加上诸多限制。

与任何巨大的风险一样，资金池需要变得很大，保障产品才能运转。实现这一目标最简单的方法就是强制保险，就像德国那样。另一种办法是自动加入一个公私合营方案并允许退出，这是新加坡正在尝试的方法。至少，一些政府干预措施似乎是让这一市场能自行立足的必需，例如为最灾难性的风险提供支持。但也许最大的问题是政府的政策变更得太频繁了。

保险公司也可以帮上忙，特别是提供更多的混合产品，例如在客户需要护理时可以提前支付的人寿保险，或者是平时支付较低收入，但在客户需要获得预先约定的护理水平时转换为较高收入的年金。而且，还需要更清楚的保证来防止保险金意外上涨。然而最重要的是，保险公司得劝说人们在需要护理之前很久就加入这些计划。

到目前为止，需要长期护理的最常见原因是阿尔茨海默症或其他形式的痴呆症。全球约有4700万人患有痴呆症。根据《世界阿尔茨海默症报告》，若没有医疗突破，到2050年，这一数字可能会增长到1.32亿。一项研究发现，痴呆症患者占全世界护理院所有入住人数的五分之四。

若没有其他选择，对于许多人而言，终极保险就是他们的家，尽管很少有屋主这样想。在富裕国家，大多数中低收入家庭的财富都被藏在了砖头瓦块里。随着许多国家的房价飙升，释放一些此类资本，可能对资产丰厚但现金贫乏的养老金领取者以及整体经济都有很大好处。

为此，最显而易见的工具就是反向抵押贷款，这样业主可以用房屋资本的一部分换取一笔钱或是收入流用于退休，但这种方式并未得到广泛采用。在美国，去年售出的反向抵押贷款不到49,000笔，其中绝大部分仅由十家银行提供。美国金融服务学院的杰米·霍普金斯（Jamie Hopkins）说，早期的不当销售丑闻似乎已经解决了，但人们发现这样的抵押贷款很吓人，担心自己可能会失去住房。由于缺乏竞争，这些产品一直还是很昂贵。主流金融家可以帮助扩大市场。

与此同时，富有创业精神的空巢人士已经找到了另一种方式来让房屋为自己挣钱：爱彼迎。60岁以上人群是这个住所分享网站上增长最快的屋主群体，并获得最高的评分。欧洲几乎一半的老年屋主表示，额外收入有助于他们留在家中。

人们活得越久，人生周期就变化越多。雇员们会放下工作来照顾孩子或回去上学，而养老金领取者将开始从事新工作或自己创业。金融供应商需要认识到这些不断变化的需求并迎合它们。这包括资助那些可以大大改善人生最后阶段的技术。 ■



Consumers

Don't call us silver

From adventure travel to dating websites, older consumers display resolutely young tastes

“THERE'S NOTHING WRONG with bingo and chicken,” says Tom Kamber, before explaining why you won't find either in the senior centre he runs in Manhattan. Instead, members of the Senior Planet Exploration Centre are given VR goggles and other digital gadgets to play with, though most head straight for a wall of computers to check their Facebook accounts or shop online. A group of 15 seniors, some in their 80s, clad in sportswear, huddle around their fitness coach. People come for classes on starting their own businesses, using smartphones, booking travel on the web and setting up online dating profiles. “We just demystify the technology and away they go,” explains Mr Kamber.

Businesses could learn from this. With longer lives, more free time and a lot of cash, older people clearly present a “silver dollar” opportunity. In America the over-50s will shortly account for 70% of disposable income, according to a forecast by Nielsen, a market-research organisation. Global spending by households headed by over-60s could amount to \$15tn by 2020, twice as much as in 2010, predicts Euromonitor, another market-research outfit. Much of this will go on leisure.

Yet the market has failed to respond to this opportunity, even though it has been clear for a long time that the baby-boomers would start to retire in larger numbers, in better health and with more money to spend than any previous generation. They feel much younger than their parents did at their age, and most of them have no intention of quietly retreating from the world. “Retirement used to be a brief period between cruise ships and wheelchairs, with a bout of norovirus,” says Joe Coughlin, who runs the

AgeLab at the Massachusetts Institute of Technology. Now it has become a complete new stage of life, as long as childhood or mid-life, which boomers want to structure very differently; “yet we still offer my grandfather’s retirement.”

Over-60s adventure travel has become a booming business opportunity. In America more than 40% of adventure travellers are over 50, according to the Adventure Travel Trade Association. In Britain older travellers are the largest spenders in the industry, with the fastest growth in the 65-74 age group. Instead of comfortable cruises or bus tours, they demand action, from expeditions to the Arctic to cultural trips to Asia.

Jane Dettloff, a 73-year-old from Minnesota, has just returned from a two-week cycling tour in Chile. “The culture, the cuisine, the beaches and—oof—the Andes wine!” By day the 16 women, aged 61 to 87, pedalled, chatted and “felt like young girls again”. By night they enjoyed “wine-o’clock, without the whining about pills”. The travel company that organised the tour, VBT, does not explicitly bill itself as a specialist in senior travel, but offers subtle hints: “at your own pace”, “since 1971”, “good wine”. More than 90% of its customers are over 50.

| *Out of date*

Another emerging market is dating. Whereas overall divorce rates are falling in some countries, including America, Australia and Britain, “silver splits” are soaring as new pensioners suddenly face the prospect of spending a lot more time with their partner. Americans over 60 are now getting divorced at twice the rate as they were in 1990, and Britons at three times the rate, write Lynda Gratton and Andrew Scott in “The 100-Year Life”. More than a quarter of the members of Match.com, a popular dating website, are between 53 and 72, and that group is growing faster than any other.

Older people seem more concerned than younger ones about the risks of online dating, prompting the setting up of specialised sites such as Stitch, an online companionship site with 85,000 members. “There’s more fun to be had after 50,” proclaims its promotional video, adding that “it’s all very safe.” Older customers seem more willing to pay for online memberships than the young, provided they add value. Stitch screens members and organises social events, explains Andrew Dowling, the co-founder. “Most people want companionship, but dating does change with age.”

Jody, from New Jersey, was inspired by her nieces, who all use dating apps, and ended up at a Stitch “drinks and mingling” event in a trendy New York bar. It turned out to be ten women sipping Margaritas, laughing as they swapped experiences of disastrous online dates and debating whether they would be more likely to meet a man if they went in for predominantly male activities such as mountain biking or golf.

Women spend more on trying to find a companion than men, because in the higher age groups there are more of them (in the rich world they live an average of five years longer), and they are more likely to be single. In 2014 nearly three-quarters of American men over 65 were married and only one in ten was widowed; of women in the same age group, under half were married and one in three was widowed. In Europe, too, women over 65 are more than twice as likely as men to be living alone. This can be problematic if they lack adequate savings, but also opens up new demand for all sorts of things that hardly anyone would have imagined a generation ago.

One is different sorts of accommodation. With longer time horizons ahead of them, the younger old are spurning lonely granny flats and looking for something more convivial, closer to a bachelor pad. “Retired golden girl seeks two cosmopolitan, easy-going, positive people with a (wacky) sense of humour to share this lovely, charming property,” starts an ad on goldengirlsnetwork.com, a single-senior housemate-finding website.

But businesses that want to get into this new market of the younger old should note that they are fussy. They do not see themselves as old, and will respond badly to ads specifically targeted at older people (as Crest found when it launched a toothpaste for the 50+ age group). The over-50s are also intolerant of websites or gadgets that underdeliver, says Martin Lock of Silversurfers.com, the largest over-50s community in Britain: “If something doesn’t work, they’ll be the first to leave.”

Between now and 2030, most of the growth in consumption in the developed world’s cities will come from the over-60s, according to McKinsey, a consultancy. So this is the market to go for; but to provide the wherewithal, the financial industry will first have to reinvent itself. ■



消费者

别叫我们老人家

从探险旅游到约会网站，老年消费者展现出绝对年轻的喜好

“宾果游戏和鸡肉没什么不好的。”汤姆·坎贝尔（Tom Kamber）说，然后开始解释为何自己开设的老年中心里，这两样都找不到。在这家位于曼哈顿的“老年星球探索中心”（Senior Planet Exploration Centre），会员们领到的是虚拟现实眼镜和其他数字小设备，不过大部分人都会径直走到一排电脑前，查看自己的Facebook账号或者开始上网购物。15名身穿运动服的老人家围在一个健身教练旁，有些人已经八十多岁了。人们到这里来参加各种课程，包括如何创业、如何使用智能手机、在线预订旅游行程、填写网上交友个人资料等。“我们只需把技术上的东西解释给他们听，然后他们就自己玩了。”坎贝尔说。

商家可以从这个案例中学到经验。如今的银发族寿命更长，闲暇更多，现金也很充裕，清楚呈现出一个“银币”机遇。据市场调研机构尼尔森预测，美国50岁以上人口拥有的可支配收入将很快占全国的70%。而据另一家市场调研公司欧睿信息咨询（Euromonitor）预测，到2020年，全球户主超过60岁的家庭总支出将达到15万亿美元，为2010年时的两倍。其中大部分开支将花在休闲娱乐上。

然而市场至今都没有对这一机遇做出反应，尽管人们早已知道婴儿潮一代将开始退休，而且他们比从前任何一代数量更大，更健康，也拥有更多可支配的钱。与他们的父母在同样年纪时的心态相比，他们的自我感受要年轻得多，大部分人都无意从这个世界悄然隐退。“过去，所谓退休只是乘邮轮和坐轮椅之间的一小段时间，还要感染一次诺如病毒，”麻省理工学院年龄实验室（AgeLab）主管乔·库格林（Joe Coughlin）说。如今，退休已变成了一个全新的人生阶段，长度和童年或中年相当。婴儿潮一代想要以完全不同的方式度过这段时期。“而社会却还在提供我们祖父辈的那种退休生活方式。”

60岁以上人口的探险旅游已变成一个快速发展的商业机遇。根据探险旅游贸易协会（Adventure Travel Trade Association）的数据，美国超过四成的探险旅游者都在50岁以上。在英国，在这一产业上花费最多的是老年人，其中增长最快的年龄段是65至74岁。这些人并不喜欢舒适的邮轮或休闲的巴士游，他们想要动起来，去北极探险，或者来一趟亚洲文化之旅。

明尼苏达州73岁的简·德特洛夫（Jane Dettloff）刚完成了一趟为期两周的智利骑行游。“文化、美食、海滩，噢，还有安第斯葡萄酒！”白天，16名女性——最年轻的61岁，最年长的87岁——一起踩单车、聊天，“感觉变回小女孩了。”夜晚，她们享受“美酒时光，而不是为吃药发牢骚”。组织这次旅行的VBT旅游公司没有明确说自己专事老年旅行，但从广告词中可以听出微妙的暗示：“按你自己的节奏来”、“自1971年以来”、“上好的葡萄酒”。超过九成的客户都已年过五旬。

| 过时

另一个新兴市场是约会交友。尽管在包括美国、澳大利亚和英国在内的一些国家，总体离婚率正在下降，但“银发族分道扬镳”的几率却在飙升——那些开始拿退休金的人们突然发现，自己和伴侣待在一起的时间将大大增加。琳达·格拉顿（Lynda Gratton）和安德鲁·斯科特（Andrew Scott）在《百岁人生》（The 100-Year Life）一书中写道，美国60岁以上人口的离婚率是1990年时的两倍，在英国是三倍。在广受欢迎的约会网站Match.com上，超过四分之一的会员年龄在53岁到72岁之间，且这一年龄段的成员数量增长得比其他任何年龄段都快。

老年人似乎比年轻人更担心网上约会的风险，由此催生了像Stitch这种专门针对老人的网站。这家在线寻觅伴侣的网站已有8.5万名会员。“50岁以后乐趣更多。”该网站的一则宣传视频中这样说道，还不忘加上一句“这里一切都很安全”。老年顾客似乎比年轻人更愿意成为网上付费会员，只要这能带来额外价值。Stitch的联合创始人安德鲁·道林（Andrew Dowling）解释说，公司的会员都经过筛选，而且公司会为他们组织社交活动。“大部人都想要伴侣，但不同年龄段的约会方式确实不同。”

来自新泽西州的乔迪（Jody）受到玩约会应用的侄女们的启发，在纽约一家时髦的酒吧里参加了Stitch组织的“喝点酒、扎扎堆”活动。结果这场活动变成了十位女性一边啜饮玛格丽特鸡尾酒，一边交流各自灾难般的网上约会经历而开怀大笑。她们还展开了一场争论：加入山地自行车或高尔夫这类更加男性化的活动是否会更容易结识男人？

女性在尝试寻找伴侣上的开销大于男性，这是因为在年纪更大的年龄段里女性人口更多（在富裕国家她们的寿命平均比男性多五年），也更可能单身。2014年，美国65岁以上男性有近四分之三已婚，仅十分之一鳏居；而在同一年龄段的女性中，不到一半已婚，三分之一寡居。在欧洲也一样，65岁以上女性独居的几率是男性的两倍还多。假如她们储蓄不足的话，这可能会带来问题，不过也打开了对各类事物的新需求，而这在二三十年前几乎无人想象得到。

其一是与从前不同的住所。预期寿命变长后，这些“更年轻的老年人”不再想要住在孤零零的祖母公寓里，而是要寻找更像单身汉公寓这样欢快闹腾的住处。“已退休‘黄金少女’寻觅两名见多识广、随和友好、正能量，有（疯疯癫癫的）幽默感的人，共享一套漂亮美好的住宅。”独居老人寻室友网站goldengirlsnetwork.com上的一则广告这样写道。

不过，商家若想进军“年轻化老年人”这一新市场，要注意一点：这些人比较难搞。他们不把自己看作老人，对那些专门针对老年人的广告很反感（佳洁士在推出50+专用牙膏后就发现了这一点）。50+们对于效果不达预期的网站或电子设备也难以容忍。英国最大的50+社区Silversurfers.com的马丁·洛克（Martin Lock）说，“假如某样东西不奏效，他们会是最先离开的。”

据咨询公司麦肯锡估计，从现在到2030年，富裕国家城市中消费增长的大头将来自60岁以上的人群。由此看来，商家应该进军这一市场。不过，要提供所需的资金，金融业首先要改造自己。■



Working on

Footloose and fancy-free

The recently retired may have a promising future as entrepreneurs and giggers

IN THE SHADOW of towering apartment blocks in Nowon-gu, a suburb of Seoul, employees of CJ Logistics, a large South Korean delivery company, gather at the local welfare centre. A truck pulls up and the group, mostly men in their 70s, leap to their feet to unload parcels. “It’s far better than staying at home,” says Eun Ho Lee, a chirpy 77-year-old who in his younger days ran a bedlinen business. Like so many of his generation in this country, he has no pension and lives mainly on his savings, so the 800,000-900,000 won (\$700-800) he makes from this job are welcome. He cannot imagine himself ever leaving.

There are drawbacks to older workers, admits a local supervisor; they carry fewer boxes and are sometimes slower than their younger colleagues. But since the company pays its employees per delivery, that does not matter, and the unhurried chattiness of this side of the business, the “Senior Parcel Delivery Service”, seems to appeal to customers.

In the rich world, and especially in Europe, the debate about retirement tends to focus on intergenerational conflict: pay-as-you-go public pension schemes mean that the young, in effect, are paying for the old. But if older people were to carry on working for longer, the resulting economic boost would benefit young and old alike, generating extra growth. The average 65-year-old in the rich world can now expect to live for another 20 years, half of them free of disability. If people in “older” countries, such as Germany, Japan and Spain, were to delay retirement by 2-2.5 years per decade between 2010 and 2050, it would be enough to offset the effect of demographic change, according to Andrew Mason, of the University of Hawaii, and Ronald Lee, of the University of California, Berkeley.

Older workers may be forgiven if they feel confused about whether or not they are wanted. In the period after the second world war, Britons preparing for retirement were told that “your economy needs you.” Then, from the 1970s onwards, they (and many fellow Europeans) were urged to make way for the young, causing large numbers to take early retirement even as life expectancy was rising. At the same time fertility rates were dropping, conjuring up the risk of future labour shortages. By the 1990s governments and employers realised they were making pension promises they would not be able to keep. The idea that there is only a finite number of jobs to go round—the “lump of labour”—was more widely exposed as a fallacy. It became fashionable to argue that “we must work till we drop.”

| *A work ethic like no other*

The baby-boomer generation, known for its energy and assertiveness, has embraced that creed, but on its own terms. Many of its members had always been planning to work past their formal retirement age, both for the fun of it and because they needed the money. Aegon, an insurer, found in a recent survey that more than half of workers over 55 were hoping for a flexible transition to retirement, but only a quarter said their employers would let them work part-time. Age discrimination in both retention and recruitment is also a serious obstacle to keeping people in work for longer. One American study involving 40,000 fictitious CVs sent in response to advertised vacancies for low-skilled jobs found that applicants between 49 and 51 had 19% fewer callbacks than those aged 29 to 31 with otherwise identical CVs. For the 64-66 age group the difference was 35%.

In response to such discrimination and inflexibility, some boomers try their luck in the gig economy. Though gigging is usually seen as something that young people do, in many ways it suits older people better. They are often content to work part-time, are not looking for career progression and are better able to deal with the precariousness of such jobs. A quarter of

drivers for Uber, an on-demand taxi service, are over 50. More broadly, a quarter of all Americans who say they work in the “sharing economy” are over 55, according to PwC, a consultancy.

“Now I manage my own future. I manage my own life,” says Aykut Durgun, a 60-year-old former retail manager who drives his beautifully kept Mazda 5 for Uber and Lyft, another ride-hailing firm, in San Francisco. The change from managing 40 people to being ordered around by a 20-year-old in the back seat took some getting used to, but he loves the socialising, flexibility and challenge of navigating the city’s grid. The money isn’t bad either; he earns about \$6,000 a month before tax and sees no reason to slow down: “It’s the best way to prevent dementia.”

It helps that the gig economy has moved well beyond delivering pizzas or people. Businesses that offer on-demand lawyers, accountants, teachers and personal assistants are finding plenty of recruits among older people. Wahve (short for Work At Home Vintage Experts), a New York-based company, provides work for hundreds of former finance and insurance professionals, mostly in their 60s and 70s. “Carriers and brokers have huge talent problems, it takes years to train an underwriter,” says Sharon Emek, the firm’s 71-year-old founder. She realised boomers were retiring from the workforce but didn’t want to stop working; so now they are “pre-tiring”.

| *Startup generation*

The boomers are also becoming entrepreneurs. In America those between 55 and 65 are now 65% more likely to start up companies than those between 20 and 34, according to the Kauffman Foundation. In Britain 40% of new founders are over 50, and almost 60% of the over-70s who are still working are self-employed, which says as much about the limitations of conventional workplaces as about these seniors’ entrepreneurial spirit.

In Japan and South Korea, which are among the world’s fastest-ageing

societies, large companies tend to get rid of older workers as they approach 60, and many of those workers then start a business. Some employers, including Hyundai, now also help older workers make the transition to life as an entrepreneur.

But “it’s not employers’ job to save society. They need to see the business case for older workers,” says Laura Carstensen of Stanford University. That requires a few myths about older workers to be tackled; mainly that they are less able-bodied, inventive and productive than the young. This may have been true 50 years ago, but both the workplace and the workers have changed. Over the past decades the point at which workers are physically no longer able to work has shifted much further up the age range. The idea that only the young can innovate has also been successfully challenged.

Whether older workers are less productive than younger ones is harder to say. In fields where physical prowess matters, such as sports, it is obvious. But in many areas performance does not necessarily decline with advancing age. And even in jobs where it might, there are often ways of getting round it.

As Gernot Sendowski, head of diversity at Deutsche Bank in Germany, explains: “In operational work older employees can be slower, but they make up for that with fewer mistakes, so in total they are no less productive. If we had teams with only older people, they’d be too slow; if we had teams with only younger ones, there’d be too many mistakes.” The bank’s answer is to deploy multigenerational teams.

Mercer, a consultancy, has also found that older workers’ contribution is more likely to show up in group performance than in traditional individual performance metrics (how many widgets someone makes per hour). “It seems the contribution of older workers materialises in the increased productivity of those around them,” says Haig Nalbantian, a partner in the

firm. In repetitive work, productivity does seem to fall with age, but in knowledge-based jobs, age seems to make no difference to performance, finds Axel Börsch-Supan, of the Max-Planck Institute in Munich. And when such jobs also require social skills (as in the case of financial advisers, for example), productivity actually increases with age, he adds. That should give older knowledge workers an advantage in the world of artificial intelligence (AI), where social skills may be at a premium.

All this bodes better for high-skilled older workers than for low-skilled ones. “Who gets to stay healthy is not random; education is by far the top predictor,” says Ms Carstensen. And more highly educated Americans are more likely to work on for longer, write David Bloom, from Harvard University, and colleagues. It has also become clear that some work can be good for both physical and cognitive health. This helps explain the substantial gap in both general and healthy life expectancy between skilled and unskilled workers, which could grow wider unless everyone has access to lifelong learning to make them more adaptable.

Fortunately the sort of changes to working life that older workers are looking for—flexible hours, a workplace designed with wellness in mind, the opportunity to keep learning—are also just the sort of things that millennials demand from prospective employers. And if employers keep their costs down by getting rid of age-related perks, such as seniority-based pay and promotion, they will have less reason to shun older people—and make the workplace fairer and more productive for everyone.

One large economic contribution made by older people that does not show up in the numbers is unpaid work. In Italy and Portugal around one grandmother in five provides daily care for a grandchild, estimates Karen Glaser from King’s College London. That frees parents to go out to work, saving huge sums on child care. In Britain unpaid older caregivers save the state around £11.4bn per year, according to Age UK, a charity.

Apart from providing support within the family, a quarter of people also aspire to doing some voluntary work after retirement, according to a recent study by Aegon. In America the over-55s formally volunteered 3.3bn hours in 2016, making an economic contribution worth \$78bn, says the Corporation for National and Community Service, a federal agency. A number of studies have found that this benefits not only the good causes they work for but also their own physical and mental health.

But there is another way in which older people support the economy: by spending their money. ■



继续工作

自由自在，无拘无束

新近退休的人也许可以去创业或做兼职，前景光明

在首尔市郊芦原区，高耸的公寓楼投下的阴影中，韩国大型快递公司希杰大韩通运（CJ Logistics）的员工们聚集在当地的福利中心。一辆卡车停下，这群人（多数是七十多岁的男性）迅速起身，开始卸货。“比在家里待着好多了。”李恩浩（Eun Ho Lee，音译）说。这位77岁的快活老人年轻时曾经营一家床上用品企业。他和这个国家的许多同辈人一样，没有退休金，主要靠自己的储蓄生活，这份工作赚来的八九十万韩元（七八百美元）对他很有用处。他难以想象自己有朝一日会辞工走人。

当地一名管理员坦言，年长的员工有短板。他们搬运的货物比年轻同事少，有时还比他们慢。不过公司按件计酬，这也就不是个问题了。而且，从事“老年人快递服务”这项业务的人不慌不忙、与人相谈甚欢的特点似乎还颇受顾客欢迎。

在富裕地区，尤其是欧洲，由退休引发的争论往往聚焦在代际冲突：现收现付的养老金制度意味着老年人的养老钱实际上是由年轻人在支付。不过，如果老年人继续工作更长时间，便能促进经济发展，这样年轻人和老人均可从中获益，进而创造更多的经济增长。在富裕国家，普通的65岁居民如今有望再活20年，而且他们中一半的人都没有残障。夏威夷大学的安德鲁·梅森（Andrew Mason）和加州大学伯克利分校的罗纳德·李（Ronald Lee）认为，如果2010年到2050年间，德国、日本和西班牙等老龄化较严重的国家每十年将退休年龄延迟2到2.5岁，便足以抵消人口结构变化带来的影响。

如果年长的员工对于社会到底需不需要自己继续工作感到茫然，这倒也可以理解。二战后，已准备退休的英国人被告知“国家的经济需要你”。70年代以后，他们（许多欧洲的同辈人也是一样）又被催促着为年轻人让路，造成大量人员提早退休，尽管预期寿命在增长。与此同时，生育率在下

降，催生出未来劳动力短缺的风险。到了90年代，政府和雇主意识到，自己承诺支付的养老金日后根本发不出来。而“社会能供应的工作数量有限”的想法越发广泛地被认为是一种谬误（即劳动合成谬误）。“生命不息，工作不止”的主张流行起来。

| 不一样的职业道德

以精力充沛、自信果断而著称的婴儿潮一代欣然接受这一信条，不过是按他们自己的方式。这代人当中有很多人一直都计划着到了正式退休年龄也要继续工作，一方面是享受工作的乐趣，一方面也是因为需要钱。荷兰全球保险集团（Aegon）最近的调查发现，超半数55岁以上的劳动者希望能灵活地向退休过渡，但只有四分之一的人表示自己的雇主愿意让他们以兼职的形式工作。员工保留及招募方面存在的年龄歧视也严重阻碍了人们延长工作年限。在美国的一项研究中，调查者向低技能工作的招工广告投递了四万份虚构的简历，结果发现，即便除年龄外这些简历并无区别，但49到51岁的申请者和29到31岁的申请者相比，前者得到的电话回应要少19%。64到66岁的人得到的回应则要少35%。

面对这样的歧视以及灵活性的欠缺，有些婴儿潮一代的人到零工经济的领域里碰运气。虽然人们一般认为打零工是年轻人的专利，但这种工作形式在很多方面都更适合老年人。他们通常都满足于做兼职工作，并不谋求职业发展和晋升，也能更好地应对这种工作的不稳定。叫车服务优步的司机有四分之一年龄超过50岁。而放眼更广泛的领域，据咨询公司普华永道的数字，所有自称在“共享经济”领域工作的美国人中，有四分之一的人超过55岁。

“现在，我的未来由我负责，我的人生由我把控。”60岁的前零售经理艾库特·杜尔根（Aykut Durgun）说道。他在旧金山开着一辆精心保养的马自达5，为优步和另一家网约车公司Lyft服务。从管理40个人到听命于后座一个20岁的年轻人，他着实花了些功夫适应这种转变。不过他很喜欢这份工作的灵活性、跟人打交道的机会，以及在旧金山网格状道路穿行的挑战。收入也不错——他每月税前能赚6000美元左右，找不出什么理由要放慢节奏。“这是预防痴呆最好的办法了。”

零工经济已远不止于送披萨或接送乘客，这一点很有帮助。提供随叫随到的律师、会计师、教师以及个人助理的企业从老年人中招到了不少人。总部位于纽约的Wahve公司（全称为 Work At Home Vintage Experts，即“在家办公的优质老专家”）为数百位前金融和保险领域专业人士提供工作机会，这些人大多六七十岁。该公司71岁的创始人莎伦·埃梅克（Sharon Emek）称，“保险机构及经纪商在人才库方面存在重大问题。培训一名核保人要花好几年的时间。”她认识到，婴儿潮一代正逐渐从劳动大军中退出，但他们并不想停止工作。因此，他们如今是“退而不休”。

| 创业的一代

婴儿潮一代还开始了创业生涯。据考夫曼基金会（Kauffman Foundation）称，在美国，55到65岁的人创办公司的可能性比20到34岁的人高出65%。在英国，有40%的创业者超过50岁，70岁以上仍在工作中的人中近60%都是自雇人士。这既揭示出传统工作环境的局限性，也展现了老年人进取的企业家精神。

日本和韩国属于全世界老龄化速度最快的社会之列，两国的大企业往往会在年长的员工快到60岁时把他们打发走，而这些员工中有很多人随后都会自己创业。如今，包括现代在内的一些雇主会为年长的员工提供帮助，使其实现向创业者的角色转变。

但是，“拯救社会并不是雇主的职责。它们需要找出雇用老年人在商业上可行的理由。”斯坦福大学的劳拉·卡斯滕森（Laura Carstensen）说道。这需要破除关于年长员工的一些错误观念，主要是认为他们的体力、创造力和生产效率都不如年轻人。这在50年前可能还是事实，但如今的工作环境和劳动者都已不同于以往。过去几十年里，员工体力不足以继续工作的年龄已大幅后延。只有年轻人才能够创新的观念也已被证明站不住脚了。

至于年长的员工是否比年轻员工生产率低，这就不那么好说了。在要求充沛体力的领域，例如体育，这一点不言而喻。但在其他很多领域，业绩并不一定会随着年龄的增长而下滑。就算年龄对于某些岗位真的有影响，通常也会有变通的办法。

正如负责德意志银行员工多元化的格诺·森多斯基（Gernot Sendowski）所解释的那样，“就操作型工作而言，年长的雇员是会慢些，不过他们出错较少，所以总体来看他们的生产率一点不低。如果团队里只有年长的员工，他们就会太慢；如果团队里只有年轻人，又会出很多错。”这家银行的解决办法是组织多代员工混杂的团队。

咨询公司美世（Mercer）也发现，相比传统的个人业绩衡量标准（看一个人一小时能制造多少件产品），采用衡量团队绩效的指标更能显现出年长员工的贡献。该公司一位合伙人海格·纳班提恩（Haig Nalbantian）说，“年长员工的贡献似乎是通过提高团队其他人的生产率来实现的。”慕尼黑马克斯·普朗克研究所的阿克塞尔·波尔什-苏潘（Axel Börsch-Supan）发现，对于重复性的工作，员工的生产率确实看起来会随着年龄的增长而下降，但在以知识为基础的岗位上，年龄对工作表现似乎并不会产生影响。他补充道，如果这些工作还要求员工有社交技能（例如财务顾问的工作），生产率其实是随着年龄增长而提升的。如此一来，在社交技能成为稀缺品的人工智能（AI）世界里，年长的知识劳动者便会享有优势。

以上种种预示着，高技能的年长员工要比低技能年长员工境遇更好。“什么人能保持健康，这并不是随机的。目前为止，教育是最重要的预测指标。”卡斯滕森说。哈佛大学的大卫·布鲁姆（David Bloom）及其同事则写道，在美国，受教育程度更高的人更有可能继续工作较长时间。有些工作对身体及认知健康均有好处，这点也已变得明确。这有助于解释技术工人和非技术工人何以在一般预期寿命和健康预期寿命方面均存在显著的差距。如果不是所有人都能获得终身学习的机会，从而提高自身的适应能力，这种差距或许会进一步拉大。

好在年长员工所寻求的职业生活的改变——灵活的工作时间、考虑员工健康的工作场所设计，以及持续学习的机会——恰好也是千禧一代要求潜在雇主提供的东西。如果雇主通过取消与年龄有关的特殊待遇控制住了成本，例如以资历决定薪资和升职，那么它们就更没有理由回避老年人了，而且这样做还可以令所有人都享有更公平、生产率更高的工作环境。

老年人做出的一项未能由数字体现出来的重大经济贡献是无偿工作。伦敦国王学院的凯伦·格雷瑟（Karen Glaser）估计，在意大利和葡萄牙，每五位祖母中就有一位每天在照看孙辈。孩子的父母得以抽身去工作，省下大笔的幼儿看护费用。慈善机构Age UK指出，在英国，无偿从事照护工作的老年人每年可为政府节省114亿英镑。

荷兰全球保险集团近期的一项研究发现，除了为家人提供支持，有四分之一的人还渴望在退休后从事一些志愿工作。美国联邦机构国家与社区服务公司（Corporation for National and Community Service）称，2016年，美国55岁以上的人正式完成了33亿小时的志愿工作，经济贡献价值780亿美元。一些研究发现，这不仅有利于公益事业，对老年人自身的身心健康也有益。

不过，老年人还有另外一种支持经济的方式：花钱。 ■



The economics of longevity

The new old

Ageing populations could be a boon rather than a curse. But for that to happen, a lot needs to change first, argues Sacha Nauta

“NO AGE JOKES tonight, all right?” quipped Sir Mick Jagger, the 73-year-old front man of the Rolling Stones (pictured), as he welcomed the crowds to Desert Trip Music Festival in California last October. The performers’ average age was just one year below Sir Mick’s, justifying his description of the event as “the Palm Springs Retirement Home for British Musicians”. But these days mature rock musicians sell: the festival raked in an estimated \$160m.

There are many more 70-somethings than there used to be, though most of them are less of a draw than the Stones. In America today a 70-year-old man has a 2% chance of dying within a year; in 1940 this milestone was passed at 56. In 1950 just 5% of the world’s population was over 65; in 2015 the share was 8%, and by 2050 it is expected to rise to 16%. Rich countries, on which this report is focused, are greying more than the developing world (except for China, which is already well on the way to getting old); the share of over-65s in the OECD is set to increase from 16% in 2015 to 25% by 2050. This has knock-on effects in older age groups too. Britain, which had just 24 centenarians in 1917, now has nearly 15,000.

Globally, a combination of falling birth rates and increasing lifespans will increase the “old-age dependency ratio” (the ratio of people aged 65 or over to those aged 15-64) from 13% in 2015 to 38% by the end of the century. To listen to the doomsayers, this could lead not just to labour shortages but to economic stagnation, asset-market meltdowns, huge fiscal strains and a dearth of innovation. Spending on pensions and health care, which already makes up over 16% of GDP in the rich world, will rise to 25% by the end of

this century if nothing is done, predicts the IMF.

Much of the early increases in life expectancy were due not to people living longer but to lower death rates among infants and children, thanks to improvements in basic hygiene and public health. From the start of the 20th century survival rates in old age started to improve markedly, particularly in the rich world, a trend that continues today. More recently, life spans—the estimated upper limits of average life expectancy—have also been increasing. Until the 1960s they seemed fixed at 89, but since then they have risen by eight years, thanks in part to medical advances such as organ replacements and regenerative medicine. The UN estimates that between 2010 and 2050 the number of over-85s globally will grow twice as much as that of the over-65s, and 16 times as much as that of everyone else.

Warnings about a “silver time bomb” or “grey tsunami” have been sounding for the past couple of decades, and have often been couched in terms of impending financial disaster and intergenerational warfare. Barring a rise in productivity on a wholly unlikely scale, it is economically unsustainable to pay out generous pensions for 30 years or more to people who may have been contributing to such schemes only for a similar amount of time. But this special report will argue that the longer, healthier lives that people in the rich world now enjoy (and which in the medium term are in prospect in the developing world as well) can be a boon, not just for the individuals concerned but for the economies and societies they are part of. The key to unlocking this longevity dividend is to turn the over-65s into more active economic participants.

This starts with acknowledging that many of those older people today are not in fact “old” in the sense of being worn out, sick and inactive. Today’s 65-year-olds are in much better shape than their grandparents were at the same age. In most EU countries healthy life expectancy from age 50 is growing faster than life expectancy itself, suggesting that the period of

diminished vigour and ill health towards the end of life is being compressed (though not all academics agree). Yet in most countries the age at which people retire has barely shifted over the past century. When Otto von Bismarck brought in the first formal pensions in the 1880s, payable from age 70 (later reduced to 65), life expectancy in Prussia was 45. Today in the rich world 90% of the population live to celebrate their 65th birthday, mostly in good health, yet that date is still seen as the starting point of old age.

This year the peak cohort of American baby-boomers turns 60. As they approach retirement in unprecedented numbers, small tweaks to retirement ages and pensions will no longer be enough. This special report will argue that a radically different approach to ageing and life after 65 is needed.

The problems already in evidence today, and the greater ones feared for tomorrow, largely arise from the failure of institutions and markets to keep up with longer and more productive lives. Inflexible labour markets and social-support systems all assume a sudden cliff-edge at 60 or 65. Yet in the rich world at least, a new stage of life is emerging, between the end of the conventional working age and the onset of old age as it used to be understood.

Those new “young old” are in relatively good health, often still work, have money they spend on non-age-specific things, and will run a mile if you mention “silver”. They want financial security but are after something more flexible than the traditional retirement products on offer. They will remain productive for longer, not just because they need to but because they want to and because they can. They can add great economic value, both as workers and as consumers. But the old idea of a three-stage life cycle—education, work, retirement—is so deeply ingrained that employers shun this group and business and the financial industry underserve it.

| *What's in a name?*

History shows that identifying a new life stage can bring about deep institutional change. A new focus on childhood in the 19th century paved the way for child-protection laws, mandatory schooling and a host of new businesses, from toymaking to children's books. And when teenagers were first singled out as a group in America in the 1940s, they turned out to be a great source of revenue, thanks to their willingness to work part-time and spend their income freely on new goods and services. Such life stages are social constructs, but they have real consequences.

This report will argue that making longer lives financially more viable, as well as productive and enjoyable, requires a fundamental rethink of life trajectories and a new look at the assumptions around ageing. Longevity is now widespread and needs to be planned for. The pessimism about ageing populations is based on the idea that the moment people turn 65, they move from being net contributors to the economy to net recipients of benefits. But if many more of them remain economically active, the process will become much more gradual and nuanced. And the market that serves these consumers will expand if businesses make a better job of meeting their needs.

The most important way of making retirement financially sustainable will be to postpone it by working longer, often part-time. But much can be gained, too, by improving retirement products. The financial industry needs to update the life-cycle model on which most of its products and advice are based. Longer lives require not just larger pots of money but more flexibility in the way they can be used.

As defined-benefit pension schemes become a thing of the past, people need to be encouraged to set aside enough money for their retirement, for example through auto-enrolment schemes. It would also help if some of the better-off pensioners spent more and saved less. They would be more

likely to do that if the insurance industry were to improve its offerings to protect older people against some of the main risks, such as getting dementia or living to 120. Many people's biggest asset, their home, could also play a larger part in funding longer lives.

And for the oldest group, increasingly there will be clever technology to help them make the most of the final stage of their lives, enabling them to age at home and retain as much autonomy as possible. Perhaps surprisingly, products and services developed mainly for the young, such as smartphones, social media, connected homes and autonomous cars, could also be of great benefit to the older old.

But the report will start with the most obvious thing that needs to change for the younger old: the workplace. Again, there are parallels with young people. Working in the gig economy, as so many of them do, may actually be a better fit for those heading for retirement. ■



长寿经济学

新型老年人

老龄化的人口可以是福音而非诅咒，但萨沙·诺塔认为许多东西要先行改变

“今天晚上不讲年龄的笑话，记住啦？”去年10月的加州沙漠之旅音乐节上，73岁的滚石乐队主唱米克·贾格尔爵士（Sir Mick Jagger）在致欢迎词时打趣道。演出者的平均年龄只比米克小一岁，证明他把这场活动描述为“英国音乐家的棕榈泉养老院”并不夸张。但在如今，成熟的摇滚音乐家非常卖座：这场音乐节大赚了约1.6亿美元。

现在的古稀老人比以前多多了，虽然大多数人并没有滚石那样的影响力。如今在美国，一名70岁的男性在一年内死亡的可能性是2%，而1940年时这个里程碑是在56岁。1950年时世界上65岁以上的人口仅占5%，2015年则是8%，到2050年预计将升至16%。本次特别报道重点关注富裕国家，它们比发展中国家老龄化更严重（除了中国，它已经老龄化到一定程度了）；经合组织国家中，65岁以上人口比例预计将从2015年的16%增加到2050年的25%。这对于更老的人群也有连锁效应。1917年时英国只有24位百岁老人，如今则有近15,000人。

从全球来看，出生率下降与寿命延长共同作用，将使“老年抚养比”（65岁以上人口与15-64岁之间的人口比例）从2015年的13%提高到世纪末的38%。悲观者会说这不仅可能导致劳动力短缺，还可能造成经济停滞、资产市场崩溃、巨额财政压力和缺乏创新。富裕国家的养老金和医保开支已经超过了GDP的16%，国际货币基金组织预测，如果什么都不做，这一比例到本世纪末将会上升到25%。

由于基本卫生和公共医疗的改善，早先预期寿命的延长主要不是因为人们活得更久，而是因为婴儿和儿童的死亡率降低了。从20世纪初开始，老年人的存活率明显提高，特别是在富裕国家，这一趋势一直延续到今天。更近些时候，预期寿命（估计平均预期寿命的上限）也开始增长。直到20世纪60年代，预期寿命似乎定格在89岁，但自那以后，这一数字已经上升了

八年，部分归功于器官更换和再生医学等医学进步。联合国估计，在2010年至2050年间，全球85岁以上人口的增长率将是65岁以上人口增长率的两倍，其他所有人口增长率的16倍。

过去几十年来，关于“银色定时炸弹”或“白发海啸”的警告不绝于耳，并且常常会谈及金融灾难和代际战争即将到来等。除非生产力提高到超乎想象的水平，不然要向人们发放丰厚的养老金长达30年或更久在经济上是无法维持的——这些人缴款的时间也差不多也就这么长。但本组特别报道却认为，富裕国家现在享受的（发展中国家在中长期也会享受的）更长寿、更健康的生活可以是一个福音，不仅是对于这些人，对于他们所属的经济体和社会都是如此。解锁长寿红利的关键，在于让65岁以上的群体更为积极地参与经济。

要做到这一点，首先要承认，如今许多老年人的“老”并不意味着他们油尽灯枯、百病缠身或无所作为。今天65岁老人的身体状况比他们的祖父母在65岁时好多了。在大多数欧盟国家，50岁时的预期健康寿命比预期寿命本身提高得更快，这意味着临终时活力和健康状况不佳的时期正在被压缩（尽管并不是所有的学者都认同这一点）。然而，大多数国家的退休年龄在过去一个世纪几乎没有变化。奥托·冯·俾斯麦在19世纪80年代推出了世界上最早的养老金制度，规定人们在70岁后（后来降低到65岁）可以领取，当时普鲁士人的预期寿命是45岁。在今天的富裕国家，90%的人能活到庆祝自己的65岁生日，其中大部分人到那时都身体健康，但这一天仍然被视为老年的起点。

今年，美国婴儿潮最高峰时期出生的一批人60岁了。当他们以前所未有的数字接近退休时，只是微调退休年龄和退休金已经不够了。本组特别报道认为，我们需要一种完全不同的方法来对待老龄化和65岁之后的生活。

问题在今天已经显现，明天恐怕会进一步加剧。这主要是缘于机构和市场未能跟上更长寿、生产力更高的生命节奏。死板的劳动力市场和社会保障体系都在60或65岁的时候搞一刀切。然而至少在富裕国家，在通常的工作年龄结束与传统意义上的老年开始之间，一个新的生活阶段正在浮现。

那些新的“年轻老人”身体状况较好，通常还在工作，有钱花在非老年用品上，如果你提到“白发”，人家还能跑一英里给你看。他们想要财务安全，但追求比传统退休产品更灵活的东西。他们还将继续工作更长时间，不仅仅是因为他们需要，而是因为他们想要、他们可以。他们作为劳动者和消费者可以增添巨大的经济价值。然而陈旧的三阶段生命周期观念——受教育、工作、退休——已经根深蒂固，雇主回避这个群体，企业和金融业为其提供的服务也不够。

| 名字有多重要？

历史表明，确定一个新的生命阶段可以带来深刻的制度变迁。19世纪时人们开始关注童年，为儿童保护法、义务教育和从玩具制造到童书等大量新业务铺平了道路。而在20世纪40年代，美国的青少年作为一个群体出现时，他们变成了一个很大的收入来源，这要归功于他们愿意兼职工作，并在新的商品和服务上自由消费自己的收入。这些生命阶段只是社会建构的概念，但却带来了实实在在的影响。

本组特别报道认为，要让更长的生命在财务上更为可行，同时生产力更高、生活更为愉快，就要从根本上重新思考生活的轨迹，重新审视关于老龄化的假设。长寿现在已很普遍，需要规划。关于人口老龄化的悲观情绪，是基于人们在65岁时就会从经济中的净贡献者变为净受益者的观念。但如果更多人在经济上保持活跃，这个过程就会变得更渐进、更微妙多元得多。如果企业能更好地满足他们的需求，为这些消费者服务的市场将会扩大。

让退休在财政上能够维持，最重要方式就是工作（往往是兼职工作）更长时间，把完全退休延后。但在改进退休产品方面也大有可为。金融业需要更新其大多数产品和建议背后的生命周期模型。更长的寿命不仅需要更多的钱，在使用这些钱方面也需要更灵活。

随着固定收益养老金计划成为过去，政府需要鼓励人们留出足够的钱以备退休，例如设立自动加入的计划。那些富裕的养老金领取者如果能花钱更多、存钱更少，也会有帮助。如果保险行业能够改进产品，为老人的一些

主要风险（如罹患痴呆症或活到120岁）提供保障，人们就更有可能这样做。作为许多人最大的资产，房屋也可在提供资金方面起到更大的作用。

对于最高龄的群体来说，会有越来越多的智能技术帮助他们最好地度过生命的最后阶段，让他们在家中老去，并尽可能保持自理。也许令人惊讶的是，主要为年轻人开发的产品和服务，如智能手机、社交媒体、智能家居和自动驾驶汽车等，对高龄老人可能也大有好处。

但本次特别报道将首先讨论需要为年轻老人做出改变的一个最明显的方面：工作场所。其实年轻人也有类似的需要。许多年轻人正投身于零工经济，而这种工作模式实际上可能更适合那些将要退休的人士。■



Longevity

Over 65 shades of grey

To get the most out of longer lives, a new age category is needed

WHAT do you call someone who is over 65 but not yet elderly? This stage of life, between work and decrepitude, lacks a name. “Geriactives” errs too much on the side of senescence. “Sunsetters” and “nightcappers” risk being patronising. Perhaps “Nyppies” (Not Yet Past It) or “Owls” (Older, Working Less, Still earning) ring truer.

Branding an age category might sound like a frivolous exercise. But life stages are primarily social constructs, and history shows that their emergence can trigger deep changes in attitudes. Such change is needed if the questions that swirl around rising longevity are to get a fitting answer.

| *End of Generation zzz*

Before 1800 no country in the world had an average life expectancy at birth beyond 40. Today there is not a country that does not. Since 1900, more years have been added to human life than in the rest of history combined, initially by reducing child mortality and lately by stretching lifespans. Longevity is one of humanity’s great accomplishments.

Yet it is seen as one of society’s great headaches. The problem lies in the increasing dependency of the old on the young. By 2100, the ratio of 65-plussers to “working-age” people will triple. As the world greys, growth, tax revenues and workforces will decline while spending on pensions and health care will increase. So, at least, goes the orthodoxy.

Doom-mongers tend to miss a bigger point, however. Those extra years of life are predominantly healthy ones. Five of the additional six years that a British boy born in 2015 can expect to live, compared with one born in 1990,

will be healthy, according to the Institute for Health Metrics and Evaluation, at the University of Washington. Too many governments and firms fail to recognise this fact, instead lumping all the extra years in the damning category of 65 and over. This binary way of thinking, seeing retirement as a cliff edge over which workers and consumers suddenly tumble, bears little relation to the real world. It also encourages unimaginative policy, whereby the retirement age is occasionally moved as lifespans lengthen.

A more radical approach would start by acknowledging that, in the rich world at least, many of the old are still young. They want to work, but more flexibly. They want to spend money, too. In western Europe the over-60s will account for 59% of consumption growth in cities between now and 2030, says McKinsey, a consultancy.

Declaring a new stage of life could help change perceptions. It has done so before. Today's conception of childhood emerged in the 19th century, paving the way for child-protection laws and a golden age of children's literature. Spotty, awkward 15-year-olds predated the 1940s, but only then did mystified adults coin the label "teenagers", fuelling all sorts of products and services, from bobby socks to the music industry. In 1944 *Life* wrote that "American businessmen, many of whom have teen-age daughters, have only recently begun to realise that teen-agers make up a big and special market." By the mid-1960s both *Time* and *Newsweek* had splashed "The Teen-Agers" on their covers.

Marking out youthful old age as a distinct phase of life might have a similar effect, prodding employers and policymakers to think differently about how to keep the young old active. As life becomes longer, the word "retirement", which literally means withdrawal to a place of seclusion, has become misleading. At 65 you are not clapped out, but pre-tired. So, as they embark on the next stage, here's to all those pre-tirees. ■



长寿

65后的65种灰

要想最大程度利用长寿的好处，需要划分出一个新的年龄组别

一个人过了65岁，但尚未老迈，该用什么词来描述？这个介于工作生涯和衰老之间的人生阶段并没有一个名称。“返老回春”（Geriactives）太过于先行强调“老”了；“夕阳红”（Sunsetters）和“陈年老酒”（nightcappers）可能有居高临下的意味。也许生造词“逆皮士”（Nyppies）或“猫头鹰一族”（Owls）在意思上更贴切些。前者是Not Yet Past It的缩写，意为“还没过气”，后者是Older, Working Less, Still earning的缩写，意指相对年长、工作量已经减少但仍在赚钱的人。

为一个年龄组别安上一个名号听上去也许无关紧要，但人生阶段主要是社会建构出来的概念，历史也证明，这些概念出现后，人们的态度会发生深刻的转变。人的寿命不断延长，由此产生的问题纷纷扰扰。若要为这些问题找到一个恰当的解答，这样的态度转变很有必要。

| 昏睡世代的终结

1800年之前，世界上没有哪个国家的人口在出生时的平均预期寿命超过40岁。如今，没有一个国家低于这个数字。自1900以来，人类生命增加的年数比其余历史时期增长的总和还要多。人类生命的增加最初是因为儿童死亡率降低，近来则是因为寿命延长。长寿是人类最伟大的成就之一。

然而，长寿却成了令社会头痛的一个大难题。问题在于老年人对年轻人的依赖程度越来越高。到2100年，65岁以上人口与“适龄”劳动人口的比率将增长两倍。随着世界老龄化加剧，经济增长、税收收入以及劳动力都会出现衰退，而养老金和医疗保健上的支出却会增加。起码主流观点是这样认为的。

然而，末世论者往往都未能领会更重要的一点：因寿命延长而增加的那些年头中，人们绝大多数时候都是健康的。据华盛顿大学健康指标与评估研

究所（Institute for Health Metrics and Evaluation）估算，与1990年出生的英国男孩相比，一个2015年出生的英国男孩的寿命预计会长六年，其中有五年是健康状态。太多政府和公司都没能认识到这一点，而是潦草地将这多出来的几年与“65岁以上”这个倒霉的年龄组别混为一谈。仿佛临退休就是走到了悬崖边，员工和消费者会猛然跌落——这样的两分法与现实世界相去甚远。这种想法还会催生缺乏创意的政策，仅随寿命延长偶尔变更退休年龄。

要采取更为激进的做法，首先要承认很多老年人仍年轻，起码在富裕国家是如此。这些人想工作，但希望工作时间更灵活。他们也想消费。咨询公司麦肯锡称，从现在起到2030年，西欧60岁以上人群将贡献59%的城市消费增长。

宣布一个新的人生阶段的存在可以帮助改变人们的认知，从前这种情形就已发生过。我们今天所说的“童年”这一概念出现于19世纪，它为儿童保护法的出台以及儿童文学黄金年代的出现铺平了道路。脸上满是痘痘、举止笨拙的15岁孩子并不是到了1940年代才有，但直到这个时期，困惑的成年人才创造出“青少年”（teenagers）这个标签。这之后便涌现出各种各样的产品和服务，从翻边短袜到音乐产业不一而足。1944年，《生活》（*Life*）杂志写道，“很多美国商人自己就有十几岁的女儿，却直到最近才开始意识到，青少年构成了一个庞大而特殊的市场。”到了1960年代中期，青少年的形象还大举登上了《时代》和《新闻周刊》的封面。

将状态仍年轻的老年时光划为一个独立的人生阶段也许会产生类似的影响，敦促雇主和政策制定者在思索如何令“年轻老人”保持活跃时跳脱窠臼。随着人们寿命变长，“退休”这个词（retirement，字面意思是退居隐蔽隔绝之处）已变得有误导性。到了65岁的人并非不顶用，而是“预退休”。所以，在这些人开始下一个人生阶段之际，让我们向所有预退休人士致以敬意和祝愿吧。■



Resource-governance index

Wealth does not necessarily mean good management

Wealth does not necessarily mean good management. According to the Natural Resource Governance Institute's index, six of the 13 high-income countries studied failed to achieve good or satisfactory ratings for the quality of their natural-resource governance. Scores are based on a framework of 133 questions, including ones on extraction rights and corruption. The majority of the members of OPEC have poor or failing resource regimes. Saudi Arabia's score is dragged down in part by murkiness surrounding its state oil firm, Saudi Aramco. Sovereign wealth funds are another problem area. The Qatar Investment Authority is ranked as one of the worst-governed of the 33 funds studied. ■



资源管理指数

富有不见得就有良好的管理

富有不见得就意味着有良好的管理。根据自然资源管理研究院（Natural Resource Governance Institute）发布的指数，在所调查的13个高收入国家中，有6个在自然资源管理评分上未达到良好或满意的等级。评分框架包含133个问题，其中有些问题涉及开采权和腐败方面。大多数欧佩克成员国的资源管理体制都处于很差或失败的等级。沙特的国家石油公司沙特阿美（Saudi Aramco）运作不透明，一定程度上拖累了该国的得分。主权财富基金是另一个问题领域。在所调查的33只基金中，卡塔尔投资局（Qatar Investment Authority）的治理处于最差之列。■



Cisco

Flicking the switch

A technology titan shifts strategy to cope with the cloud

WHEN John Chambers ran Cisco, the world's biggest maker of networking gear, his hyperactivity nearly matched that of the high-speed switches and routers that made the firm's fortune. He pushed Cisco into dozens of new businesses, from set-top boxes to virtual health care. He travelled the world preaching the virtues of connectivity. In interviews it was hard to get a word in edgeways. Conversations invariably ended on a restless question: "What should we do differently?"

Chuck Robbins, who succeeded Mr Chambers in July 2015, has two decades of experience selling Cisco gear and seems more comfortable talking about its core business than about diversifications. He avoids the limelight and comes across as almost shy. But he, too, is aware of the need to keep moving. "Networking is getting complex. We need intuitive networks that are secure and can learn and adapt."

Different times require different bosses. Mr Chambers led Cisco to the top during the dotcom boom; in the early 2000s it became the world's most valuable firm (see chart). Mr Robbins's task is to keep it relevant as more and more computing moves into the cloud, which entails the provision of all kinds of services over the internet. On June 20th the firm announced a collection of new products which show how it is adapting: Cisco will focus on software and services, particularly the sort that automate the management of data networks.

Cisco is best known for its switches and routers (the former are the central building blocks of networks, the latter connect them with each other). Although it embraced the internet's open standards, Cisco came to

dominate data networking for telecoms firms and other enterprises. Its boxes work well with each other and they can be centrally managed. Most firms' network engineers know how to use Cisco's boxes. Although its market share has declined in recent years, the firm still sells more than half of all new switches and routers, which together generate more than half of its annual revenue of about \$50bn.

Owning the mightiest platform in networking, says Pierre Ferragu of Sanford C. Bernstein, a research firm, provides a defence against competitors, such as China's Huawei and Arista Networks, based in California. It also makes Cisco less vulnerable to a problem bedevilling some makers of computing and storage gear, such as Dell, EMC or HPE: "commoditisation", meaning they are losing pricing power.

But Cisco's franchise is facing two threats. First, the more computing is done in the cloud, the less firms have to buy their own gear, including networking equipment. Instead of paying for an "end-to-end network" from Cisco, big cloud operators such as Amazon and Microsoft prefer gear that precisely fits their requirements. This is why Cisco's cloud sales have disappointed, while more specialised vendors such as Arista have made inroads. The second threat is that software is increasingly important to how networks are run: that makes it easier for rivals to sidestep or overtake Cisco's products.

Under Mr Robbins, Cisco has responded in several ways. It is offering tailor-made products to the big cloud providers. It has beefed up its software and services business and, to ensure more stable revenues, is making more of its products available as a subscription. Earlier this year the firm bought AppDynamics, which makes software to monitor the performance of corporate applications, and Viptela, whose programs manage networks, for \$3.7bn and \$610m respectively. Subscriptions and other recurring income now make up a tenth of Cisco's revenues from products.

Cisco's bet is that computing will never be fully centralised in vast data centres (ie clouds), but will live on many systems, big and small, says Rohit Mehra of IDC, a research firm. Cisco thinks that trends such as an explosion in the number of connected devices, also known as the "internet of things", will almost certainly add to complexity, not reduce it.

The products introduced in late June are designed for this kind of environment. They include software which lets engineers control hundreds of thousands of devices, programs to define who or what is allowed to access a network and services to detect malware in encrypted traffic. For the first time, Cisco will sell new switches that come with subscriptions which unlock these sorts of extra capabilities. Developers will get more tools to write applications for Cisco's platform.

Being the firm that makes ever more complex networks safe and "intuitive", to quote Mr Robbins's new catchphrase, seems a sensible goal. It is already one of the biggest vendors of cyber-security products. It has enough money to pursue its ambitions: more than \$70bn in cash.

But computing could yet become much more centralised, leaving less space for Cisco to knit things together. Big cloud providers will also try to get into the business of managing and automating networks. And Cisco has a mixed record of implementing its strategy. However well it does, Cisco is unlikely to achieve a goal set by Mr Chambers back in 2013: to become the world's "number-one player" in corporate-information technology. The more realistic Mr Robbins is unlikely to articulate such an ambition—he would probably be happy if Cisco remained among the top five. ■



思科

转换策略

科技巨头改变策略应对云计算

在执掌全球最大的网络设备制造商思科（Cisco）时，约翰·钱伯斯（John Chambers）动作频频，活跃度堪比为公司带来滚滚财源的高速交换机和路由器。他将思科推入数十个新业务领域，从机顶盒到虚拟医疗保健无不涉足。他走遍世界，到处宣讲网络联通的好处。采访他的时候别人很难插上话，而对话最后总是回到同一个问题上来：“我们该做些什么不同的事呢？”

于2015年7月接替钱伯斯的查克·罗宾斯（Chuck Robbins）有20年销售思科设备的经验。他似乎更愿意谈论思科的核心业务而非多元化。他不喜欢出风头，给人近乎害羞的印象。但他同样清楚知道思科需要不断前进。“网络变得越来越复杂，我们需要安全的、有学习和适应能力的直觉网络（intuitive networks）”。

不同的时代需要不同的老板。钱伯斯在互联网热潮期间领导思科攀上顶峰，令其在21世纪初一度成为世界上最有价值的公司（见图表）。随着越来越多的计算转到云端，需要在互联网上提供各种服务，罗宾斯的任务就变成了让思科在新时代里保有一席之地。6月20日，思科发布了一系列新产品，展示了公司正在如何适应市场：专注软件和服务，尤其是将数据网络管理自动化的那类软件和服务。

思科以制造交换机和路由器闻名（前者是网络的中心组件，后者则把它们彼此连接起来）。虽然思科支持互联网的开放标准，但仍主宰了电信公司和其他企业的数据网络。它的设备互相之间协调运转，可以集中管理。大多数公司的网络工程师都知道如何使用思科的设备。尽管近年来其市场份额有所下降，但仍占有所有新售出交换机和路由器的一半以上。思科的年收入约为500亿美元，这些设备的销售额占到了其中的一半还多。

研究公司盛博（Sanford C. Bernstein）的皮埃尔·费拉古（Pierre Ferragu）认为，拥有最强大的网络连接平台让思科可以抵御诸如中国的华为和加州的Arista Networks等竞争对手的挑战，也让思科不太容易像戴尔、EMC或慧与（HPE）等计算和存储设备制造商那样，因为设备变得“大众商品化”而失去定价能力。

但思科的产品面临两大威胁。首先，进入云端的计算越多，企业必须自己购买的设备就越少，包括网络设备。大型云运营商，如亚马逊和微软，更喜欢精准符合其要求的设备，而不是向思科购买“端到端网络”。因此，思科的云业务销售业绩令人失望，而Arista Networks这样更专业的供应商则攻城略地。第二个威胁是，软件对网络的运行越来越重要，这让竞争对手更容易绕过或超越思科的产品。

在罗宾斯的领导下，思科从几个方面做出了回应：向大型云供应商提供定制产品；加强软件和服务业务；把更多的产品变成续订类产品，以确保更稳定的收入。今年早些时候，思科分别以37亿美元和6.1亿美元的价格收购了AppDynamics和Viptela，前者开发监控企业应用程序性能的软件，后者是一家网络管理程序供应商。续订类产品和其他经常性收入现在占思科产品收入的十分之一。

调研公司IDC的罗希特·麦赫拉（Rohit Mehra）表示，思科押注计算永远不会完全集中在庞大的数据中心（即云端）内，而是会存在于许多大大小小的系统中。思科认为，类似联网设备（即物联网）数量呈爆炸式增长的种种趋势几乎肯定会增加而非减少网络的复杂性。

思科于6月底推出的产品就是为这样的环境而设计，其中包括能让工程师控制成千上万个设备的软件，用于界定网络访问权限的程序，以及检测加密数据流中恶意软件的服务。思科将首次销售新型交换机，用户可以通过续订服务另外购买上述附加功能。开发人员将获得更多工具，为思科平台编写应用程序。

成为一家能让日益复杂的网络保持安全和“直觉化”（引用罗宾斯的新口头

禅)的公司,这似乎是一个合理的目标。思科已经是网络安全产品最大的供应商之一,它也有足够的资金——700多亿美元的现金——来实现抱负。

但未来的计算可能会变得比如今集中得多,让思科编织网络的空间减少。大型云供应商也将尝试进入网络管理和自动化的业务领域;而思科在战略执行的方面表现有好有坏。不管思科做得多好,都不太可能实现钱伯斯在2013年设定的目标——成为企业信息技术领域的世界“第一”。为人更加现实的罗宾斯不太可能会表达这样的野心——如果思科的排名能保持在前五,他可能就很满意了。■



Retailing in Pyongyang

Minisocialist

A hip, cheap home-goods upstart from China sets up shop in North Korea

WHEN Miniso said in January that its stores would “bring the happiness of stress-free shopping to the Koreans”, you would be forgiven for thinking they were referring to emporium-loving Seoulites. In fact, the home-goods store, co-founded by a Chinese entrepreneur and a Japanese designer, was announcing that it would be taking its capitalist trinkets into (ostensibly socialist) North Korea. In a joint-venture deal with one of the country’s state-owned enterprises, it agreed to establish the first foreign-branded chain store in Pyongyang, the destitute country’s showcase capital.

The first Miniso store opened there in April, eight months after its first shop in South Korea began operating, and just before it launched in America. Its arrival is remarkable in a place where displays of branding are rare (the exception is a handful of billboards advertising a local car firm, Pyeonghwa Motors).

Miniso’s coup in the secretive kingdom is part of a global advance. Since it opened its first store in Guangzhou in China in 2013, it has signed deals to expand into more than 50 countries, from Mexico to Mongolia; it has more than 1,800 outlets in total. Revenue amounted to 10bn yuan (\$1.5bn) in 2016, almost double that of the previous year.

Ye Guofu, the Chinese entrepreneur who co-founded Miniso with Junya Miyake, who runs its design team in Tokyo, sends out some 200 buyers around the world in search of ideas. New household goods hit its shelves every week, from nail polishes to bath mats and frying pans. Its few pricey products cost no more than about \$40. Its young fans see it as a cross between three popular Japanese retailers: Daiso, a ¥100 chain, where

everything costs less than 90 cents; Uniqlo, a clothing company with minimalist design; and Muji, a lifestyle chain with a massive product range. Others gripe that it is misleadingly plugging its Japaneseness (it says it was founded in Tokyo, though it has only four shops there and over 1,000 in China) to appeal to Asian consumers keen on *kawaii*, or Japan's brand of cuteness.

Anecdotal evidence from Pyongyang suggests that the city's coterie of privileged North Koreans is already enthusiastic. On a recent visit a foreign resident saw mainly toys, cosmetics and home-decor baubles being bought for between \$2 and \$10. Price tags at Miniso are in North Korean won but customers must pay in dollars, euros or Chinese yuan—an embarrassment to the regime, which knows its won are worthless. The store is in a lotus-flower-shaped building on Ryomyong Street, a cluster of high-rise apartments and shops (pictured) opened in April to fanfare by Kim Jong Un, the North's leader, who took power on the death of his father in 2011.

The young Mr Kim has promised his oppressed people more leisure and consumption: shopping centres, renovated funfairs and a water park have in recent years been unveiled in the capital. That helps to explain the entry of Miniso, which says it wants not only to “enrich people's choices in North Korea, but also improve people's living standard”. Lim Eul-chul of Kyungnam University in South Korea expects Miniso will soon be stocked with locally produced goods too. Yet this is not a market for the faint-hearted. Egypt's Orascom Telecom entered into a joint venture with the state in 2008 to set up North Korea's first 3G cellular network. It has yet to repatriate any profits, and in 2015 it said that the North Korean state had established a second carrier to compete with its own network. ■



平壤的零售业

名创优品的社会主义事业

中国一家平价时尚家居用品新贵在朝鲜开店

名创优品在1月表示，它的门店将“为朝鲜族人民带来无压力购物的幸福感”。你如果以为它指的是喜欢逛商场的首尔人，那也情有可原。可事实上，这家由中国企业家和日本设计师共同创立的家居用品商店当时是在宣布，要把带有资本主义情调的小饰品带到（自称社会主义国家的）朝鲜。它和朝鲜一家国有企业签订了合资协议，在这个贫困国家的窗口城市平壤设立了当地第一家外国品牌连锁店。

朝鲜的首个名创优品店铺于4月份开业，比韩国首家门店晚八个月，略早于其登陆美国的时间。在平壤，除了本地汽车公司平和汽车（Pyeonghwa Motors）的几块广告牌，很少会见到品牌展示，名创优品的开张令人瞩目。。

名创优品在这个神秘王国的成功出击是其全球发展的一部分。自2013年在广州开设第一家门店以来，它已同各国签署协议，进军从墨西哥到蒙古的50多个国家；它总共拥有1800多家门店。2016年的收入已达100亿元（15亿美元），比2015年几乎翻了一番。

中国企业家叶国富和三宅顺也（Junya Miyake）联合创办了名创优品，三宅顺也在东京领导设计团队，叶国富则向世界各地派出了大约200名买手收集点子。每周都有新的家庭用品上架，从指甲油到浴室防滑垫和煎锅。为数不多的一些高价产品价格也不超过40美元。年轻粉丝们认为名创优品是日本很受欢迎的三大零售商的混合体：百元连锁店大创（Daiso，所有商品的价格均低于100日元/90美分）、追求极简设计的服装公司优衣库，以及产品种类丰富的生活方式连锁店无印良品。其他人抱怨说，该公司带有误导性地宣传其日本血统（它宣称自己创立于东京，但在当地只有四家店铺，在中国却有1000多家），以此来吸引热衷日本“卡哇伊”文化的亚洲消费者。

来自平壤的传闻显示，城里的特权圈子已经热情高涨。一位当地的外籍居民最近去过这家店，看到那里主要销售的是价格在2至10美元之间的玩具、化妆品和家居饰品。商品以朝鲜元标价，但顾客必须支付美元、欧元或人民币——这让明白本国货币毫无价值的政府很尴尬。这家店位于黎明大街（Ryomyong Street）上的一座莲花形建筑内。这条汇集了高档公寓和商店（见图）的大街于今年4月由金正恩大张旗鼓地揭幕，这位朝鲜领袖在2011年其父去世后执掌政权。

年轻的金正恩已经向其受压迫的人民承诺，要给予他们更多的休闲和消费选择。近年来在首都开张了一些购物中心、新翻修的游乐场，以及一座水上乐园。这也能解释名创优品的入场——该公司表示它不仅要“丰富朝鲜人民的选择，也想提高他们的生活水平”。韩国庆南大学的林乙哲（Lim Eul-chul，音译）预计，名创优品也很快将销售朝鲜本地生产的商品。不过，这个市场可不适合胆小之人。埃及的奥斯康电信（Orascom Telecom）在2008年与朝鲜政府建立合资企业，建设了朝鲜首个3G移动网络，但它至今尚未向国内汇回任何利润。而在2015年，该公司表示朝鲜政府已经建立了第二家电信运营商来与自己的网络竞争。 ■



Additive manufacturing

Printing things everywhere

3D printers will shape the factory of the future

MANUFACTURING advances often take time to catch on. Only later does their real significance become apparent. The flying shuttle, invented in 1733 by John Kay, a British weaver, allowed the production of wider pieces of cloth. Because its movement could be mechanised, the shuttle later became one of the innovations which paved the way for the Industrial Revolution. In 1913 Henry Ford brought motoring to the masses by making his Model T on a moving assembly line; but it was Ransom Olds, a decade earlier, who had come up with the idea of an assembly line to boost production of the Olds Curved Dash. Throughout the 1980s factory bosses scratched their heads over Taiichi Ohno's Toyota Production System and its curious methods, such as the just-in-time delivery of parts. Now it is the global benchmark for factory efficiency.

What, then, to make of the potential of Chuck Hull's invention in 1983 of "stereolithography"? Mr Hull is the co-founder of 3D Systems, one of a growing number of firms that produce what have become known as 3D printers. These machines allow a product to be designed on a computer screen and then "printed" as a solid object by building up successive layers of material. Stereolithography is among dozens of approaches to 3D printing (also known as additive manufacturing).

Printing has become a popular way of producing one-off prototypes, because changes are more easily and cheaply made by tweaking a 3D printer's software than by resetting lots of tools in a factory. That means the technology is ideal for low-volume production, such as turning out craft items like jewellery, or for customising products, such as prosthetics. Dental crowns and hearing-aid buds are already being made by the million

with 3D printers. Because it deposits material only where it is needed, the technology is also good at making lightweight and complex shapes for high-value products ranging from aircraft to racing cars. GE has spent \$1.5bn on the technology to make parts for jet engines, among other things.

But sceptics still rule the roost when it comes to goods made in high volumes. They say that 3D printers are too slow and too expensive—it can take two days to create a complex object. Unlike the techniques pioneered by Kay, Olds and Ohno, additive manufacturing will never revolutionise mass production. Such scepticism looks less and less credible.

Some of the new methods of 3D printing now emerging show that its shortcomings can be overcome. Adidas, for one, has started to use a remarkable form of it called “digital light synthesis” to produce the soles of trainers, pulling them fully formed from a vat of liquid polymer. The technique will be used in a couple of new and highly automated factories in Germany and America to bring 1m pairs of shoes annually to market much more quickly than by conventional processes. A new technique called bound-metal deposition has the potential to change the economics of metal printing, too, by building objects at a rate of 500 cubic inches an hour, compared with 1-2 cubic inches an hour using a typical laser-based metal printer.

| *Layers of meaning*

As in previous manufacturing revolutions, factories will take time to be transformed. The dexterity of human hands still beats the efforts to introduce the fully automated production of clothing, for example. But automation is spreading to every production line in every country, and 3D printing is part of that trend. As wages in China rise, some of its mass-production lines are being fitted not just with robots but the first 3D printers, too. And as global supply chains shorten, bosses will want to use additive manufacturing to tailor products to the demands of local

consumers. The full consequences of the technology's spread are hard to predict. But when they do become clear, Mr Hull's name may well be bracketed with the likes of Kay, Olds and Ohno. ■



增材制造

无处不打印

3D打印机将塑造未来的工厂

制造业的进步要普及往往需要时间。这些进步的真正意义总要到后来才显现出来。1733年，英国织造商约翰·凯（John Kay）发明了飞梭，生产出了更宽幅的布料。飞梭实现了梭子的机械化运动，后来成为了为工业革命铺平道路的创新之一。1913年，亨利·福特用流水装配线来生产他的T型车，让普罗大众享受到了驾驶的乐趣。不过比这早十年，兰塞姆·奥茨（Ransom Olds）就已想出用装配线来提高奥茨Curved Dash车的产量。整个20世纪80年代，工厂老板们绞尽脑汁，试图弄明白大野耐一（Taiichi Ohno）始创的丰田生产方式以及其中的准时交付零部件等新奇的方法是怎么回事。如今，这已是全球工厂效率的基准。

那么又该如何看待查克·赫尔（Chuck Hull）于1983年发明的“立体光刻法”的潜力呢？赫尔是3D Systems公司的联合创始人，该公司生产如今被称为3D打印机的设备，这样的公司现在越来越多。有了这种打印机，产品可以先在计算机上设计，然后再将材料逐层累积起来，“打印”出固体物品。3D打印（也称为增材制造）有几十种方法，立体光刻便是其中之一。

3D打印已成为生产一次性产品原型的流行方式。微调3D打印机的软件就能调整原型，这比在工厂里重新设置大量工具更容易也更便宜。这让该技术非常适合小批量生产，比如生产首饰之类的工艺品和假肢等定制产品。3D打印机已经用于生产数百万计的人造牙冠和助听器。由于3D打印仅在需要的地方沉积打印材料，所以该技术还可以为从飞机到赛车等高价值产品制造轻量而复杂的部件。通用电气已经在这一技术上投资15亿美元，为喷气发动机等设备制造零件。

但是，在大批量生产的商品上，对3D打印持怀疑态度的人仍占主导。他们说3D打印机太慢，成本太高，打印一个复杂的物品可能要花两天的时间。与凯、奥茨和大野耐一所开创的技术不同，增材制造永远不会彻底改变批

量生产。不过这种怀疑似乎越来越不可信。

3D打印如今出现了一些新方法，表明3D打印的缺点是可以克服的。举例来说，阿迪达斯已经开始使用一种称为“数字光合成”的方法来生产运动鞋的鞋底，这种令人赞叹的3D打印方法可以把液态聚合物直接固化成形。该技术将在德国和美国新建的几座高度自动化工厂内应用，每年会将100万双鞋推向市场，比传统工艺要快得多。一种名为结合金属沉积（bound-metal deposition）的新技术也有可能改变金属印刷的经济可行性。这种技术能够以每小时500立方英寸的速度构建物体，而常规的激光金属打印机每小时只能打印出一到两立方英寸。

| 多层意义

和以前的制造革命一样，工厂也将需要时间来实现转变。例如，人手的灵巧度高，所以在成衣制造中仍然没有引进全自动化。然而，自动化正向每个国家的每条生产线蔓延，3D打印也是这一趋势的一部分。中国的工资水平不断上涨，一些大规模生产线不仅加装了机器人，也首次安装了3D打印机。随着全球供应链的缩短，工厂老板们也希望利用增材制造提供定制产品，满足本地消费者的需求。3D打印技术普及的全面影响难以预测，不过当这些结果清晰显现出来时，赫尔的名字很可能将与凯、奥茨和大野耐一等技术开拓者相提并论。■



Free exchange

National treasure

Expanded state ownership is a risky solution to economic ills

WHEN Jeremy Corbyn unveiled his Labour manifesto ahead of the recent British election, opponents gawked at pledges to renationalise the postal and rail systems. Such enthusiasm for state ownership smacks of a philosophy long since abandoned by leaders on both left and right. Despite Labour's decent electoral performance, nationalisation is not everywhere on the march; on June 5th Donald Trump made public his desire to privatise air-traffic control. But the rise of Mr Corbyn and Bernie Sanders hints at a weakening of the rich-world consensus that the less of the economy owned by government, the better. That is a pity. Expanded state ownership is a poor way to cure economic ailments.

For much of the 20th century, economists were open to a bit of *dirigisme*. Maurice Allais, an (admittedly French) economist who won the Nobel prize in 1988, recommended that the government run a few firms in each industry, the better to observe the relative merits of public and private ownership. Economists often embrace state control as a solution to market failure. Since there is no way to provide national security only to citizens who sign up to pay for it while denying it to the rest, it requires a government with the power to tax to provide defence. In cases of natural monopoly, in transport and telecommunications, nationalisation is an alternative to allowing a dominant firm to use its market power to overcharge for subpar service. And state control looks attractive when private markets are bad at providing universal access to critical services. Private schools or health insurers have an incentive to skim off the best-prepared students and healthiest patients, and to deny services to harder cases, creating a large pool of people that cannot profitably be served.

But in the 1970s economists came to see state ownership as a costly fix to such problems. Owners of private firms benefit directly when innovation reduces costs and boosts profits; bureaucrats usually lack such a clear financial incentive to improve performance. Firms with the backing of the state are less vulnerable to competition; as they lumber on they hoard resources that could be better used elsewhere. Inattention to cost-cutting is not always a flaw. Oliver Hart, co-winner of last year's Nobel prize for economics, pointed to private prisons as a case in which profit-focused managers might accept a cost-efficient decline in the welfare of prisoners that society would prefer not to have. Yet economists saw in the productivity slowdown of the 1970s evidence that an overreaching state was throttling economic dynamism. Mr Corbyn first won election to parliament when the Tory government of Margaret Thatcher, inspired by Milton Friedman, was busily selling off bits of state firms like British Leyland (the nationalised carmaker), British Airways and what was then called British Petroleum. Other governments followed suit although public assets in most countries remain large (see right-hand chart).

State-owned firms pose risks beyond that to dynamism. Government-run companies may prioritise swollen payrolls over customer satisfaction. More worryingly, state firms can become vehicles for corruption, used to dole out the largesse of the state to favoured backers or to funnel social wealth into the pockets of the powerful. As state control over the economy grows, political connections become a surer route to business success than entrepreneurialism. Even botched privatisations can improve governance in corruption-plagued emerging economies.

If antipathy to nationalisation is fading, however, that has less to do with newfound confidence in state competence and more with disappointment in private business. Although studies typically find that countries with more of the economy under state control grow more slowly than those with less, much of the rich world—including enthusiastic privatisers like

America and Britain—is limping through productivity doldrums. High corporate profits suggest that private markets are not hotbeds of cut-throat competition. Recent economic growth has done more to enrich shareholders and a small set of highly skilled workers than the public as a whole. Tech dynamos like Google and Facebook delight consumers, but these companies increasingly wield unsettling economic and social power. Both the financial crisis and growing suspicion of Silicon Valley fan suspicions that private ownership is not a sure way to advance the public good.

Modern forms of public ownership are designed to look more benign than the old models. The new nationalisation might involve governments sitting quietly in the boardroom, grabbing a share of profits for the public purse and reminding firms not to neglect their social responsibilities, while leaving enough shares in private hands to harness the benefits of red-blooded capitalism.

| *Hire, not fire*

Even this modest version of state capitalism could disappoint. Shared ownership, even at small scales, has the potential to blunt competition in ways that harm consumers. The rise of large asset managers, like BlackRock and Vanguard, means that huge stakes in firms representing much of the stockmarket are controlled by a few passive investors running money for private savers. Recent research suggests that this concentrated ownership may be bad for competition. As a result of common ownership of airlines by asset managers, for instance, fares are estimated to be 3% to 5% higher than if ownership were more dispersed.

Some on the left might see higher prices as an acceptable cost for a reduction in corporate power (and it is hard to imagine service at some airlines getting worse in public hands). Yet there are other risks to consider. China's state-owned sector is proving difficult to shrink in part because it

accounts for so much employment. Governments trying to deliver good jobs may be tempted to lean on state-controlled firms to hire more staff, particularly in countries with powerful public-sector unions. Consumers and taxpayers would bear the costs of such bloating. Corporate power, inequality and underemployment are all real worries. Expanding state ownership is the wrong way to tackle such ills. ■



自由交流

国家宝藏

扩大国有化是解决经济弊病的险招

在最近的英国大选之前，杰里米·科尔宾（Jeremy Corbyn）公布了工党竞选宣言，誓要让邮政和铁路系统重新国有化，令对手瞠目结舌。如此热衷国有化，让人想到多年前就已被左右两派放弃的那一套理念。工党在大选中表现不俗，不过国有化却并未在各国风行：6月5日，特朗普公开表示希望实现空中交通管制私有化。但科尔宾和伯尼·桑德斯（Bernie Sanders）的崛起暗示着富裕世界中认为国有经济成分越少越好的共识正在减弱。这令人遗憾。以扩大国有化来治疗经济问题实在是一条下策。

二十世纪的大部分时间里，经济学家多少会接受一点“国家干预”。1988年获诺贝尔奖的法国经济学家莫里斯·阿莱（Maurice Allais）建议，每个行业都应该有一些由政府经营的企业，以更好地体现公有制和私有制的相对优缺点。经济学家们往往视国家管制为市场失灵的药方。由于无法只向同意付费的公民提供国家安全防卫而把其他人排除在外，所以就需要有权力征税的政府来提供国防服务。在交通运输和电信这样的自然垄断行业，国有化是一种替代方案，可以防止一家主导企业利用其市场支配力以高价提供低质服务。当私人市场无力为所有人提供关键服务时，国有制就显出了吸引力。出于利益考虑，私立学校或医疗保险公司会挑拣最具潜质的学生和最健康的投保人，而拒绝条件较差的对象，这样便会形成一个庞大的群体，向这一群体提供服务无法获利。

但到了20世纪70年代，经济学家们开始意识到，以国有化解决这类问题，代价很高。创新可以降低成本、提升利润，令私营企业主直接获益，而政府官员通常缺乏如此明确的财务激励来提升业绩。政府扶持的企业较少受到竞争的冲击；它们行动迟缓，所囤积的资源本可在别处得到更好的利用。但疏于削减成本也不总是缺点。去年诺贝尔经济奖得主之一奥利弗·哈特（Oliver Hart）以私营监狱为例，指出注重利润的管理者可能会通过降低囚犯福利来节约成本，而社会大众并不希望这样。然而，上世纪70年

代生产力放缓，经济学家们据此认为政府的过度干预扼杀了经济活力。科尔宾在撒切尔夫人执政时首次当选议员，当时的保守党政府受经济学家米尔顿·弗里德曼（Milton Friedman）的启发，正忙于出售部分国有企业，如国有车企英国利兰（British Leyland）、英国航空公司，以及英国石油公司（当时叫“British Petroleum”）。其他政府也随之效仿，但大部分国家仍保持相当比例的公有资产（见右图）。

国有企业带来的风险还不止影响经济活力。政府经营的企业可能会把自身庞大的薪资单放在首位，而忽视顾客满意度。更令人担忧的是，国有企业可能成为腐败的手段，用来向偏爱的支持者派发国家资财或向权贵输送社会财富。随着政府对经济的操控增强，相比企业家精神，政治关系成了获得商业成功更稳妥的途径。在腐败成风的新兴经济体里，私有化即便很拙劣，也能改善企业治理。

然而，如果人们对国有化的反感有所减弱，这与其说是对政府的能力重燃信心，还不如说是对私营企业的失望使然。尽管研究通常都显示，政府对经济管控程度高的国家经济增速相对较慢，但大部分富裕国家（包括英美这些热衷私有化的国家）却也陷于生产力低迷的困局。高涨的企业利润表明私人市场并不一定会促成激烈竞争。从近期经济增长中得利更多的是股东和少数高技术雇员，而非社会整体。谷歌和Facebook等科技领军企业赢得了消费者的欢心，但这些公司对经济和社会的影响力越来越大，令人不安。金融危机以及对硅谷质疑的增多加重了人们的疑虑——也许私有制并非推动大众福祉的万全之策。

公有制的现代形式显得比旧模式更加温和无害。在新的国有化形式下，政府也许会安静地待在董事会里，拿走企业的部分利润去充实国库，并提醒企业不要忘记自己的社会责任，同时也让私人资本掌握足够的股份来发挥资本主义澎湃的活力。

| 要招聘，而非解聘

即便是这种温和的国家资本主义也可能令人失望。共享所有权，就算只是小规模，也有可能削弱竞争，导致消费者利益受损。贝莱德

（BlackRock）和先锋（Vanguard）等大型资产管理公司的崛起，意味着股市主流企业的巨额股份掌控在少数为私人储户管理资金的被动投资机构手中。近期研究显示，所有权如此高度集中，可能不利于竞争。举例来说，由于资产管理公司对多家航空公司拥有共同所有权，机票价格估计要比所有权更分散的情形下高出3%到5%。

部分左派人士可能认为，为了削弱企业的权力，略高的价格是可以接受的代价（而且也难以想象一些航空公司在国有化后服务还会变得更糟）。但还有其他风险需要考虑。中国的国有部门难以缩减，部分原因在于它们提供了大量就业。希望提供优质工作岗位的政府也许会很依赖国有企业来聘用更多员工，尤其是在公有部门工会强大的国家。消费者和纳税人将为这类人事臃肿买单。企业权力、不平等、就业不足的确令人担忧，但为解决这些弊病而扩大国家所有权，则是误入歧途。■



Apple and the iPhone

The new old thing

Apple is struggling to find another blockbuster product. The old one might do

APPLE has a new hit device, so popular that it has sold out across most of America and Britain. If you order it online it takes six weeks to arrive. “Best Apple product in a long time,” sings one online review. Useful and (of course) slickly designed, it enjoys the highest consumer satisfaction of any Apple product in history, according to a study by two firms, Creative Strategies and Experian.

Such enthusiasm must be bittersweet for Apple’s bosses. The gadget in question is AirPods, a set of wireless headphones that look a lot like Apple’s traditional ear buds, just without a wire. Priced at \$159, AirPods could become a business worth billions of dollars, like the Apple Watch, a wearable device that Apple started selling in 2015. But headphones are hardly the transformative, vastly profitable innovation that many have been waiting for.

That wait started only a few years after its biggest blockbuster launched. On June 29th 2007 the iPhone first went on sale. Since then Apple has sold some 1.2bn phones and notched up more than \$740bn in sales from the bestselling tech gadget in history (see chart). Two-thirds of Apple’s \$216bn in sales in 2016 came from the iPhone.

Atop a hill there is usually nowhere to go but down. Questions about the future of the iPhone and whether Apple will ever design another product to match it pursue the company. The relentless rise of smartphone ownership is slowing, with around two-fifths of the global population now owning one. Apple is also facing more competition, especially in China (its second most important market after North America) where sales have been

declining, lending weight to fears that Apple is experiencing “peak iPhone”.

Even though Apple has been spending \$10bn a year on research and development, “people aren’t banking on innovation”, says Amit Daryanani of RBC Capital Markets, a bank. That helps to explain why the firm’s shares are valued on a price-to-earnings ratio of around ten times its forecast 2018 earnings (stripping out cash), lower than the 12-14 times that the information-technology industry trades on.

Certainly, Apple’s attempts to diversify away from its hit product have been flawed. One disappointment has been television, worth some \$260bn globally. Its TV offering is a cable box that is little more than a portal to content from other firms, such as Netflix, not the disruptive offering that Apple executives promised.

There is also justified scepticism about another possible avenue for growth: personal transportation, an industry that is worth some \$10trn. In June, for the first time, Tim Cook, Apple’s chief executive, publicly discussed the firm’s ambition to develop an autonomous-car system. Apple could surely design a sleek car, but the big shift is away from ownership toward transportation as a service. Routing cars to specific places, as Uber does, is a leap.

Many people believe that Apple could expand in health care, on which people spend an estimated \$8trn each year globally. Today Apple allows people to store their fitness information on their devices and offers a platform for developers to create health and fitness apps. But it is as yet unclear what Apple’s edge will be. Its stance on consumers’ privacy, which it protects more assiduously than other technology giants, may be an advantage. But dealing with a complex web of companies and reams of red tape, as any foray into health care would require, would again be a big departure from what it is used to.

Part of Apple's difficulty in finding the next big thing may be that it is still steered by a small, insular group of executives who have mostly been at the firm since the 1990s. They include Mr Cook, who took over shortly before the death of Steve Jobs, the firm's adored founder, in 2011. Apple is not good at hiring people from outside who could help bring new skills and ideas. Other companies have a far better record of bringing outsiders into the fold. Amazon's Prime video offering and the work that formed the basis for Echo, its home speaker, drew on newcomers' expertise.

Yet Apple will have every chance to adapt because of the enduring strength of its hit product. The iPhone business will not grow as rapidly as in the past but it will remain more important for far longer than people think, says Ben Thompson of Stratechery, a research firm. The iPhone 8, due to be unveiled in September, is likely to be innovative enough to encourage around 250m-300m iPhone users to upgrade, driving a new "supercycle" of sales.

Katy Huberty of Morgan Stanley, a bank, goes as far as to say that "for Apple the next iPhone will be the iPhone." The inclusion of augmented reality (AR), which superimposes digital information onto real-world images, for example, is likely to drive strong future iPhone sales. Apple is likely to include a 3D camera in the iPhone, and it recently said it would begin operating ARKit, a platform for software developers to design new apps that integrate AR. This step is akin to when Apple launched its app store in 2008. That set off a wave of innovation in mobile apps, which in turn gave consumers more reasons to buy iPhones. One early experiment is by the retailer IKEA, which is working on an iPhone and iPad app that lets users point their phone and see what furniture looks like superimposed in a particular space.

By encouraging app developers to start work on AR now, Apple will have a two- or three-year head start on Google's Android operating system, says

Tim Bajarin of Creative Strategies. Google has launched an AR platform, called Tango, but it is only available on two devices, the Lenovo Phab 2 Pro and the Asus ZenfoneAR, which have few users. If Apple can keep a lead on integrating AR into its software, that would also give users a reason to keep on preferring the iPhone over cheaper smartphones. This will be particularly helpful in China, where local brands such as Vivo and OPPO have taken share—last summer OPPO's R9 phone, which costs just \$400, overtook the iPhone in the country.

Other revenue streams are tied in part to the iPhone's success. One area of strong growth—if the base of iPhone users continues to expand—will be Apple's services business, which includes revenue from app sales, cloud storage, insurance of Apple devices and more. Services are already Apple's second-largest business, having overtaken personal computers in 2016.

| *Spec for smart specs*

Another promising new business is smart glasses, which Apple has begun referencing in its patent applications. These will overlay digital information onto the real world without the need to look down at a screen. Work that Apple has done in developing AirPods, the Apple Watch and ARKit, such as waterproofing and elongating battery life, are the building blocks for smart glasses, says Benedict Evans of Andreessen Horowitz, a venture-capital firm. Many reckon that glasses may render phones useless, but for a long while, glasses will only work with the help of the computing power of a nearby smartphone.

Yet it may be another question entirely—its use of data—that matters most to Apple's next decade. Apple has made a point of distinguishing itself from firms like Alphabet, Google's parent company, which mine user data to target ads online. It has made a great effort to make ad blockers easy for users to install, for example. But data are increasingly central to designing the smartest software; Apple already risks lagging behind in areas such as

voice recognition and predictive software if it remains inflexible about hoovering up consumers' information. Whether to prioritise privacy ahead of innovation may turn out to be Mr Cook's most important decision yet. ■



苹果与iPhone

旧瓶新酒

苹果难创重磅新品，谜底可能还是旧王牌

苹果有一款热销新品，在英美大部分地区已卖到断货。网上订购需要六星期才能到手。“多年来最好的一款苹果产品。”一条网上点评写道。该产品不仅实用，设计也精巧（那是自然），据市场研究公司创意策略（Creative Strategies）和益博睿（Experian）的调查称，它是至今为止消费者满意度最高的苹果产品。

这样的热情追捧，肯定让苹果高层苦乐参半。我们说的这款新品是无线耳机AirPods，与苹果的传统耳机很像，只是去掉了连接线。这款耳机售价159美元，销售额可达数十亿美元，就像苹果在2015年推出的可穿戴设备Apple Watch那样。但耳机这类产品不是许多人拭目以待的那种充满变革性、能创造高额利润的创新产品。

苹果最畅销的王牌产品推出后没几年，这种期待就已开始。2007年6月29日，苹果公司首款iPhone发售。至今苹果已售出约12亿台手机，销售额超过7400亿美元，是史上最畅销的科技设备（见图表）。苹果在2016年的销售额为2160亿美元，其中三分之二来自iPhone。

通常来说，登顶过后只有下坡路可走。iPhone前景如何？苹果是否还能设计出可与之媲美的另一种产品？这些问题困扰着苹果公司。目前全球约五分之二的人口已经拥有智能手机，这种设备拥有率的迅猛增长正在放缓。苹果还面临更多的竞争，尤其是在中国这一仅次于北美的第二大市场，其销量一直下滑，令人愈发有理由担心苹果公司正面临“iPhone见顶”。

加拿大皇家银行资本市场（RBC Capital Markets）的阿米特·达里亚纳尼（Amit Daryanani）表示，尽管苹果每年的研发经费高达100亿美元，但“人们没指望能有什么创新”。这可以解释为什么苹果的市盈率是其2018年预期收益（剔除现金）的10倍左右，低于信息技术行业普遍的12至14倍。

当然，苹果从拳头产品转移向多元化发展的尝试并不完美。败绩之一出现在全球价值约2600亿美元的电视市场。它的电视产品是一个有线机顶盒，无非就是能接入其他公司（如Netflix）提供的节目内容，并非苹果高管们所承诺的颠覆性产品。

对另一潜在增长路径的怀疑也有其道理：价值约10万亿美元“个人交通”行业。今年6月，苹果的首席执行官库克首次公开谈论了公司开发无人驾驶汽车系统的雄心。苹果当然能设计出时尚亮眼的汽车，但市场的大潮流已经从买车自用转向提供交通服务了。像优步那样，将汽车调度至特定地点的做法才是一大飞跃。

许多人认为苹果可在医疗保健行业拓展，在这领域全球年开支估计达到八万亿美元。今天，苹果让人们可在自己的设备上存储个人健康信息，并提供平台让开发人员创建医疗和健身类应用。但目前仍不清楚苹果公司能建立何种优势。在保护消费者隐私上，苹果比其他科技巨头更为执着，这种姿态也许是一项优势。然而，要进军医疗保健业则必然涉及错综复杂的企业关系网和繁冗的层层审批，这再一次与苹果熟悉的模式大相径庭。

苹果难以找到下一个重磅产品，部分原因可能是它仍为一小群封闭保守的高管所控制，他们大部分人在上世纪90年代就已进入公司，库克便是其中之一。2011年，库克在备受尊崇的公司创始人乔布斯去世前不久接手了公司。苹果不善于从外部招聘人才来获得新鲜的技能和创意。其他公司在这方面的表现要好得多。亚马逊的Prime视频服务以及家用智能音箱Echo项目的基础工作均利用了新人的才智。

然而苹果公司仍有充分的机会去适应，毕竟其拳头产品经久不衰。研究公司Stratechery的本·汤普逊（Ben Thompson）表示，iPhone业务增速将不比过去，但仍会超越人们的预期，在很长时间内都将保持重要的地位。定于今年9月推出的iPhone8可能会有足够的创新，可吸引约2.5至3亿iPhone用户升级换机，从而推动新一轮的销售“超级周期”。

摩根士丹利银行的凯蒂·休伯特（Katy Huberty）甚至说：“对苹果来说，

下一个iPhone还会是iPhone。”比如说，加入增强现实技术（AR，即把数字信息叠加到现实影像上）很可能在未来强力推动iPhone的销售。苹果公司可能会在iPhone中加入一枚3D镜头，它最近还表示将启动ARKit平台，供软件开发人员设计具有AR功能的新应用。这一步很像苹果在2008年推出应用商店的做法。当时，此举引发了一股手机应用的创新浪潮，进而令消费者更有理由去购买iPhone。零售商宜家参与了ARKit的一个前期实验，打造一款iPhone及iPad的应用，让用户举起手机就可以看到把家具放入某个空间里会是什么样子。

从现在起鼓励应用开发人员开始AR方面的开发，苹果将比谷歌的安卓系统领先两三年，创意策略公司的蒂姆·巴加林（Tim Bajarin）说。谷歌已推出一个名为“探戈”（Tango）的AR平台，但只能在两款智能手机上使用——联想的Phab 2 Pro和华硕的ZenfoneAR，而这两款手机的用户很少。假如苹果可以保持领先，在自家软件中集成AR，用户就又有理由继续选择iPhone而舍弃其他便宜一些的手机。这在中国尤其有用，毕竟Vivo和OPPO等本地品牌已经抢走了不少份额。去年夏天，售价仅400美元的OPPO R9手机在中国的销量已超越iPhone。

其他收入来源也在一定程度上依靠iPhone的成功。假如iPhone用户群继续扩大，苹果一大强势增长领域将是其服务业务，包括应用销售、云存储、苹果设备保险等方面的收入。服务已在2016年超越个人电脑，成为苹果的第二大业务。

| 着眼智能眼镜

前景看涨的另一新业务是智能眼镜，苹果已在其专利申请中提到了这一产品。智能眼镜将把数字信息叠加在现实世界上，不需要人们再低头看屏幕。风投公司安德森-霍罗维茨（Andreessen Horowitz）的本尼迪克·埃文斯（Benedict Evans）表示，苹果为研发AirPods、Apple Watch及ARKit所做的努力，比如防水及延长电池续航时间的技术，都是智能眼镜的构成要素。许多人认为智能眼镜可能会使手机变得无用，但在很长一段时间内，智能眼镜还是需要借助匹配的智能手机的计算能力才能发挥作用。

然而，在未来十年，对苹果至关重要的可能完全是另一件事——对数据的使用。谷歌母公司Alphabet通过挖掘用户数据来精准投放网络广告，苹果重视将自己与这样的企业区别开来。例如，苹果费了很大的劲让自己的用户更便于安装广告拦截器。但要设计出最智能的软件，数据越来越具有核心的重要性；假如苹果公司在收集消费者信息方面坚持不做变通，它就要冒在语音识别和预测软件等领域落后对手的风险。保护隐私与锐意创新，哪个在先？这也许是库克要做的最重要的决定。 ■



The world economy

The German problem

Why Germany's current-account surplus is bad for the world economy

THE battle-lines are drawn. When the world's big trading nations convene this week at a G20 summit in Hamburg, the stage is set for a clash between a protectionist America and a free-trading Germany.

President Donald Trump has already pulled out of one trade pact, the Trans-Pacific Partnership, and demanded the renegotiation of another, the North American Free-Trade Agreement. He is weighing whether to impose tariffs on steel imports into America, a move that would almost certainly provoke retaliation. The threat of a trade war has hung over the Trump presidency since January. In contrast, Angela Merkel, Germany's chancellor and the summit's host, will bang the drum for free trade. In a thinly veiled attack on Mr Trump, she delivered a speech on June 29th condemning the forces of protectionism and isolationism. An imminent free-trade deal between Japan and the European Union will add substance to her rhetoric.

There is no question who has the better of this argument. Mr Trump's doctrine that trade must be balanced to be fair is economically illiterate. His belief that tariffs will level the playing field is naive and dangerous: they would shrink prosperity for all. But in one respect, at least, Mr Trump has grasped an inconvenient truth. He has admonished Germany for its trade surplus, which stood at almost \$300bn last year, the world's largest (China's hoard was a mere \$200bn). His threatened solution—to put a stop to sales of German cars—may be self-defeating, but the fact is that Germany saves too much and spends too little. And the size and persistence of Germany's savings hoard makes it an awkward defender of free trade.

| *Imperfect harmony*

At bottom, a trade surplus is an excess of national saving over domestic investment. In Germany's case, this is not the result of a mercantilist government policy, as some foreigners complain. Nor, as German officials often insist, does it reflect the urgent need for an ageing society to save more. The rate of household saving has been stable, if high, for years; the increase in national saving has come from firms and the government.

Underlying Germany's surplus is a decades-old accord between business and unions in favour of wage restraint to keep export industries competitive. Such moderation served Germany's export-led economy well through its postwar recovery and beyond. It is an instinct that helps explain Germany's transformation since the late 1990s from Europe's sick man to today's muscle-bound champion.

There is much to envy in Germany's model. Harmony between firms and workers has been one of the main reasons for the economy's outperformance. Firms could invest free from the worry that unions would hold them to ransom. The state played its part by sponsoring a system of vocational training that is rightly admired. In America the prospects for men without college degrees have worsened along with a decline in manufacturing jobs—a cause of the economic nationalism espoused by Mr Trump. Germany has not entirely escaped this, but it has held on to more of the sorts of blue-collar jobs that America grieves for. This is one reason why the populist AfD party remains on the fringes of German politics.

But the adverse side-effects of the model are increasingly evident. It has left the German economy and global trade perilously unbalanced. Pay restraint means less domestic spending and fewer imports. Consumer spending has dropped to just 54% of GDP, compared with 69% in America and 65% in Britain. Exporters do not invest their windfall profits at home. And Germany is not alone; Sweden, Switzerland, Denmark and the Netherlands

have been piling up big surpluses, too.

For a large economy at full employment to run a current-account surplus in excess of 8% of GDP puts unreasonable strain on the global trading system. To offset such surpluses and sustain enough aggregate demand to keep people in work, the rest of the world must borrow and spend with equal abandon. In some countries, notably Italy, Greece and Spain, persistent deficits eventually led to crises. Their subsequent shift towards surplus came at a heavy cost. The enduring savings glut in northern Europe has made the adjustment needlessly painful. In the high-inflation 1970s and 1980s Germany's penchant for high saving was a stabilising force. Now it is a drag on global growth and a target for protectionists such as Mr Trump.

| *The shift from thrift*

Can the problem be fixed? Perhaps Germany's bumper trade surplus will be eroded as China's was, by a surge in wages. Unemployment is below 4% and the working-age population will shrink, despite strong immigration. After decades of decline, the cost of housing is rising, meaning that pay does not stretch as far as it used to. The institutions behind wage restraint are losing influence. The euro may surge. Yet the German instinct for caution is deeply rooted. Pay rose by just 2.3% last year, more slowly than in the previous two years. Left to adjust, the surplus might take many years to fall to a sensible level.

The government should help by spending more. Germany's structural budget balance has gone from a deficit of over 3% of GDP in 2010 to a small surplus. Officials call this prudence but, given high private-sector savings, it is hard to defend. Germany has plenty of worthwhile projects to spend money on. Its school buildings and roads are crumbling, because of the squeeze on public investment required to meet its own misguided fiscal rules. The economy lags behind in its readiness for digitalisation, ranking 25th in the world in average download speeds. Greater provision of after-

school care by the state would let more mothers work full-time, in an economy where women's participation is low. Some say such expansion is impossible, because of full employment. Yet in a market economy, there is a tried and trusted way to bid for scarce resources: pay more.

Above all, it is long past time for Germany to recognise that its excessive saving is a weakness. Mrs Merkel is absolutely right to proclaim the message of free trade. But she and her compatriots need to understand that Germany's surpluses are themselves a threat to free trade's legitimacy. ■



世界经济

德国问题

为什么说德国经常账户盈余有害世界经济

战线已然拉开。本周全球各贸易大国在汉堡举行的G20峰会，正是倾向保护主义的美国和主张自由贸易的德国之间的角力场。

特朗普已经退出了《跨太平洋伙伴关系协定》，并要求就另一个协定《北美自由贸易协定》重新进行谈判。他还权衡着是否要对美国进口的钢铁征收关税，此举势必会引发报复。自1月以来，贸易战的威胁一直笼罩着特朗普政府。而本次峰会的东道主——德国总理默克尔，将会为自由贸易擂鼓助威。她在1月29日发表演讲，谴责保护主义和孤立主义势力，这几乎是对特朗普毫不掩饰的攻击。日本和欧盟之间即将达成的自由贸易协定将为她的言辞提供实据。

谁在争论中占上风是毫无疑问的。特朗普认为贸易必须平衡才算公平的说法显露出经济学上的无知。他认为关税能维持公平竞争的想法很幼稚，也很危险：高额关税会损害各方的繁荣。但至少在一个方面，特朗普抓住了一个令人感到窘迫的事实。德国的贸易顺差在去年几乎达到3000亿美元，为全球最高（中国仅为2000亿美元），特朗普为此向德国提出了告诫。他扬言要采取的解决办法是禁止德国汽车在美国销售，但也许会适得其反。然而德国确实是储蓄太多而花费太少。规模持续增加的德国储蓄令它在捍卫自由贸易时很是尴尬。

| 不完美的和谐

从根本上说，贸易顺差是国内储蓄超过国内投资的部分。就德国而言，贸易顺差并非如一些外国人控诉的那样，是重商主义政府政策的结果。也不像德国官方时常强调的那样，是由于老龄化社会迫切需要更多储蓄。德国国家储蓄率虽高，但多年来一直保持稳定。国内储蓄的增长来自公司和政府。

商界和工会之间达成了数十年之久的协议，通过抑制工资增长来保持出口工业的竞争力，从而支撑起了德国的顺差。这样的克制帮助德国出口导向的经济实现了战后的恢复，以及之后的发展，也揭示了德国如何从上世纪90年代时的“欧洲病人”变身如今的肌肉发达而僵硬的冠军选手。

德国模式有很多令人艳羡的地方。和谐的劳资关系一直是该国经济表现出众的主要原因。公司可以放心投资，不必担忧工会的要挟。政府则是通过为本国备受推崇的职业培训体系提供资助而发挥作用。在美国，随着制造业工作岗位的流失，没有大学文凭的人前途已变得惨淡，这成为特朗普所支持的经济民族主义的一个起因。德国并没能完全避免这种情况，但它保有了更多的蓝领岗位，而这正是美国所痛失的。这也是民粹主义的德国另类选择党（AfD）在德国政治中处于边缘地位的一个原因。

但是这种模式的不利副作用也渐渐明显。它让德国经济和全球贸易陷入危险的失衡状态。抑制工资意味着更低的国内消费和进口。德国的消费支出已经降至其GDP的54%，而美国的数字是69%，英国为65%。出口商不会把意外得来的高额利润投资于国内。不止德国如此，瑞典、瑞士、丹麦和荷兰也一直在积累巨额顺差。

一个处于充分就业的大型经济体，其经常账户盈余却超过GDP的8%，这给全球贸易体系带来了过度的负担。为了抵消这些顺差，并保持足够的总需求来维持就业，世界其他国家必须以同等规模借债并支出。在有些国家，特别是意大利、希腊和西班牙，持续的赤字最终导致了危机。它们随后付出了沉重代价来转向保持顺差。北欧长期储蓄过剩，给调整平添了不必要的痛苦。在上世纪七八十年代的高通胀时期，德国保持高储蓄是一股稳定的力量，现在则拖累了全球增长，并成了特朗普等保护主义者攻击的目标。

| 不再节俭

这一问题能够得到解决吗？也许德国的巨额贸易顺差会因工资的飙升而受到侵蚀，就像中国那样。失业率不足4%，尽管有大量移民，工作年龄人口仍将会减少。在经历数十年的下滑后，房价正重新上涨，意味着工资不

像过去一样够用。支持抑制工资的机构正在失去影响力。欧元也可能会上涨。然而德国人小心谨慎的天性根深蒂固。去年工资仅上升了2.3%，增速比之前两年还慢。靠这样调整，顺差可能要很多年才能回落到合理水平。

政府应该通过增加开支来帮忙。德国的结构性预算余额在2010年为赤字，占GDP的3%还多，现在已经稍有盈余。官员们认为这是谨慎之举，但是考虑到私营部门的高储蓄，这种说法很难成立。德国有大量值得投资的项目。为了满足误导性的财政规则的要求，公共投资受到挤压，导致学校设施和道路日渐破旧。德国经济在拥抱数字化方面处于落后位置，平均下载速度在全球排在第25位。德国妇女的劳动参与率较低，如果政府提供更多的课后托儿服务，就能让更多的母亲全职参加工作。有人认为这种扩张不可能，因为就业已经很充分。然而在市场经济中，要获取稀缺资源有个可靠又可信的方法——付更多钱。

最重要的是，德国早就该认识到自己的过度储蓄是个缺点。默克尔表态支持自由贸易绝对正确。但她和她的同胞需要知道，德国的顺差本身就是对自由贸易合理性的威胁。 ■



Saudi Aramco's IPO

A king-to-be's ransom

The world's biggest oil company cannot be seen in isolation from the kingdom that it bankrolls

THE proposed sale of 5% of Saudi Aramco is not just likely to be the biggest initial public offering (IPO) of all time. "It's like Gibraltar selling the rock," as one expert on Saudi Arabia's oil policy puts it. The world's biggest oil company keeps the House of Saud in power, bankrolled 60% of the national budget last year, and is a paragon of efficiency in an economy otherwise mired in bureaucracy.

The elevation on June 21st of Muhammad bin Salman, the 31-year-old architect of the IPO, to crown prince is likely to add more momentum to a sale planned for the second half of 2018. The news will further sideline domestic critics of the IPO, some of whom wonder whether it would be better to borrow the money than sell the family silver. But the success of the IPO is not guaranteed. The tendency of MBS, as the prince is known, to micromanage the listing runs counter to the spirit of openness and liberalisation that he says he wants for Saudi Arabia. That could backfire on the IPO itself. The more he interferes, the less keen investors will be to buy shares.

Aramco's role underpinning the Saudi economy is an even bigger challenge in valuing this IPO than the firm's immense size. On the one hand, advisers say, its low costs and lean workforce make it comparable to blue-chip oil supermajors such as ExxonMobil and Royal Dutch Shell. On the other, the risks of political interference mean that it is likely to suffer from the stigma associated with being a national oil company (NOC). Many NOCs, such as PetroChina and Brazil's Petrobras, have come to market amid the sort of fanfare that Aramco is generating. In a decade, they have destroyed more

than \$500bn-worth of value compared with their private peers (see chart).

As an oil company, the selling-points for Aramco are strong (provided the oil price is high enough). It has a concession for 12 times more oil and gas than ExxonMobil and 27 times more than Shell. Its production levels are several times higher. It has fewer employees, higher debt-adjusted cashflow per barrel, and decent margins in its refining and petrochemicals businesses as well as upstream. By the time it lists, its advisers hope it will have a board structure similar to that of the supermajors, and will be comparable on a number of parameters, including dividend projections, that will enable investors to value it accordingly. “The day this company goes public, it will look like one of the top blue-chip oil companies,” one says.

The trouble is, MBS has already stated what he thinks the valuation should be, and at \$2trn, it is punchy enough to make even a Silicon Valley boss look bashful. To achieve it, a 5% sliver would be worth \$100bn—four times the biggest IPO to date, that of China’s Alibaba, an e-commerce firm, in 2014.

According to an analysis by Sanford C. Bernstein, a research firm, at \$2trn its value per barrel of oil equivalent coming out of the ground would be about 60% higher than that of its blue-chip peers. A valuation at or below \$1.5trn would be closer to the mark, but risks disappointing the new crown prince. “He may have to make a choice between selling cheap and pulling the plug on the process. Either case would be a loss of face,” says Steffen Hertog of the London School of Economics, a writer on the state and oil in Saudi Arabia.

To get closer to his target, the kingdom recently slashed tax rates on Aramco, from 85% to 50%. That brings them nearer to international norms for oil firms and will appeal to investors: lower taxes mean the company

can pay out higher dividends.

The country also has a plan to wean its people off some of the world's cheapest energy by 2020, which would bolster Aramco's profits. According to Jim Krane, of Rice University's Baker Institute for Public Policy, about a third of Aramco's output is sold for domestic purposes, with power generation, for instance, enjoying discounted prices of under \$6 a barrel—a "massive opportunity cost".

But investors would be wise not to view issues like taxes and subsidies in isolation. Some analysts express worry that dividends are unstable, and that the kingdom would have to unwind the tax cuts on Aramco if the state needed the money. The introduction of more realistic pricing could also have political and social ramifications, since Saudis are some of the world's biggest consumers of cheap energy.

Another worry for investors would be if MBS continues to use Aramco as a tool of global oil policy on behalf of OPEC, the producers' cartel. The kingdom may believe that OPEC serves as a stabilising force in global oil markets, which benefits Aramco. But its latest attempts to play puppet-master with the oil market have been counter-productive. On June 21st global oil prices fell to their lowest level since August, despite an agreement by OPEC and non-OPEC producers to cut output until next March. As a result, Aramco is not only losing income, it is losing market share to rivals not bound by the cuts.

Last, as his global stature grows, the prince may be tempted to mix up geopolitics and commerce. Anecdotal evidence of this emerged during President Donald Trump's visit to Riyadh in May. Even as Aramco was supposedly disentangling itself from the myriad noncore activities it carries out on behalf of the state, the firm was on extra-curricular duty. At breakneck pace, it built the Global Centre for Combating Extremist Ideology

in Riyadh, where Mr Trump and MBS's 81-year-old father, King Salman bin Abdel Aziz Al Saud, performed a weird inauguration ceremony involving a glowing globe. The reason for Aramco's involvement: no other body in the kingdom could do it half as quickly.

| *Venue, vidi, vici*

Such strategic considerations may also be influencing the decision on whether to list the non-Saudi portion of the IPO in New York or London (a small slice will be listed on Tadawul, the local bourse). Aramco's lawyers are more comfortable with a London Stock Exchange (LSE) listing, on the ground that it would spare the company the real risk of class-action lawsuits related, for instance, to the terror attacks of September 11th 2001, of litigation from tree-hugging attorneys-general, and of other claims on its assets that it might face on the New York Stock Exchange (NYSE).

But MBS is believed to be leaning more towards New York. This may be because of liquidity: listed companies on the NYSE have a combined market capitalisation of about \$20trn, versus \$4trn on the LSE. The NYSE also has more prestige; the big peers Aramco wants to be judged against are listed there. Yet he is also understood to have been under pressure from the White House for a New York listing, and is keen to cement ties with Mr Trump. If that were to sway the final consideration, investors might not thank him for it.

Many will shrug. The chance to buy shares in one of the world's most resilient oil firms will be hard to resist. Moreover, sovereign-wealth funds may well be keen to become "anchor tenants" of the IPO, to deepen their own countries' relationships with Aramco and the new crown prince.

But MBS's leapfrog towards the throne will not silence the questions that still swirl. What will happen to the money raised? Will the listing plug a budget gap of 8% of GDP? Will it fund domestic industries such as mining,

defence and tourism? Or will it become a “magic money tree”, promising all things to all people? The original goal of the IPO was to bring more transparency and stronger market forces to Saudi Arabia—creating a sort of Thatcherite oasis in the Arabian desert. If that is truly what MBS wants, he should learn to leave well alone. ■



沙特阿美IPO

王储的赎金

要评估世界最大的石油公司，不能脱离它所支撑的王国

沙特阿美石油公司（Saudi Aramco，以下简称沙美）拟出售5%的股份，这很可能将是有史以来规模最大的首次公开募股（IPO）。但其意义不止于此。正如一位沙特石油政策专家所言，“这好比直布罗陀要出售它的巨岩”。这家全球最大的石油公司支撑着沙特王室的统治，去年提供了全国60%的预算资金，在沙特这一深陷官僚主义泥潭的经济体中堪称效率的典范。

策划此次IPO的31岁的穆罕默德·本·萨勒曼（Muhammad bin Salman）在6月21日被擢升为王储，这应该会推动2018年下半年上市的计划。沙特国内反对IPO的声音将进一步被边缘化。部分反对者认为，与其卖掉传家宝，不如举债。但IPO也不一定能获得成功。在IPO事务上，这位人称MBS的王储事必躬亲，这和他宣称要带给沙特自由与开放的精神背道而驰。这可能对IPO本身不利。他插手越多，投资者购入股份的兴致就越低。

相比公司的巨大规模，沙美在沙特阿拉伯经济中的地位更是这次IPO估值的大难题。顾问们表示，一方面，沙美运作成本低，员工队伍精简，堪比埃克森美孚和荷兰皇家壳牌等蓝筹石油巨头。另一方面，因为存在政治干预的风险，沙美很可能会因为国家石油公司这一身份所携带的污名而受损。中国石油和巴西石油等许多国家石油公司都在人们狂热的追捧中上市，就像沙美目前掀起的热烈氛围一样。十年来，与私营石油企业相比，这些国家石油公司的市值已经跌去超过5000亿美元（见图表）。

作为一家油企，沙美有强大的卖点（前提是油价足够高）。它拥有的油气开采权规模是埃克森美孚的12倍、壳牌的27倍，产出水平也高出好几倍。员工数量更少，每桶石油的债务调整后现金流更高，其炼油、石油化工及上游业务均有不俗的利润率。它的顾问希望，到上市时，沙美能拥有类似世界石油巨头的董事会架构，而且在预期股息等指标上也能进行比较，从

而使投资者能相应地对其估值。“到上市时，这家公司会像是一家顶级蓝筹石油公司。”一位顾问说。

问题是，本·萨勒曼已表明他认为估值应在两万亿美元，要价之高就连硅谷的老板也会自愧不如。如此算来，5%股份的价值将为1000亿美元，是迄今世界最大规模IPO（2014年中国电子商务公司阿里巴巴上市）的四倍。

据盛博研究公司（Sanford C. Bernstein）的分析，若按两万亿美元的估值计算，则沙美生产的每桶石油的价值将比同行蓝筹企业高约60%。估值定为1.5万亿美元或以下会更接近标准值，但可能令新王储失望。伦敦政治经济学院的斯蒂芬·赫尔托格（Steffen Hertog）曾撰写有关沙特政府及石油业的著作。他说：“王储可能需要二选一，要么减价出售，要么叫停计划。但都有失面子。”

为接近王储的目标，沙特最近把沙美的税率从85%降至50%，从而接近石油企业的国际标准，此举也将吸引投资者：税率降低意味着公司可支付较高的股息。

沙特还计划在2020年前削减能源补贴，不再让其国民享受全球最低廉的一些能源价格，这将有助提升沙美的利润。美国莱斯大学（Rice University）贝克公共政策研究所的吉姆·克雷恩（Jim Krane）称，沙美约三分之一的产出在国内销售，举例来说，发电厂享受的补贴价为每桶油不到六美元——这是“巨大的机会成本”。

但对投资者而言，明智的做法是不要孤立地看待税收和补贴等问题。有分析师担心，沙美的股息会不稳定，而且沙特王国在需要资金时可能会不得不取消对沙美的减税。引入较为现实的定价还可能产生政治和社会影响，因为沙特国民是世界上廉价能源的最大消费群体。

投资者的另一个忧虑是，本·萨勒曼可能会继续利用沙美为工具，代表石油生产国联盟欧佩克实施全球石油政策。沙特也许相信欧佩克是稳定全球石油市场的力量，会有利于沙美。但沙特最近企图操纵石油市场的举动却

适得其反。尽管欧佩克和非欧佩克产油国已达成协议，把减产延续到明年3月，全球油价在6月21日仍降至去年8月以来的最低水平。因此，沙美不仅仅损失了收入，其市场份额也被不受减产协议限制的对手抢走。

最后，随着自己全球地位的提高，本·萨勒曼可能会忍不住要把地缘政治和商业混为一谈。从美国总统特朗普5月到访利雅得时的轶闻可见端倪。沙美替政府扛起了许多非核心事务，正在努力从中挣脱，但还是难逃额外职责。沙美以惊人的速度在利雅得建成了“打击极端主义意识形态全球中心”（Global Centre for Combating Extremist Ideology），在那里特朗普和本·萨勒曼81岁的父亲萨勒曼·本·阿卜杜勒·阿齐兹·阿勒沙特国王出席了一场古怪的开幕典礼，共同点亮了一个“地球”。沙美之所以参与其中是因为国内没有其他机构能有它一半的效率。

| 我来了，我征服

这类战略性考虑也可能影响沙美IPO中的非沙特部分是在纽约还是在伦敦发行（一小部分将在本地的沙特证券交易所上市）。沙美的律师们更倾向在伦敦证券交易所（LSE）上市，理由是免去一些在纽约证券交易所（NYSE）上市可能遭受的切实风险，例如因911恐怖袭击等事件而引发的集体诉讼、被环保派州检察长起诉，以及其他针对其资产的索赔。

但据信本·萨勒曼更倾向在纽约上市。这可能是出于流动性方面的考虑：纽交所上市公司的总市值约为20万亿美元，而伦敦证交所为四万亿美元。纽约证交所的声望也更高，沙美想要与之相提并论的同行巨头也都在那里上市。但据了解，他也受到白宫施压希望沙美在纽约上市，而他也渴望与特朗普加强关系。假如这影响到最终决定，投资者可能不会感谢他。

许多人会不以为然。眼前是世界上最强韧的石油公司之一，买入其股票的机会显得难以抗拒。此外，主权财富基金很可能渴望成为这次IPO的“大户”，从而加深本国与沙美及新王储之间的关系。

但本·萨勒曼向王位的迈步并不会使萦绕的疑问声沉寂下来。融到的资金将如何使用？上市能堵住达GDP8%的预算赤字吗？能为采矿、军工及旅游

等国内行业提供资金吗？或是成为“神奇的摇钱树”，向所有人许诺一切？此次IPO的最初目标是在沙特提高透明度、加强市场力量，在阿拉伯沙漠中创造“撒切尔夫人”式的新自由主义绿洲。假如这是本·萨勒曼真正的愿望，那么他应该学会听其自然，不加干预。■



Aircraft finance

Maximum altitude

The aircraft-leasing business may be flying too high

AIR shows are where the aerospace business shows off. At this year's Paris show, the world's largest, which opened at Le Bourget airport on June 19th, the military types are most ostentatious. Aeronautical party tricks include helicopters that ascend into the sky tail-first and stealth fighters that fly backwards.

But no one is keener to strut their stuff than Airbus and Boeing, the world's two biggest makers of airliners. At the 2015 show the pair sold 752 planes worth around \$107bn. But the party atmosphere at that event—with copious food and wine laid on for customers and journalists alike—has given way this year to a more sober mood, weaker sales and a bring-your-own-lunch policy. This should give pause to investors in one of the world's fastest-growing asset classes: aircraft.

Airbus and Boeing still booked plenty of orders. But for the first time, most came from lessors, which lease them to operators, rather than from the airlines that use them. This has fuelled fears that the surge in investment going into aircraft finance is pushing orders for new jets, and prices for old ones, to unsustainable levels. “We’re in a bubble that will burst,” says Adam Pilarski of Avitas, a consultancy. “It is only a question of timing and severity.”

In the past airlines bought planes with expensive unsecured bank loans or state handouts. But since the 1970s, the ownership of aircraft has gradually been hived off to financial firms. This has benefits for both airlines and investors, explains Alec Burger, chief executive of GECAS, the world's biggest lessor. Leasing rather than buying gives carriers the flexibility to

expand or shrink fleets quickly. It can cut tax bills. And as lessors are often bigger than airlines, they can strike better deals with planemakers and borrow more cheaply.

Investors also find aircraft attractive assets. International agreements make it easy to repossess one when an airline defaults on a payment. The market for planes is more liquid than that for ships or trains. And unlike houses, planes are mobile.

The doubts centre on whether there really is enough demand for the lessors' latest orders. Peak leasing may soon be reached, according to new research from Toulouse Business School. Using data from 73 carriers over 15 years, it calculates that airline profits are maximised when 53% of fleets are leased—not far off the current figure of around half for narrowbodied jets.

Cheap debt and stronger balance-sheets have made it more attractive for carriers to buy planes directly, says Neil Sorahan, the finance director of Ryanair, Europe's biggest airline. In February it issued €750m (\$803m) in unsecured bonds at an annual rate of just 1.2% to buy more jets.

Airlines are not alone in using cheap money to go on a shopping spree; so are lessors and banks. As the rate of return on other investments is so low, aircraft have become even more attractive investments, explains Michel Dembinski of MUFG, a bank, particularly for short-term “hot” money. Many doubt this is being invested wisely. New leasing outfits with no experience of preparing for a downturn are expanding particularly recklessly. The number of Chinese lessors alone has grown from almost none to over 50 in a decade.

Mr Pilarski detects signs that the bubble may be about to burst. Air-passenger numbers are rising faster than the long-term average, but there is already severe overcapacity in Europe, the Middle East and Asia, and too

many new planes are coming on stream. Many lessors struggle to find new operators for aircraft returned to them when leases expire. Interest-rate rises may also threaten asset prices. “Lessors made a lot of money on the way up,” says Saj Ahmad, an aviation expert. “They will also lose a lot if things come down.”

A full-blown crash in airliner values—like the one since 2013 for ships which left banks nursing \$400bn in bad loans—is far from certain. With demand for air travel expected to double every 15 years, as the growing middle classes of Asia take to the sky, the long-term future of aircraft as an asset is still seen as solid. And given rapid changes in travel patterns, the flexibility leasing offers will continue to be in demand. Even so, aircraft investors should prepare for a bumpy ride. ■



飞机融资

极限高度

飞机租赁业务可能飞得太高了

航空展是航空航天业的秀场。6月19日，全球最大的航空展巴黎航展在布尔歇机场（Le Bourget airport）开幕，其中最招摇的是军用飞机。这次航空派对上演了各种把戏，有尾部先升空的直升飞机，还有倒着飞行的隐形战斗机。

但最急于炫耀自家产品的还是空客和波音这两家世界最大的飞机制造商。在2015年的航展上，两家公司共售出752架飞机，价值约1070亿美元。那次航展上派对氛围浓厚，有丰盛的美食和葡萄酒供客户和新闻记者享用。但今年，气氛更严肃，销售更疲软，人们还要自带午餐。这应该会让投资者在飞机这一世界上增长最快的资产类别前刹一刹车。

此次空客和波音仍然收到了大量订单，但这些订单大多数来自把飞机租赁给运营商的飞机租赁公司，而不是自己使用飞机的航空公司，这种情况还是头一回。这加剧了市场原本已经浮现的担忧：大量资金涌入飞机融资租赁，正在把新飞机的订购量和旧机型的价格推向不可持续的水平。咨询公司Avitas的亚当·皮拉斯基（Adam Pilarski）说：“我们身处的泡沫必将破裂，只是时间早晚和严重程度问题。”

过去，航空公司购买飞机靠的是高息无担保银行贷款或国家拨款。但自20世纪70年代以来，飞机的所有权已经逐渐转移到金融公司手中。全球最大的飞机租赁公司是通用电气商业航空服务公司（GECAS），其首席执行官亚力克·博格（Alec Burger）解释说，这对航空公司和投资者都有好处。通过租赁而非购买，飞机运营商就能灵活地迅速扩大或缩小机队规模，还可以减少税负。而且由于租赁公司通常比航空公司规模更大，它们可以和飞机制造商谈成更好的价格，申请到利息更低的贷款。

投资者也认为飞机这种资产很有吸引力。航空公司如果付款违约，根据国

际协议，租赁公司可以轻松收回飞机。飞机市场的流动性好于船舶或火车。和房子不一样，飞机可以移动。

人们的疑虑主要是，对飞机租赁公司最新订购的飞机是否真有足够大的需求。图卢兹商学院（Toulouse Business School）的最新研究显示，飞机租赁业务可能很快就会达到顶峰。该商学院利用73家航空公司15年的数据计算得出，当有53%的飞机是租来的，航空业的利润最大，这一数据与目前窄体飞机约50%的租赁比例相差不远。

欧洲最大的航空公司瑞安航空（Ryanair）的财务总监尼尔·索拉汗（Neil Sorahan）说，低廉的借贷成本和更强劲的资产负债表已经让航空公司更倾向于直接购买飞机。2月，瑞安航空为购买更多飞机发行了7.5亿欧元（8.03亿美元）的无担保债券，年均利率仅为1.2%。

利用廉价贷款大肆采购的不止航空公司，飞机租赁公司和银行也一样。投资银行三菱日联金融集团（MUFG）的米歇尔·德宾斯基（Michel Dembinski）解释说，由于其他投资的回报率太低，飞机已变成了更有吸引力的投资资产，对短期“热钱”而言尤其如此。很多人怀疑这种投资是否明智。有的新租赁公司没有为市场下滑做准备的经验，在扩大规模时尤其肆意。仅中国的飞机租赁公司数量就在十年间从无到有增加到了50多家。

皮拉斯基已经察觉出泡沫可能即将破裂的迹象。虽然目前航空旅客人数上升速度高于长期平均水平，但欧洲、中东和亚洲地区的航空运力已经严重过剩，而太多新飞机还在投入运营。许多飞机租赁公司在租赁期满飞机归还后，很难找到新的运营商。利率上升也可能威胁资产价格。“租赁公司在市场上升期赚了很多钱，”航空专家萨迦·艾哈迈德（Saj Ahmad）说，“如果需求下降，它们也会亏很多钱。”

2013年以来船只价格全面跳水，让银行落下4000亿美元的不良贷款，飞机价值是否会全面崩溃目前还远不能确定。亚洲不断壮大的中产阶级会更多地搭飞机出行，航空旅行需求预计每15年翻一番，飞机作为资产的长远前景看起来仍然可靠。鉴于人们的出行模式在快速变化，租赁业务所提供的

灵活性仍然会是市场需要的。即便如此，飞机投资者也应该为未来颠簸的旅程做好准备。■



Housing markets

Maple grief

The lessons from Canada's attempts to curb its house-price boom

IN MATTERS of finance, if not climate, Canada is usually temperate. It was barely moved by the economic storms that blew the roof off America and Europe in 2008-09. Its banks were steady, it was argued, in part because they were shielded from the ferocious competition for market share that pushed banks elsewhere into hazardous loans. For all that, in its housing market Canada has lately become a place of extremes.

Household debt has climbed to almost 170% of post-tax income. House prices rose by 20% in the year to April. Looked at relative to rents, they have deviated from their long-run average by more than any other big country *The Economist* covers in its global house-price index. In Toronto, one of two cities, along with Vancouver, where the boom has been concentrated, rental yields are barely above the cost of borrowing, even though interest rates are at record lows. In its twice-yearly health-check on the financial system, published in June, the Bank of Canada concluded that “extrapolative expectations” are a feature of the market. In other words, people are buying because they hope, or fear, that prices will keep rising.

Canada is not alone. House prices also look high relative to rents in Australia, where a few cities, notably Sydney and Melbourne, are booming. Prices in some American cities, such as Seattle and San Francisco, have been rising much faster than the national market, which looks reasonably priced.

Common to all these cities are buyers from emerging markets, notably China, who have helped to drive a wedge between the price of homes and the local fundamentals of incomes and rental payments. They are willing to

pay above the odds to secure a safe place for their savings. Though fairly small in number, their presence is enough to inflate bubbles.

Canada's housing market thus opens a window on a tragic flaw in the global economy. In only a few decades China has mastered the manufacture of high-quality goods. But it takes far longer to be able to manufacture safe stores of value. Instead, their affluent citizens seek out rich-country assets, including houses. This fundamental mismatch limits the ability of policymakers to stop bubbles from inflating.

Raising interest rates, which stand at just 0.5% in Canada, might seem the obvious answer. The economy is recovering and the Bank of Canada's deputy governor has hinted in June that rates might climb. But several rises in succession might be needed to cool the housing market and that would probably send the economy into recession.

The authorities have instead attempted to deal with the problem at its source. Last summer Vancouver imposed a 15% tax on foreigners' house purchases. The city's property market has since cooled. But one effect of this extra tax has been to shift housing demand to other places, such as nearby Victoria, and to Toronto, where house-price inflation is above 30%. The province of Ontario imposed a similar tax in April, prompting fears of a price surge in Montreal. To improve the supply of rental properties, Ontario has also permitted cities to slap a tax on vacant homes. That will help, but it will not solve the problem. There are tentative signs that prices in Vancouver are reviving, suggesting that the tax there has only deterred foreign buyers temporarily. In any event, some foreign owners hope to settle in Canada soon, and so will be entitled to claim a rebate.

There is no fail-safe administrative tool for curbing house-price booms. The best course is to insure against the fallout from a house-price bust. Canada has been more active in this than most countries. People with

mortgages above 80% of the value of the home on which it is secured are obliged to pay for insurance against default. The underwriting standards on such mortgages have been steadily tightened. Canada's biggest banks have some protection against potential storms. They are highly profitable and exceed international benchmarks for capital.

| *Strong foundations*

Even so, a further tightening of such macroprudential measures would be wise, not because it would do much to slow the rise in house prices but as insurance against their eventual fall. The demand from emerging markets for safe assets will not soon diminish. Recent history shows that big run-ups in property prices often reverse suddenly. Better to batten down the hatches now in case the weather turns bad. ■



住房市场

枫叶之伤

从加拿大试图遏制房价上涨得来的教训

如果不谈气候，只论金融，加拿大通常是温和平稳的。2008至2009年爆发的经济风暴把美国和欧洲的屋顶都掀翻了，加拿大却基本没受影响。有人认为，加拿大的银行业之所以稳定，部分原因是它们没有加入争夺市场份额的激烈竞争，而这种竞争让其他国家的银行争相推出了高风险贷款。尽管如此，最近加拿大住房市场还是出现了极端情况。

家庭债务已经攀升至税后收入的近170%。从去年4月到今年4月，房价上涨了20%。从房价和租金的比率来看，加拿大的房价已偏离其长期平均水平，幅度超过《经济学人》全球房价指数所涵盖的其他任何大国。房价上涨主要集中在多伦多和温哥华这两个城市。在多伦多，租金收益仅略高于贷款成本，尽管利率处于历史低位。加拿大央行6月发布了一年两次的金融体系健康检查报告，得出结论称，目前住房市场呈现出“推定预期”的特征。换言之，人们买房是因为他们希望或担心房价会持续上涨。

出现这种问题的不止是加拿大。澳大利亚的房价租金比看起来也很高，有几个城市（特别是悉尼和墨尔本）楼市火爆。美国全国楼市的总体定价看起来还算合理，但一些城市（如西雅图和旧金山）的房价涨幅远高于全国整体水平。

这些城市都有一个共同点，那就是来自新兴市场的买家，特别是中国买家，拉大了房价和收入与租金支出这两个当地市场基本面之间的差距。这些买家愿意支付高价，为他们的储蓄找到安全的去处。虽然这些买家数量很少，但他们的存在足以吹大泡沫。

加拿大的住房市场因而打开了一扇窗，让人们一窥全球经济中一个悲剧性的缺陷。短短几十年里，中国已然精于制造高质量的商品，但要打造出安全储存财富的渠道，需要的时间要长得多。中国的富裕公民转而寻求投资

富裕国家的资产，房产正在其中。这种根本上的错配限制了政策制定者阻止泡沫膨胀的能力。

加拿大的利率目前只有0.5%，提高利率似乎是明显的解决方案。加拿大经济正在复苏，6月加拿大央行副行长暗示利率可能会上调。但要冷却住房市场可能需要连续多次加息，而这又可能会使经济陷入衰退。

当局转而试图从源头上解决问题。去年夏天，温哥华开始对外国人购房加征15%的税，楼市自此已经降温。但这种额外征税的一个影响是令购房需求转移到了其他地方，比如附近的维多利亚以及多伦多。多伦多的房价涨幅已超过30%。安大略省在4月开征了类似的税收，又引发了蒙特利尔房价暴涨的担忧。为了增加出租物业的供应，安大略省还允许各市对空置住宅征税。这类征税措施有助于缓解楼市压力，但治标不治本。初步迹象显示温哥华的房价正在复苏，表明税收政策只是暂时让外国买家却步。无论如何，有些外国业主希望很快在加拿大定居，所以未来有权要求退税。

遏制房价上涨没有万全的行政手段，最好的做法是防范房价泡沫破灭后的不良影响。加拿大在这方面比大多数国家更为积极。贷款额超过房屋总价80%以上的买家必须支付违约保险金。加拿大已稳步收紧了这类房贷保险的要求。最大的一些银行也已采取了保护措施防范潜在风险。这些银行利润水平高且超过国际资本基准。

| 坚实的基础

即便如此，进一步加强这类宏观审慎措施将是明智之举，不是因为它能够减缓房价上涨，而是因为它有助于防范房价最终下跌的后果。新兴市场对安全资产的需求不会很快减退。近年的历史表明，房价大涨后经常突然回落。最好还是未雨绸缪。 ■



Global football

Head in the turf

A year before the World Cup in Russia, FIFA is shunned by sponsors

AT THE World Football Museum in Zurich, run by FIFA, football's global governing body, visitors take their photo with the World Cup trophy, try their hand at match commentary and gawk at artefacts ranging from the original handwritten set of the rules of the game to the yellow card famously shown to Paul Gascoigne, a lachrymose English footballer, in 1990. Those wanting a glimpse of the luxurious bedsheets that were used to shield FIFA officials as they were hustled out of a ritzy Swiss hotel in 2015 having been arrested on corruption charges may feel cheated—they are not on display.

If FIFA's shrine to itself ignores this squalid period of its history, its balance-sheet bears the traces. FIFA lost \$369m in 2016, triple the losses of the year before, and forecasts a loss of \$489m in 2017. Reserves, which have been above \$1bn since 2008, are predicted to fall to \$605m next year.

The latest loss is partly because of higher development funding for member football associations, and partly because of accounting changes on how costs and revenue are booked. But the probes into alleged bribery and corruption launched by American and Swiss law-enforcement officials have not helped. FIFA's legal bills rose from \$20m in 2015 to \$50m in 2016. Its financial statements also bemoan a series of "ill-considered" investments, including the museum, which cost \$190m and has failed to attract many visitors.

FIFA still thinks it will meet its revenue target of \$5.6bn over the 2015-18 cycle, thanks to a steep rise in revenue from the 2018 World Cup in Russia. But that depends on money from television and sponsorship. Several

sponsors, including Sony, Emirates and Castrol, have not renewed their contracts. With less than a year to go before the tournament, FIFA has lined up only 12 sponsors out of the 34 slots on offer. It has attracted one local backer, the Moscow-based Alfa-Bank, and is without a broadcaster to carry the games in the host country. At the same stage before the 2014 World Cup in Brazil, most sponsorship slots were filled, with many deals agreed to years in advance. “With one year to go, this situation is unheard of,” says Michael Payne, a former marketing chief for the International Olympic Committee.

FIFA’s latest sponsorship deal is with China’s Vivo, a smartphone-maker. It is the third Chinese firm to back FIFA; the country is believed to be considering a World Cup bid of its own. Chinese firms’ stance appears to be that FIFA is changing after its scandal. But questions remain. In May FIFA replaced a judge and a prosecutor serving on its ethics committee with new people. The outgoing officials were responsible for the investigations that led to the suspension of Sepp Blatter, a former FIFA president, and other top officials. They claimed that their dismissal, with hundreds of investigations in progress, would mean the “de facto end to the reform efforts”. Gianni Infantino, FIFA’s new boss, described it as a “storm in a teacup”. That message, like FIFA’s broadcast rights, may prove a tough sell. ■



世界足球

逃避现实

距俄罗斯世界杯只剩一年，国际足联赞助却乏人问津

在苏黎世，足球运动的全球管理机构国际足联运营的世界足球博物馆里，游客们与世界杯奖杯合影，尝试自己做比赛解说，或是出神地凝视各种展品——包括最初手写的比赛规则，以及1990年让英国球员保罗·加斯科因（Paul Gascoigne）泪流满面的那张著名的黄牌。不过，有些游客可能会觉得受骗上当，因为他们没看到那几张豪华床单——2015年，国际足联的几名官员因贪污指控在瑞士某家高级酒店被捕，在几张床单的遮掩下被匆匆带离酒店。

如果说国际足联自我供奉的圣殿无视了这段肮脏的历史，它的资产负债表上却留下了痕迹。2016年国际足联亏损3.69亿美元，是前一年的三倍，预计2017年将亏损4.89亿美元。2008年以来，其储备金一直超过10亿美元，不过预计明年将降至6.05亿美元。

最近的亏损有部分原因是增加了各成员足协的发展经费，也有一部分是因为成本和收益的会计记账方式改变了。美国及瑞士的执法人员发起的对贿赂和腐败的调查更是火上浇油。国际足联的诉讼费用从2015年的2000万美元飙升至至2016年的5000万美元。其财务报表也遗憾地显示有一连串“考虑不周”的投资，包括上文提到的博物馆——其成本达1.9亿美元，却未能吸引大量游客。

考虑到2018年源自俄罗斯世界杯的收入会急剧上升，国际足联仍自认将实现2015到2018年间56亿美元的收入目标。但这取决于来自电视转播和赞助的收入。包括索尼、阿联酋航空、嘉实多在内的几个赞助商都没有续约。距离世界杯还有不到一年的时间，国际足联只拉到了12个赞助商，而赞助席位有34个。国际足联成功拉拢了一家本地赞助商——莫斯科的阿尔法银行（Alfa-Bank），但仍未谈妥在主办国转播赛事的广播机构。在2014年巴西世界杯前的同一时段，大部分赞助席位都已填满，其中许多协议好几

年前就已谈妥。“只剩一年时间，目前这样的情况真是闻所未闻。”国际奥委会前营销总监迈克尔·佩恩（Michael Payne）说。

国际足联最新的赞助协议是与中国智能手机制造商Vivo签署。这是第三家支持国际足联的中国公司。据信，中国正考虑在未来申办世界杯。中国企业似乎认为国际足联在丑闻后正在改过自新。但问题仍然存在。今年5月，国际足联道德委员会的一位法官和一名调查员被新人替换。离任官员之前负责的调查导致国际足联前主席塞普·布拉特（Sepp Blatter）等高层官员被停职。两人称，本来手头有数百宗调查正在进行中，此番遭撤换，意味着“改革的努力实际上已经停止”。国际足联的新任主席詹尼·因凡蒂诺（Gianni Infantino）形容这只是“茶杯里的风波”。这番言辞就像国际足联的电视转播权一样，可能很难让人买账。■



European business

Getting its fizz back

Much of corporate Europe is giddy with optimism. Some of it is warranted

IT IS remarkable what a difference a single election can make. “The way Europe is regarded by the rest of the world has changed in a few months,” says Gérard Mestrallet, chairman of both Engie and SUEZ, two big French energy firms, and a board member at Siemens of Germany, the region’s biggest engineering firm. The arrival of Emmanuel Macron as France’s reform-minded new president—his party has just won a giant victory in parliamentary elections—is helping to transform attitudes from gloom to cheer.

Mr Mestrallet echoes many corporate leaders in describing “real hope and enthusiasm”, amid expectations that the new president will, within months, “de-block” the euro zone’s second-largest economy. Mr Macron will start freeing business activities, he says, first with legislative reform of a rigid labour market to simplify rules on hiring and firing, and then by cutting tax rates (the corporate kind will fall from 34.4% to 25%). Measures to boost entrepreneurship and young technology firms are also expected. This may all sound over-optimistic, but Mr Mestrallet merely captures an ebullient mood that is spreading across Europe.

In truth, business sentiment in France and elsewhere was ticking up before Mr Macron’s success. The gradual emergence of animal spirits was encouraged by an improving European economy, owing to low oil prices, supportive monetary policy and a cheap euro. Worries have eased among manufacturers that President Donald Trump would spark a trade-stifling confrontation between America and China; exports are thriving.

German firms have long benefited from a combination of a steady domestic

economy and their own exporting prowess. But most of corporate Europe is enjoying similar tailwinds: the 19 economies of the euro zone in aggregate grew by an annualised rate of 2.3% in the first quarter, nearly double America's rate. Surveys say sentiment at manufacturers in Spain and Portugal is the brightest it has been in years. Inditex, a giant Spanish producer of fast-fashion clothing, which has sales predominantly in Europe, reported booming sales and profits for the first quarter on June 14th.

Business is also reassured that Angela Merkel, Germany's chancellor, is likely to be re-elected in the autumn. She is signalling an intent to join Mr Macron in seeking European-level reforms to spur growth. These have long been promised and not delivered upon, but could include speeding the creation of a digital single market and encouraging more cross-border mergers to create industrial and other kinds of champion. The talk in Paris is that cross-border takeovers of banks could follow—something that nationalist politicians, at least in France, previously discouraged.

| *Renaissance era*

Xavier Niel, founder of Iliad, a big French telecoms company that is poised to expand into Italy this year or next, says that more integration is essential if European firms are to mature properly. (A recent survey of European business leaders found that 60% want “more Europe”.) Mr Niel reckons that France will emerge as a vibrant centre for tech firms—Station F, a massive incubator he is funding for 1,000 startups, opens in Paris soon. But for such companies to scale up fast, as American ones do, he says that Europe needs to “unify all fiscal rules and norms” into a true single market.

Ifo, a German think-tank, talks of a “euphoric” mood in Germany, after years of sustained economic growth. Its business-climate index has reached a peak not seen since 1991, a year after reunification. The Association of German Chambers of Commerce and Industry says its

25,000 member companies report an outlook brighter “than ever before”.

Producers of capital goods are especially hopeful of a sustained upturn. Illustrative of the rising cheer is Jungheinrich, a Hamburg-based firm with 15,000 staff that is one of Europe’s largest producers of fork-lift and other equipment. Its net sales leapt by 19% year on year in the first quarter, in part as other companies in Europe buy its machinery. Volker Hues, its chief financial officer, describes “persistent intensification of business” from clients in the food, car-making and retail industries in particular. His firm is investing 13% more this year to meet rising orders.

Adding to this sense of dynamism is a welter of M&A deals, even as activity has dried up across the Atlantic. One measure—counting announced transactions involving American and European firms in the first five months of the year—points to \$172bn of transactions, an increase of over 80% on the same period in 2016. A count of all deals involving European firms, by Bloomberg, for the first quarter, suggests activity is up by 34%.

“You can feel it, smell it. It’s in the air, real excitement,” says Forrest Alogna, an American mergers lawyer in Paris describing a rush of business since Mr Macron’s victory. Deals include an attempted Italian-Spanish merger of road-toll companies, which would be the biggest takeover in Spain for a decade, and a gas-industry tie-up, worth \$70bn, agreed by Praxair, of America, and Linde, of Germany.

Some of these deals reflect European firms’ weakness and relative cheapness, as well as renewed optimism. Europe’s companies have fallen behind their global peers in the past decade, leaving some vulnerable to predators. In 2007 Europe claimed 14 firms among the world’s largest 100 listed ones (by market capitalisation); today it counts only seven. A big reason for the fall is the market fragmentation that worries Mr Niel.

But buyers are also drawn to firms that offer expanding revenues, and European ones look set to profit from rising growth. In Spain a revival of car production has seen SEAT, a subsidiary of Volkswagen, turn to profit for the first time in a decade. Portuguese exporters and tourism firms report rapid growth. In France defence firms expect that talk of higher military spending in Europe, a response to anxiety over America's support for NATO, will mean new orders.

Even in Italy, an economic laggard, manufacturers sound chipper. Alberto Bombassei of Brembo, a producer of brake systems, says his firm is doing well from rising car sales at home and also surging exports. The declining fortunes of Italy's populist Five Star Movement, and the re-emergence of a centrist former prime minister, Matteo Renzi, could portend a more business-friendly political climate there, too (though such hopes have repeatedly been dashed before).

The real test is if firms translate their optimism into far more investment. This is needed, for example, for more of them to push on with digitalisation, where continental firms lag. A recent survey of 2,000 European firms by McKinsey, a consultancy, found that they still hoard cash against a future downturn. It estimates gross corporate savings of some €2trn (\$2.2trn). Investment is only just back to the absolute levels seen before the financial crisis of 2007-08 and remains low in relative terms.

That is not because of tight credit but as a result of lingering timidity. On average, respondents plan investment increases of 6.9%, cumulatively, in the next three years. That is hardly a boom. But the consultancy received its responses before Mr Macron and other centrists in Austria and the Netherlands had won power. Reforms by these political leaders are not yet in the bag. But if European business leaders trust changes are coming, they have a simple way to respond: spend again. ■



欧洲商业

活力再现

许多欧洲企业乐观得忘乎所以，其中一些是合理的

没想到一场选举能产生如此巨大的影响。“世界对欧洲的看法在几个月内已经发生了改变。”热拉尔·梅斯特雷（Gérard Mestrallet）说。他是法国两大能源公司Engie和苏伊士（SUEZ）的董事长，也是欧洲最大的工程企业德国西门子的董事。主张变革的埃马纽埃尔·马克龙当选法国总统——他所在的政党也刚刚在议会选举中大胜——这让人们的态度从忧虑转为振奋。

人们期盼新总统将在几个月内“解锁”欧元区第二大经济体。梅斯特雷和许多企业领袖一样，在这样的氛围中谈论着“真切的希望和热情”。他认为，马克龙将着手解放经济活动，首先会通过立法改革僵化的劳动力市场，简化聘用和解雇的相关法规，然后再降低税率（企业税将从34.4%下降到25%）。人们还期望马克龙政府推出推动创业和年轻科技公司发展的措施。这些听起来可能都太过乐观，但一股高涨的热情正在欧洲蔓延，梅斯特雷只是捕捉到了这种情绪而已。

事实上，法国和欧洲其他地方的商业信心在马克龙当选之前就有所改善。低油价、支持性的货币政策和廉价的欧元让欧洲经济出现好转，“动物精神”或者说非理性信心随之显现。制造业对特朗普会挑起中美对抗、进而遏制贸易的担忧有所缓解，出口蒸蒸日上。

德国企业一直受益于国内经济稳定及自身的出口实力。不过，如今大多数欧洲企业也都在享受类似的利好因素：欧元区19个经济体在第一季度的总体年化增长速度为2.3%，几乎是美国的两倍。调查表明，西班牙和葡萄牙制造企业的信心达到多年来最高水平。Inditex是西班牙大型快时尚服装生产商，产品主要在欧洲销售，6月14日公布的数据显示，其第一季度销售额和利润均大幅增长。

德国总理默克尔可能会在秋季再次获得连任，这也给商业发展吃了定心丸。默克尔表示有意与马克龙联手，在欧洲层面寻求改革，以刺激经济增长。这类改革承诺由来已久，但从未兑现，其中可能包括加快创建数字化单一市场，鼓励更多的跨国并购从而创造出工业和其他领域的龙头企业。法国人的看法是接下来可能会有更多的跨境银行收购，这在以前是遭到民族主义政客反对的，至少在法国是如此。

| 复兴的时代

法国大型电信公司Iliad准备今年或明年向意大利市场扩展，其创始人泽维尔·尼尔（Xavier Niel）表示，欧洲企业如果想要发展成熟，更多的市场整合至关重要。（最近对欧洲商业领袖的调查发现，他们中有60%希望看到“更加一体化的欧洲”。）尼尔认为，法国将成为一个充满活力的科技企业聚集地。他投资的一个大型孵化器Station F即将在巴黎启动，其中将容纳1000家创业公司。尼尔说，要想让这些公司像美国同类企业一样迅速成长，欧洲需要“统一所有的财政制度和规范”，变成一个真正的单一市场。

德国智库Ifo提到，经过多年的持续经济增长，德国有种“欢欣鼓舞”的氛围。商业景气指数达到1991年即德国统一一年后以来的最高点。德国工商总会表示，其2.5万家会员公司对未来的展望“比以往任何时候”都要乐观。

生产资料生产商对未来经济持续上涨尤其抱以厚望。永恒力集团

（Jungheinrich）便是这种高涨的振奋之情的一个例证。这家位于汉堡的公司有1.5万名员工，是欧洲叉车等设备最大的生产商之一。公司今年一季度净销售额同比增长19%，部分增长来自欧洲其他公司对其设备的采购。永恒力的首席财务官沃尔克·休斯（Volker Hues）称各行各业的客户“业务不断加强”，尤其是食品、汽车制造和零售行业的客户。休斯的公司今年增加了13%的投入，以应付不断增加的订单。

一系列并购交易也在为这种活力十足的氛围添柴加薪，虽然大西洋对岸的并购活动已很贫乏。有一项指标计算了今年前五个月公布的涉及欧美企业的并购交易，显示交易总额为1720亿美元，比2016年同期增长了80%以上。彭博的数据显示，涉及欧洲企业的并购交易在第一季度增长了34%。

“兴奋的情绪四处弥漫，你可以感觉到，甚至闻得到。”在巴黎工作的美国并购律师福里斯特·阿龙纳（Forrest Alogna）这样描述马克龙获胜后业务大增的情形。这些并购交易包括拟合并的意大利和西班牙公路收费公司，交易一旦达成，将是西班牙十年来最大的合并案。此外还有一桩天然气行业的合并——美国普莱克斯（Praxair）公司已与德国林德（Linde）公司达成了价值700亿美元的合并协议。

有些交易反映了欧洲企业的弱势和相对廉价，以及复燃的乐观情绪。欧洲企业在过去十年中的发展已落后于全球同行，让一些强势企业有了可乘之机。2007年，全世界最大的100家上市公司（以市值计）中，欧洲公司占14家，如今却只占7家。欧洲落后的一个重要原因正是尼尔所担心的市场分散。

不过，买家也很青睐收入不断增加的公司，而欧洲企业看似铁定能从经济增长中获利。在西班牙，汽车生产复苏，大众的子公司西雅特（SEAT）十年来首次盈利。葡萄牙的出口商和旅游公司也实现了快速增长。由于担心美国减少对北约的支持，欧洲在探讨增加军费开支，法国军工企业期望这将为它们带来新订单。

即使在经济落后的意大利，制造商的情绪似乎也很乐观。制动系统制造商Brembo的阿尔贝托·邦巴塞伊（Alberto Bombassei）表示，由于国内汽车销量上涨、出口急剧增长，他的公司生意兴隆。意大利民粹主义政党五星运动（Five Star Movement）人气下降，中间派前总理马泰奥·伦齐（Matteo Renzi）再次崛起，似乎也预示着意大利的政治气候会对商业更友好（不过这种希望之前已多次破灭）。

真正的考验是看企业是否会将乐观的态度转化为大幅增加投资。这样的投资是必须的，比如可以让更多欧洲企业推进相对落后的数字化进程。咨询公司麦肯锡近期对2000家欧洲企业所做的调查发现，这些企业仍然在为抵御未来可能出现的衰退而囤积现金。麦肯锡估计，公司总储蓄额高达2万亿欧元（2.2万亿美元）左右。目前投资才刚刚回到2007至2008年金融危机前的绝对水平，相对来说仍处于低位。

这不是因为信贷紧张，而是因为欧洲企业畏手畏脚惯了，一时难以改变。麦肯锡调查的企业计划在未来三年内平均累计增加投资6.9%，这算不上大幅增长。不过麦肯锡收到这些答复时，马克龙以及奥地利和荷兰的其他中间派人士还没有赢得权力。这些政治领导人寻求的改革并非稳操胜券，但如果欧洲商界领袖深信变革即将到来，他们回应的方式很简单，那就是追加投资。■



High-security locks

Forging the unforgeable

A key that can't be copied (probably)

KEYS have been around for a long time. The earliest, made from wood, date back 4,000 years, to the ancient Egyptians. The Romans improved them a bit by making them from metal. But there, more or less, they have stayed. Electronic card-keys aside, a key is still, basically, a piece of metal sporting a series of grooves, teeth and indentations which, when inserted into a keyway, line up to move pins and levers to lock or unlock a mechanism.

Such keys are made with conventional manufacturing techniques, such as cutting and stamping. But now there is a new way, in the form of 3D printing, to craft metal objects. And keys are about to succumb to it, to the great benefit of keyholders.

A 3D printer works by melting together layers of material that are added successively to the object being created. It can thus make something from the inside out, as it were, by printing intricate internal features and then covering them with a solid layer. Features shielded from view are extremely difficult to copy, let alone reproduce using normal machine tools. What better way to reinvent the key, reckoned Alejandro Ojeda, a mechanical engineer who at the time was studying at the Swiss Federal Institute of Technology, in Zurich, than to 3D-print it in this way.

What prompted his interest is how simple it is to copy most keys: a few minutes at a local key shop will usually suffice. And copying is getting easier. It is now possible to take a picture of a key with a smartphone and turn the image into a computer file that can be used to make a replica with the aid of a cheap, hobbyist 3D printer. The resulting duplicate will probably be printed in plastic, and thus lack durability. But it is likely to be

good enough to work at least once—and once might be enough.

Dr Ojeda's answer is the Stealth Key (pictured). This is printed in titanium, one of the toughest of metals. Its teeth are hidden under a pair of narrow ledges, making it unscannable. But when inserted into the lock the teeth can operate the mechanism.

To bring the Stealth Key to market, Dr Ojeda teamed up with Felix Reinert, an expert on 3D-printing metal, to found a firm called UrbanAlps. Jiri Holda, a lock designer, joined them to help devise a keymaking process that employs an industrial 3D-printing system called selective laser melting (SLM). This is currently used to make high-strength components for jet engines and gas turbines. Indeed, it was these uses, which also involve printing a lot of concealed detail, that gave Dr Ojeda his key-printing idea in the first place.

SLM, as its name suggests, uses a laser to fuse the layers of metallic powder of which the object being printed is made. It is good at its job, but slow. It takes only seconds to cut a conventional key, but making a Stealth Key can occupy the best part of a day. UrbanAlps' SLM machine does, however, print 850 of them at a time—each, naturally, different from the others.

Stealth keys are not cheap. A pair, together with a lock mechanism (made the conventional way), cost about \$200. But UrbanAlps' founders hope the added security they bring will make them attractive—probably to industrial customers to start with, and to the general public as padlocks. They do have a downside, though. If you lose one, getting a replacement will involve a security check, because only UrbanAlps has the digital-design file for the original. And a duplicate will take another day in the 3D printer. ■



高安全锁

打造不可仿造之匙

（可能）无法复制的钥匙

钥匙的存在由来已久。最早的钥匙可追溯到4000年前，由古埃及人用木头制成。罗马人对钥匙做出了一些改进，改用金属制造。不过自那以后，钥匙差不多就再无变化。除电子门禁卡外，钥匙基本上还是一块金属，上面有凹槽、齿和凹刻。插入锁孔时，钥匙与弹子和锁杆吻合，就可以上锁或打开锁。

这种钥匙是用切割和冲压等传统制造工艺制成的。但现在有一种制作金属物件的新方法——3D打印。钥匙的制作将使用这种技术，这对用钥匙的人大有裨益。

3D打印机的工作原理是把逐层添加的材料熔融在一起形成某个物品。因此，可以说它能由内向外地制造物品：先打印出复杂的内部结构，然后再加上一个坚实的外壳。隐藏于其中的内部构造极难复制，更别说用普通的机床来仿造了。机械工程师亚雷汉德罗·奥积达（Alejandro Ojeda）还在苏黎世瑞士联邦理工学院（Swiss Federal Institute of Technology）学习时就认为，3D打印是彻底改造钥匙的绝佳方法。

激发他这方面兴趣的原因是大多数钥匙都太容易复制了，一般在家附近配钥匙的小店几分钟就可以办到。而且复制钥匙也越来越容易。用智能手机给钥匙拍张照片，把图像转成计算机文件，然后用一部廉价的非专业3D打印机就能把钥匙复制出来。复制品可能是用塑料打印的，并不耐用，但至少能用一次，而一次说不定也就够了。

奥积达的应对之策是隐形钥匙（Stealth Key，如图）。这种钥匙用钛打印出来，而钛是硬度最高的金属之一。钥匙的齿隐藏在一对狭窄的卷边里，无法扫描。但插入锁芯时，匙齿可以如常发挥作用。

为了将隐形钥匙推向市场，奥积达与3D打印金属器件的专家菲利克斯·莱纳特（Felix Reinert）合作，成立了一家名为UrbanAlps的公司。锁具设计师吉利·赫达（Jiri Holda）也加入进来，帮他们设计一种钥匙制造工艺。此工艺用到了选择性激光熔化（SLM）这种工业3D打印系统。这个系统目前用于制造喷气发动机和燃气轮机的高强度部件，这些部件也涉及到很多隐蔽细节的打印。实际上，奥积达最初正是从这类应用中得到了打印钥匙的灵感。

所谓SLM，顾名思义，就是利用激光来熔融3D打印物体所用的金属粉末层。效果很好，但是很慢。切割出一把常规钥匙只需几秒，而打印一把隐形钥匙得花大半天。不过UrbanAlps的SLM设备一次可打印850把钥匙——当然了，每把都不一样。

隐形钥匙可不便宜。两把钥匙连同一把以常规方式制造的锁，成本约为200美元。但UrbanAlps的创始人希望，它们增加的安全性能吸引到用户——开始可能是工业客户，然后再作为挂锁普及到一般消费者。不过，这种钥匙确实有个缺点。如果你把钥匙弄丢了需要重配，就要接受安全检查，因为只有UrbanAlps有原配钥匙的数字设计文件。用3D打印机再打一把出来又得再花一天。■



Financial crises

Secret agents

A new book argues that economists have misunderstood the financial system

AS QUEEN ELIZABETH II famously once pointed out, most economists failed to predict the crisis of 2007-08. In a lecture to the American Economic Association in 2003, Robert Lucas argued that macroeconomics had succeeded in so far as the “central problem of depression prevention has been solved, for all practical purposes”. Yet within five years the world faced its worst crisis since the 1930s.

In his new book, “The End of Theory”, Richard Bookstaber approaches the issue from a different direction, as someone who has managed risk at leading investment banks and hedge funds. He believes that “traditional economic theory, bound by its own methods and structure, is not up to the task” of predicting crises.

The author argues that the economy is subject to four important phenomena that make traditional economic models useless. The first are “emergent phenomena”. The sum of human interactions can produce unexpected results that are not related to the intentions of the individuals involved, just as traffic on a motorway can bunch, or crowds can suddenly stampede. The second phenomenon is “non-ergodicity”. An ergodic process follows the same rule every time. If you roll traditional dice, the odds of getting a three will always be one in six. But in the world of human interactions, probabilities constantly change. A linked phenomenon is known as “radical uncertainty”; people do not know the range, or the probability, of future outcomes. The fourth is “computational irreducibility”; the future is so complex, and the effect of human interactions so unfathomable, that people cannot possibly create models to anticipate the outcome.

Mr Bookstaber is also keen on the concept developed by George Soros, a hedge-fund manager, of “reflexivity”—the idea that observations and beliefs about the state of the economy change behaviour, and those changes in behaviour affect the economy. For example, a belief that house prices will always go up makes buyers willing to pay high prices for homes, and banks more willing to lend; the resulting enthusiasm among debtors and creditors duly pushes house prices higher.

What people must do, Mr Bookstaber argues, is embrace the complexity and understand the way the system operates. There are several different types of agents in the financial system, each with their own motivations; some of these (banks in particular) play multiple roles. The way each agent behaves in any given situation may differ depending on the liquidity in the market, and the extent to which it is using borrowed money to finance its activities. The crisis of 2007-08 was the result of indebted institutions operating in an illiquid market.

Watching what markets do in normal times is thus of little help in understanding how they will operate in a crisis. As the author writes: “Measuring relatively small transactions does not give us much insight, just as watching snowshoe hares scurry across a frozen lake gives no indication of whether the ice will support a man.” He takes readers through a step-by-step explanation of the crisis of 2007-08, showing the gradual infection of the system as the different agents followed their own goals.

The analysis is top-notch, and anyone who wants to understand the workings of the financial system will benefit from reading this book. But those looking for a quick fix will be disappointed. Mr Bookstaber says there is no specific model to deal with crises. Instead, he is describing a process—an intellectual approach to understanding the system.

Furthermore, although the author gives a kicking to mainstream

economics in general, his analysis focuses entirely on the financial sector. The problems that bedevil economists (inflation, unemployment, productivity) do not feature. The challenge facing traditional economists is to incorporate Mr Bookstaber's insights into their forecasts. A daunting task. ■



金融危机

秘密代理

一本新书认为经济学家误解了金融系统

伊丽莎白二世曾经的一番话很出名。她指出，大部分经济学家都没能预测到2007年至2008年的那场经济危机。2003年，罗伯特·卢卡斯（Robert Lucas）在美国经济学会演讲时宣称，宏观经济学已经取得了胜利，因为“预防经济萧条的核心问题实际上已得到解决”。然而这之后不到五年，全球就经历了自上世纪30年代以来最严重的危机。

在新书《理论的终结》（The End of Theory）中，作为曾经在顶尖投行和对冲基金从事过风险管理的人士，理查德·布克斯塔伯（Richard Bookstaber）从另外一个角度讨论了这个问题。他确信，“传统的经济理论受其自身方法和结构的制约，无法承担起”预测危机的任务。

作者认为经济受制于四种重要现象，这些现象令传统经济模型毫无用处。第一是“涌现现象”（emergent phenomena）。各种人际互动汇集起来会产生预料不到的结果，而这些结果与身在其中的个人的意愿并无关联，就好像高速公路上会发生拥堵，或是人群会突然推搡踩踏。第二种现象是“非遍历性”（non-ergodicity）。一个遍历的过程每一次都遵循同样的规则。如果你扔个传统的骰子，抛出三点的几率总是六分之一。但是在人际互动的世界，概率是不断变化的。与此相关的一个现象被称作“根本不确定性”（radical uncertainty）：人们不清楚未来结果的范围或可能性。第四种现象是“计算不可化归性”（computational irreducibility）：未来如此复杂，人际互动的影响如此深不可测，人们不可能创造出能够预测结果的模型。

布克斯塔伯对于对冲基金管理人乔治·索罗斯（George Soros）提出的“自反性”理论颇为着迷。该理论认为，对经济状况的观察和信念会改变行为，而这些行为上的改变又会影响经济。例如，相信房价会持续上涨的想法令买家愿意出高价买房，而银行也更愿意提供贷款，由此产生的借贷双

方的热情进而又推高房价。

布克斯塔伯认为，人们必须做的是欣然接受这种复杂性，并且了解系统运作的方式。金融系统中有几种不同类型的代理，每一种都有自己的动机，有些代理（尤其是银行）身兼数职。每个代理在特定情况下的行为方式可能不同，这取决于市场的流动性以及它运用贷款资助自身活动的程度。2007年至2008年的金融危机就是负债机构在一个低流动市场上运作的结果。

因此，观察市场在正常时期的表现对了解它们在危机中会如何运作帮助甚微。正如作者所述：“衡量相对较小的交易并不会给我们带来多少启发，就好比看着北美野兔匆匆跑过结冰的湖面并不能判断冰层能不能承受住一个人。”他带领读者一步步解读2007年至2008年的危机，展示了在不同代理追逐各自的目标时，整个系统如何逐渐受到感染。

这一分析确实出众，任何想了解金融系统运作的人都能从这本书中获益。但寻求快速解决方法的人要失望了。布克斯塔伯说，并没有能够专门对付危机的模型。他只是描述了一个了解这一系统的理性方式。

而且，尽管作者总体说来是敲打了主流经济学一番，但他的分析完全专注于金融领域，而长期困扰经济学家的那些问题（通货膨胀、失业、生产力）并非本书的重点。传统经济学家面临的挑战是将布克斯塔伯的见解融入到他们的预测中。这可真叫人为难。■



Information technology

Truth, all the truth—and statistics

Big Data is remodelling social science just as the microscope transformed medicine

TO MANY people Big Data is less shiny than it was a year ago. After Hillary Clinton's defeat at the hands of Donald Trump, her vaunted analytics team took much of the blame for failing to spot warnings in the midwestern states that cost her the presidency. But according to research by Seth Stephens-Davidowitz, a former data scientist at Google, Mrs Clinton's real mistake was not to rely too much on newfangled statistics, but rather too little.

Mrs Clinton used the finest number-crunchers. But their calculations still relied largely on traditional sources, such as voter files and polls. In contrast, Mr Stephens-Davidowitz turned to a novel form of data: Google searches. In particular, he counted the frequency of queries for the word "nigger", America's most toxic racial slur. Contrary to the popular perception that overt racism is limited to the South, the numbers showed comparatively high interest in the term across the Midwest and the rustbelt relative to the rest of the country. In the Republican primaries in 2016 that variable outperformed all others in predicting which geographic areas would support Mr Trump over his intraparty rivals. Had Mrs Clinton's team made better use of such information, they might have concluded, before it was too late, that the foundations of her "blue firewall" were cracking.

This is just one of the striking findings in "Everybody Lies", a whirlwind tour of the modern human psyche using search data as its guide. Some of the book's discoveries reaffirm conventional wisdom, like the concentration of queries about do-it-yourself abortions and about men who are confused about their sexual orientation in America's socially conservative South. Some turn it on its head: although rags-to-riches

narratives are widespread in basketball, the data show that growing up in poverty actually reduces a boy's chances of making the National Basketball Association—perhaps because poor children are less likely to grow tall enough to play in it. Some results are both disturbing and perplexing, such as the prevalence of searches on pornographic sites for videos depicting sexual violence against women, and the fact that women themselves seek out these scenes at least twice as often as men do. Other results are just weird: why are adult men in India so eager to have their wives breastfeed them?

The empirical findings in “Everybody Lies” are so intriguing that the book would be a page-turner even if it were structured as a mere laundry list. But Mr Stephens-Davidowitz also puts forward a deft argument: the web will revolutionise social science just as the microscope and telescope transformed the natural sciences.

Modern microeconomics, sociology, political science and quantitative psychology all depend to a large extent on surveys of at most a few thousand respondents. In contrast, he says, there are “four unique powers of Big Data”: it provides new sources of information, such as pornographic searches; it captures what people actually do or think, rather than what they choose to tell pollsters; it enables researchers to home in on and compare demographic or geographic subsets; and it allows for speedy randomised controlled trials that demonstrate not just correlation but causality. As a result, he predicts, “the days of academics devoting months to recruiting a small number of undergraduates to perform a single test will come to an end.” In their place, “the social and behavioural sciences are most definitely going to scale,” and the conclusions researchers will be able to reach are “the stuff of science, not pseudoscience”.

Mr Stephens-Davidowitz is not just any knee-jerk cheerleader for the Big Data revolution. He devotes ample space both to the ways that quantitative

findings can lead decision-makers astray, and to the risk that the nearly omniscient owners of such data sets may find ways to abuse them. If liking motorcycles turns out to predict a lower IQ, he asks, should employers be allowed to reject job applicants who admit to liking motorcycles? As a result, he calls for extreme caution in extending the use of Big Data from large groups of people to making decisions about individuals. On the whole, however, the author is an optimist. As a result of improvements in information technology, he writes, humans will “be able to learn a lot more” about themselves “in a lot less time”. ■



信息技术

真相，全部的真相——还有统计数字

大数据正在改变社会科学，正如显微镜彻底改变了医学一样

很多人都觉得大数据已不再像一年前那样光鲜。希拉里·克林顿败给特朗普之后，矛头大多指向了她那个备受吹捧的分析团队，因为他们没能发现中西部各州发出的警告，致使她与总统之位失之交臂。但根据前谷歌数据科学家赛斯·斯蒂芬斯-大卫德维茨（Seth Stephens-Davidowitz）的研究，希拉里真正的错误不是对新奇的统计方式太过依赖，而是利用得太少。

希拉里聘用了一流的数字分析人员，但他们的计算大体上仍依赖传统的数据来源，例如选民档案或民意测验。而斯蒂芬斯-大卫德维茨则选用了一种新颖的数据：谷歌的搜索结果。他特别统计了美国最恶劣的种族歧视字眼“nigger”（“黑鬼”）的查询频率。人们一般认为美国南方才存在公然的种族主义言行，但数据显示，和美国其他地方相比，中西部和锈带相对来说更喜欢用这个词。2016年共和党初选期间，在预测哪些地理区域会支持特朗普而非其党内对手时，这一变量的影响超出其他所有变量。如果希拉里的团队当初更好地利用了这样的信息，也许就能及时推断出，她那“蓝色防火墙”的根基正在崩裂。

这只是《人人都会说谎》一书的惊人发现之一。这本书以搜索数据为向导，快速地领略了现代人的内心世界。书中的某些发现再次确定了普遍的看法，例如DIY流产、对自己的性取向感到困惑的男性的有关搜索都集中在美国社会风气保守的南方。有些发现则与普遍看法相左：虽然从赤贫到巨富的故事在篮球界广为流传，但数据显示，在贫穷的环境中成长实际上会减少一个男孩打入NBA的机会，原因也许是穷孩子长到足够身高的可能性更低。有些结果让人不安，也令人费解。例如人们在色情网站上大量搜索展示对女性施加性暴力的视频，而女性本身搜索这种场景的频率至少是男性的两倍。其他的一些发现也很古怪：为什么印度的成年男子那么热切地想让妻子给他们喂奶？

《人人都会说谎》给出的实证结果非常有趣，想来就算将它们简单罗列，也会令人手不释卷。然而斯蒂芬斯-大卫德维茨还提出了一个巧妙的论点：网络将为社会科学带来一场革命，就像显微镜和望远镜彻底变革了自然科学那样。

现代的微观经济学、社会学、政治学以及计量心理学在很大程度上都依赖调查，最多也就抽样几千人。斯蒂芬斯-大卫德维茨认为，相比之下，“大数据具备四种不同寻常的力量”：提供新的信息来源，例如对色情内容的搜索；捕捉人们真实的行为和想法，而不是他们决定告诉民意测验机构的那些；让研究人员可以直接着手处理和比较人口统计或地理数据的子集；可以快速地进行随机对照试验，既可证明相关性，也能说明因果联系。因此，他预言“学者们花费几个月招募一小批本科生开展单项试验的日子将会终结”。作为替代，“社会及行为科学的研究绝对会扩大规模。”此外，研究者们得出的结论也将会是“货真价实的科学，而不是伪科学”。

斯蒂芬斯-大卫德维茨并不属于那些个不假思索就为大数据革命摇旗呐喊的人。他辟出充分的篇幅，既阐述量化分析结果会如何误导决策者，也详述了这类数据“全知”般的拥有者可能会想办法滥用数据。他发问道：如果从喜欢摩托车这一点可预测一个人智商较低，那么应不应该容许雇主拒绝那些承认自己喜欢摩托车的求职者？因此他呼吁，将大数据的运用从大规模的人群扩展至针对个人的决策时，要格外谨慎。不过，总的来说作者还是持乐观态度。他写道，由于信息技术的进步，人类将在“更短的时间内”，对自己有“更多的了解”。■



The Volkswagen emissions scandal

Bad smell

Why the emissions scandal still hangs over the German carmaker

WHEN an American policeman pulled over a Volkswagen (VW) Jetta in 2013, he suspected that the array of pipes sticking out of the back of the car and the grey box and portable generator in the vehicle were a sign of something fishy. He was right. The West Virginia University researchers inside the car had nothing to hide. But the tests they were conducting on the exhaust fumes, meant to prove the cleanliness of modern diesel engines, uncovered one of the biggest and boldest frauds in corporate history. The decision by VW, a pillar of Germany's car industry, to fit "defeat devices" and cheat emissions tests in up to 11m cars has so far cost the company \$21bn in fines and compensation in North America alone.

Why did the company deliberately set out to engineer cars that spewed out up to 35 times more poisonous nitrogen oxides on the road than stated in official tests? Jack Ewing, a journalist for the *New York Times*, offers a timely guide to the scandal, setting out in detail why VW's corporate culture led to the deception.

He delves into VW's origins, when Adolf Hitler ordered the construction of a "people's car", or *Volkswagen* in German. VW set up shop in the German countryside. Wolfsburg bred a "headquarters mentality" that insulated the firm from outside influence. Unprecedented union power, handed over in the 1960s as the price the federal government paid for floating the firm on the stockmarket, and the sway of the state of Lower Saxony, which retained a 20% voting stake in the company, gave outside shareholders little say.

This allowed autocratic bosses to have their way. Ferdinand Piëch became chief executive in 1993 at a time when the company was struggling. To win

back sales, Mr Ewing argues, he created the conditions that allowed the fraud to “fester”. To keep workers onside, the company had to carry on growing. Managers were kept quiet through fear. The ruthless Mr Piëch replaced almost the entire management board by his second year in the job.

His successor as CEO, Martin Winterkorn, a man cut from the same cloth, wanted the firm to become the world’s biggest carmaker. An assault on the American market, where VW was weak and emissions regulations much tighter than in Europe, was vital to overtaking Toyota and General Motors. To meet that demanding target, though, VW had to cheat.

Mr Ewing explains why VW cheated, but pinpointing who was responsible has been much harder. The company insists the deception was cooked up by middle managers and that senior bosses, despite a reputation for microscopic attention to detail, knew nothing of the fraud until it was too late. If there is clear evidence implicating bigger fish it has yet to emerge.

The scandal still haunts VW, despite a settlement with American law enforcers and compensation for American car-buyers. European customers are pursuing class-action lawsuits for compensation, though VW insists it did nothing wrong in Europe, where the rules are laxer. Mr Piëch left the company before the scandal erupted and Mr Winterkorn has since resigned. Several employees have been arrested or charged with criminal offences in America. German prosecutors are investigating nearly 40 employees and have begun a probe into Matthias Müller, the latest CEO and another long-serving insider, for failing to warn shareholders in a timely manner about the scandal. The company has denied those allegations. In any event, Mr Ewing’s tale will need a new edition with extra chapters. ■



大众排放门 臭气不散

为何排放门仍然困扰着这家德国汽车公司？

2013年，一位美国警察拦下了一辆大众捷达车，他怀疑车后方伸出来的一排管子以及车厢内的灰盒子和便携式发电机有什么猫腻。他是对的。车里坐着的几位西弗吉尼亚大学的研究人员并没有什么问题。不过他们正在进行的汽车尾气检测（原本是为证明现代柴油机的清洁）却揭露了企业史上最大规模、最无耻的欺诈行为之一。德国汽车工业的支柱大众在多达1100万辆汽车上安装了“排放失效装置”（defeat device），在尾气排放检测中作弊。这个做法令大众至今仅在北美就支付了210亿美元的罚款和赔偿。

这些汽车上路时排放的有毒氮氧化合物比官方检测时记录的数据高35倍。大众为何要故意对汽车动手脚？《纽约时报》记者杰克·尤因（Jack Ewing）为这一丑闻提供了适时的解读，详细分析了大众的企业文化何以导致了这一骗局。

他深入研究了大众的起源：当年希特勒下令制造“人民的汽车”，德语即Volkswagen。大众从德国乡间起步。沃尔夫斯堡培育出一种“总部心态”，令该公司不受外界的影响。上世纪60年代，联邦德国政府为了让该公司上市，将空前的权力移交给工会，再加上持有20%投票权股份的下萨克森州（Lower Saxony）的影响，外部股东几乎没有话语权。

这让专横的老板能够一意孤行。1993年，费迪南德·皮耶希（Ferdinand Piëch）在公司举步维艰之际出任CEO。尤因指出，为了挽回销量，皮耶希创造条件让欺诈行为进一步“恶化”。要让员工跟自己一条心，公司就必须继续发展壮大。管理层则因恐惧而噤声。到就任的第二年，冷酷的皮耶希几乎换掉了整个管理团队。

他的继任者马丁·文德恩（Martin Winterkorn）和他如出一辙。文德恩希望公司成为世界上最大的汽车制造商。要超越丰田和通用，猛攻美国市场

至关重要，而大众在美国市场表现疲弱，美国的排放标准又比欧洲严苛得多。因此，为了达到这一高难度目标，大众只得采取欺骗手段。

尤因解释了大众为何会欺骗，但要准确指出谁该对此负责就难得多。大众坚称是中层经理策划了这次欺骗行为，高管们尽管一向拥有无比关注细节的美誉，却始终对此一无所知，直至局面不可收拾。到目前为止还没有出现清晰的证据把矛头指向更大的人物。

尽管大众已和美国执法机构达成和解，也赔偿了美国车主，但这一丑闻仍困扰着这家公司。欧洲消费者正在提请集体诉讼要求赔偿，尽管大众坚称自己在法规较为宽松的欧洲并无过失。皮耶西在丑闻爆发前就离开了公司，而文德恩则为此引咎辞职。在美国，数名员工被捕或被控刑事犯罪。德国检方正在调查近40名员工，并且开始因未就这一丑闻及时提醒股东而调查接任CEO的马蒂亚斯·穆勒（Matthias Müller），他同样是在大众工作多年的内部人士。公司已否认了相关指控。不论如何，尤因的故事都需要出个新版本，增补些章节。 ■



Machine-learning in finance

Unshackled algorithms

More firms are experimenting with artificial intelligence

MACHINE-LEARNING is beginning to shake up finance. A subset of artificial intelligence (AI) that excels at finding patterns and making predictions, it used to be the preserve of technology firms. The financial industry has jumped on the bandwagon. To cite just a few examples, “heads of machine-learning” can be found at PwC, a consultancy and auditing firm, at JP Morgan Chase, a large bank, and at Man GLG, a hedge-fund manager. From 2019, anyone seeking to become a “chartered financial analyst”, a sought-after distinction in the industry, will need AI expertise to pass his exams.

Despite the scepticism of many, including, surprisingly, some “quant” hedge funds that specialise in algorithm-based trading, machine-learning is poised to have a big impact. Innovative fintech firms and a few nimble incumbents have started applying the technique to everything from fraud protection to finding new trading strategies—promising to up-end not just the humdrum drudgery of the back-office, but the more glamorous stuff up-front.

Machine-learning is already much used for tasks such as compliance, risk management and fraud prevention. Intelligent Voice, a British firm, sells its machine-learning-driven speech-transcription tool to large banks to monitor traders’ phone calls for signs of wrongdoing, such as insider trading. Other specialists, like Xcelerit or Kinetica, offer banks and investment firms near-real-time tracking of their risk exposures, allowing them to monitor their capital requirements at all times.

Machine-learning excels in spotting unusual patterns of transactions,

which can indicate fraud. Firms ranging from startups such as Feedzai (for payments) or Shift Technology (for insurance) to behemoths such as IBM are offering such services. Some are developing the skills in-house. Monzo, a British banking startup, built a model quick enough to stop would-be fraudsters from completing a transaction, bringing the fraud rate on its pre-paid cards down from 0.85% in June 2016 to less than 0.1% by January 2017.

Natural-language processing, where AI-based systems are unleashed on text, is starting to have a big impact in document-heavy parts of finance. In June 2016 JPMorgan Chase deployed software that can sift through 12,000 commercial-loan contracts in seconds, compared with the 360,000 hours it used to take lawyers and loan officers to review the contracts.

Machine-learning is also good at automating financial decisions, whether assessing creditworthiness or eligibility for an insurance policy. Zest Finance has been in the business of automated credit-scoring since its founding in 2009. Earlier this year it rolled out a machine-learning underwriting tool to help lenders make credit decisions, even for people with little conventional credit-scoring information. It sifts through vast amounts of data, such as people's payment history or how they interact with a lender's website. Lemonade, a tech-savvy insurance startup, is using machine-learning both to sell insurance policies and to manage claims.

Perhaps the newest frontier for machine-learning is in trading, where it is used both to crunch market data and to select and trade portfolios of securities. The quantitative-investment strategies division at Goldman Sachs uses language processing driven by machine-learning to go through thousands of analysts' reports on companies. It compiles an aggregate "sentiment score" based on the balance of positive to negative words. This score is then used to help pick stocks. Goldman has also invested in Kensho, a startup that uses machine-learning to predict how events like natural disasters will affect market prices, based on data on similar events.

| *Quantifiable progress*

Quant hedge funds, both new and old, are piling in. Castle Ridge Asset Management, a Toronto-based upstart, has achieved annual average returns of 32% since its founding in 2013. It uses a sophisticated machine-learning system, like those used to model evolutionary biology, to make investment decisions. It is so sensitive, claims the firm's chief executive, Adrian de Valois-Franklin, that it picked up 24 acquisitions before they were even announced (because of telltale signals suggesting a small amount of insider trading). Man AHL, meanwhile, a well-established \$18.8bn quant fund provider, has been conducting research into machine-learning for trading purposes since 2009, and using it as one of the techniques to manage client money since 2014.

So it seems odd that some prominent quant funds are machine-learning sceptics. Martin Lueck of Aspect Capital finds the technique overrated, saying his firm has found only limited useful applications for it. David Siegel, co-founder of Two Sigma, a quant behemoth, and David Harding of Winton Capital, have also argued that the techniques are overhyped.

In other fields, however, machine-learning has game-changing potential. There is no reason to expect finance to be different. According to Jonathan Masci of Quantenstein, a machine-learning fund manager, years of work on rules-based approaches in computer vision—telling a computer how to recognise a nose, say—were swiftly eclipsed in 2012 by machine-learning processes that allowed computers to “learn” what a nose looked like from perusing millions of nasal pin-ups. Similarly, says Mr Masci, a machine-learning algorithm ought to beat conventional trading strategies based on rules set by humans.

The real vulnerability may in any case lie outside trading. Many quant funds depend on human researchers to sift through data and build algorithms. These posts could be replaced by better-performing machines.

For all their professed scepticism, Two Sigma and its peers are busy recruiting machine-learning specialists. ■



金融领域的机器学习

算法冲破疆界

越来越多的公司在尝试人工智能

机器学习已开始震撼金融界。作为人工智能的一个子集，机器学习擅长发现规律并作出预判，这在以前一直是科技公司的专属技术。如今金融业也赶上了这趟风潮。只举几个例子：咨询审计公司普华永道、大型银行摩根大通和对冲基金管理公司Man GLG都设有“机器学习主管”。自2019年起，如果想要获得业内广受追捧的资质、成为“特许金融分析师”，必须掌握AI专业知识才能通过考试。

尽管许多人表示怀疑，其中甚至包括一些专门根据算法来进行交易的“量化”对冲基金，但机器学习势必将产生巨大的影响。创新的金融科技公司和一些灵敏的传统金融企业已开始将这一技术应用到方方面面，例如防欺诈和寻找新的交易策略等。这不仅有望颠覆单调乏味的后台苦差，还将深刻影响更为风光的前台部门。

机器学习已经广泛应用于合规、风险管理和预防欺诈等工作。英国公司智能语音（Intelligent Voice）向大银行出售基于机器学习的语音转录工具，可用于监控交易员的电话，以发现内幕交易等不正当行为的迹象。其他的专业公司如Xcelerit或Kinetica向银行和投资公司提供接近实时的风险敞口跟踪，让它们能随时监控自己的资本要求。

机器学习擅于发现不寻常的交易模式，而这种异常背后可能存在欺诈。从Feedzai（面向支付业务）或Shift Technology（面向保险业务）这类创业公司，到IBM这样的巨头都在提供此类服务。有些企业正在自行研发这样的技术。英国银行业创业公司Monzo建立了一个模型，能够及时阻止诈骗嫌疑人完成交易，这令它的预付费卡欺诈率从2016年6月的0.85%降至2017年1月的不到0.1%。

自然语言处理将人工智能系统的威力释放到文字上，开始对金融业繁重的

文书工作产生巨大影响。2016年6月，摩根大通部署了每秒能筛查1.2万份商业贷款合同的软件。换在过去，审查这些合同要耗费律师和信贷员36万个小时。

机器学习还擅长自动化金融决策，无论是评估信用还是保单的投保资格。Zest Finance自2009年成立后就从事自动化信用评分业务。今年早些时候，该公司推出了一款机器学习信贷审核工具，可帮助贷款方做出信贷决策，甚至可以决定是否贷款给那些几乎没有传统信用评分信息的人。该工具筛查大量的数据，如这些人的付款历史，或是他们与贷款方网站的互动。精通科技的保险创业公司Lemonade既利用机器学习来卖保险，也用它来管理索赔。

机器学习的最新应用领域可能是在交易上，人们用它来分析市场数据，以及选择并交易证券投资组合。高盛的量化投资部门用机器学习驱动的语言处理技术来通读分析师撰写的成千上万份公司研报。该技术根据积极言论和消极言论的数量对比，编制出一个综合的“情绪评分”，然后用这一评分来帮助选择股票。高盛还投资了Kensho，这家创业公司根据自然灾害等事件的有关数据，用机器学习预测这些事件将如何影响市场价格。

| 可量化进展

新老量化对冲基金都纷纷涌入这一行列。自2013年成立以来，位于多伦多的行业新贵Castle Ridge资产管理公司年均回报率已达32%。该公司采用了一套精密复杂的机器学习系统来做投资决策，类似于进化生物学的建模系统。公司CEO艾德里安·德·瓦卢瓦-富兰克林（Adrian de Valois-Franklin）称，该系统非常灵敏，甚至在24桩收购交易公布之前就捕捉到了消息（因为指示信号显示有小额内幕交易）。同时，资产规模达188亿美元的老企业Man AHL量化基金公司自2009年起就开始研究机器学习在交易上的应用，并在2014年起将其用作管理客户投资的手段之一。

这样看来，一些知名的量化基金反而是机器学习的怀疑者，似乎就有些奇怪了。Aspect Capital的马丁·卢埃克（Martin Lueck）认为人们高估了这一技术，称他的公司觉得机器学习用处有限。量化基金巨头Two Sigma的

联合创始人大卫·西格尔（David Siegel）和Winton Capital的大卫·哈丁（David Harding）也同样认为这种技术被过分炒作。

然而在其他领域，机器学习具有颠覆性的潜力。金融界也没有理由成为例外。机器学习基金管理公司Quantenstein的乔纳森·马茨（Jonathan Masci）认为，在计算机视觉领域，多年来的努力方向都是从规则出发，例如告诉计算机如何识别鼻子；而在2012年，机器学习进程迅速超越了一切——它让计算机通过仔细观察数百万张鼻子的图片，“学习”鼻子长什么样。马茨说，与此类似，机器学习的算法终将战胜以人为设定的规则为基础的传统交易策略。

无论如何，真正的弱点可能在交易之外。许多量化基金依赖人类研究人员筛查数据、构建算法。这些岗位可能会被表现更好的机器代替。虽然Two Sigma及其同行们宣称自己不信机器学习那一套，但它们都在忙着招揽机器学习专家。■



High-tech construction

Back to the future

Clever computers and 3D printing allow builders to design lavish, complicated and highly efficient structures

SET in the heart of Cambridge, the chapel at King's College is rightly famous. Built in the Gothic style, and finished in 1515, its ceiling is particularly remarkable. From below it looks like a living web of stone (see picture). Few know that the delicate masonry is strong enough that it is possible to walk on top of the ceiling's shallow vault, in the gap beneath the timber roof.

These days such structures have fallen out of fashion. They are too complicated for the methods employed by most modern builders, and the skilled labour required to produce them is scarce and pricey. Now, though, new technologies are beginning to bring this kind of construction back within reach. Powerful computers allow designers to envisage structures that squeeze more out of the compromise between utility, aesthetics and cost. And 3D printing can help turn those complicated, intricate designs into reality.

In a factory that makes precast concrete, 16km south of Doncaster, in northern England, a robotic arm hangs over a wide platform, a dribble of hard pink wax dangling from a nozzle at its tip. The arm is mounted on a steel gantry which lets it move about in three dimensions, covering a volume 30 metres long, 3.5 metres wide and 1.5 metres deep. Called FreeFAB, the system uses specialised wax to print ultra-precise moulds that, in turn, are used to cast concrete panels. Hundreds of these panels are being installed in passenger tunnels as part of Crossrail, Europe's biggest construction project, which is digging a new east-west railway line across London.

Run by Laing O'Rourke, a construction firm, FreeFAB is the first 3D-printing technology used in a big commercial building project. Show offices and show homes have been printed in places such as Dubai and China, but are, for now, just concepts. The problem, says Bill Baker, an engineer who worked on the Burj Khalifa in Dubai, the world's tallest building, is that printed concrete is currently produced in layers, which are fused together to make a thicker panel. But the boundaries between the layers introduce weaknesses that make the panels unsuitable for real buildings. "These things can peel apart," he says.

| *Breaking the moulds*

FreeFAB gets around that problem by printing moulds rather than trying to print structural material directly. Invented by James Gardiner, an Australian architect, it has big advantages over traditional mould-making techniques. One is that it creates far less waste. Ordinary moulds are made from wood and polystyrene, and can only be used to produce a single shape. Once they are finished with, they are scrapped and sent to landfill. FreeFAB's wax can be melted down and poured back into the tank, ready to be re-extruded into a new form. It took Dr Gardiner three years to find a wax which could be printed, milled and recycled.

The system also makes it cheaper to make even complicated moulds. Production of traditional moulds is highly skilled work. Making a mould for a concrete panel that curves along two different axes, like the ones used in Crossrail, takes about eight days, says Alistair O'Reilly, general manager at GRCUK, the firm in whose factory FreeFAB is installed. FreeFAB can print one in three hours. That speed makes it possible to meet the design demands of more complicated buildings. Subtly curved panels can be used inside houses to deaden sound and keep certain rooms quiet, for instance. Doing that with traditional methods would be too expensive. FreeFAB—or something like it—could make such components much cheaper. And

because the concrete itself is not being printed, the panels are just as strong as ones made in the traditional way. FreeFAB's parts do not peel, and have withstood twice the required force in bomb-proofing tests.

It is early days. The factory in Doncaster has had teething problems—it has proved tricky to print moulds without flaws big enough to be visible in panels cast from them. For now the factory supplies concrete cast from a mix of traditional moulds and 3D-printed ones. But if the technology matures enough, Laing O'Rourke plans to spin it out as a startup focused on this new way of creating buildings.

If that happens, Philippe Block, an architectural engineer at the Swiss Federal Institute of Technology, in Zurich, might be an early customer. Dr Block makes floors that have the flowing, veined look of biological membranes. Just a few centimetres thick, they are modern versions of the chapel ceiling at King's. Instead of building floors that rely on steel reinforcement to hold them up, Dr Block builds them under compression, so that each bit of the floor holds up the rest in a shallow vault. Each is bespoke, designed by a computer to efficiently deal with the specific loads it must bear. This allows him to build much thinner structures out of materials much weaker than reinforced concrete.

Such floors are useful as well as beautiful. In skyscrapers, for instance, the floors and the structures that support them account for a good deal of the building's mass. Dr Block calculates that his new, thinner floors would need only about a third as much material as a typical floor slab. At the same time, their thinness allows him to claw back enough vertical space to fit three floors into the space that would be taken by two floors built in the standard way.

Dr Block has already tested many versions of his ideas, most recently at the Venice Architecture Biennale in 2016. There, he and a team constructed a

15-metre vaulted “tent” out of 399 blocks of cunningly shaped limestone, each precisely milled to match the pattern of forces necessary to hold the vault up. Called the Armadillo Vault, its dome was half as thick as an eggshell would be at the equivalent size.

The next test is in a real building, specifically a demonstration house called NEST in the Zurich suburbs. Dr Block’s group will make the floors for a new part of the building called HiLo. The main bottleneck in the production of Dr Block’s structures is the creation of each element. It is expensive and slow to mill all the parts from blocks of stone, or to build traditional moulds for each individual component. So Drs Block and Gardiner are planning to work together on HiLo, using FreeFAB to print moulds that will produce segments of the floors. If all goes according to plan, the work should be done by 2018.

That could be just the beginning. Dr Gardiner talks of using ductal concrete, which is reinforced with steel fibres that make it lighter than concrete reinforced with steel rods but just as strong, to build thin bridges that span rivers in a single bound. For now, that is a project for the future. But all the components are in place. ■



高科技建筑

回到未来

强大的电脑和3D打印让建筑专业人士得以设计出奢华、复杂和高效的结构

国王学院礼拜堂坐落于剑桥大学的心脏地带，这一建筑广为人知，绝非浪得虚名。礼拜堂为哥特式风格，建成于1515年，其拱顶尤为特色。从下面看去，就像一张由石头织成的、富有生命力的网（见图）。很少有人知道，这个精巧的石砌结构足够坚固，人可以进入它和最顶层的木质屋顶之间的空间，在拱顶上行走。

如今，这样的结构已不再流行。对于大多数现代建筑公司所采用的建筑方法而言，它们太过复杂，能制作这种结构的熟练工人也很稀缺，人工成本太高。不过，如今的新技术开始让这种建筑再次变得可行。有了强大的计算机，设计人员在达成实用、美观和成本的平衡时拥有了更大的自由度，而3D打印可以帮助实现那些繁复精细的设计。

英国北部城市唐卡斯特（Doncaster）以南16公里的一间预制混凝土工厂里，一条机械手臂悬挂在一个宽阔的操作平台上，手臂末端的喷嘴口挂着一团已经凝固的粉色蜡。手臂安装在钢制龙门架上，可以在30米长、3.5米宽和1.5米高的空间内上下来回移动。整套系统叫作FreeFAB，使用专用蜡打印超精密模具，用于浇筑混凝土板。“横贯城铁”（Crossrail）项目的客运隧道便使用了数百块这样的混凝土板。该项目是正在兴建的一条横贯伦敦东西的城铁，也是欧洲最大的建筑项目。

FreeFAB由建筑公司Laing O'Rourke经营，是首个用于大型商业建筑项目的3D打印技术。由3D打印制作的办公室和住宅样板间已在迪拜和中国等地出现，不过目前还处于概念阶段。曾参与建造世界最高建筑迪拜哈里发塔的工程师比尔·贝克（Bill Baker）指出了问题所在。目前3D打印的混凝土是逐层打印，然后融合在一起，形成一块更厚的板，但层与层之间的结合处强度不足，不适用于真正的建筑物。“这些板会剥落的。”贝克说。

| 打破旧模式

FreeFAB打印的是模具，而不是直接打印结构材料，从而解决了这个问题。这套系统由澳大利亚建筑师詹姆斯·加德纳（James Gardiner）发明，相比传统模具制作技术有很大的优势，其一是可以大大减少废弃物。普通模具由木材和聚苯乙烯制成，只能用于生产一种形状的产品，完成任务后就会报废，送到垃圾填埋场。FreeFAB的蜡可以熔化后倒回罐中，重新挤出制成新的形状。为了找到可以打印、切削和回收的蜡，加德纳花了三年的时间。

该系统还降低了制作更复杂的模具的成本。生产传统模具的技术含量很高。GRCUK公司的工厂里安装了FreeFAB系统，公司总经理阿利斯泰尔·奥雷利（Alistair O'Reilly）表示，要为一块向两个方向延展弧度的混凝土板制作模具，比如在横贯城铁项目中用到的那种，需要大约八天时间，而FreeFAB三个小时就能打印一套。这样的速度可以满足更复杂的建筑物的设计需求。例如，室内可以使用微弯的混凝土板来消音，保持某些房间的安静。采用传统做法成本太高，而FreeFAB或类似的系统会使这样的组件变得便宜许多。而且由于混凝土本身不是打印出来的，所以混凝土板与传统方法生产出来的一样坚固。FreeFAB的部件不会剥落，并且在防爆测试中承受住了两倍于规定的冲击力。

这项技术还处于早期阶段，在唐卡斯特的工厂已经出现了一些初期问题——打印的模具很难浇筑出没有明显瑕疵的混凝土板。目前，该工厂同时提供由传统模具和3D打印模具浇筑出来的混凝土板。但如果技术能够变得足够成熟，Laing O'Rourke公司计划单独成立创业公司，专注发展这种创造建筑的新方式。

如果这个计划得以实现，位于苏黎世的瑞士联邦技术研究所（Swiss Federal Institute of Technology）的建筑工程师菲利普·布洛克（Philippe Block）可能会是首批客户之一。布洛克设计的楼板具有生物膜一般的流线型脉状肌理，只有几厘米厚，是剑桥国王学院教堂天花板的现代版本。这些楼板不需要钢筋来支撑，而是通过压缩力，让浅拱天花板上的每一块板材互为支撑。每块板都是由计算机单独设计的，以有效承受其必须承受

的荷载，这让布洛克能够用比钢筋混凝土强度低得多的材料打造出更薄的结构。

这种楼板既实用又美观，例如，在摩天大楼里，楼板及其支撑结构占了建筑物材料的很大一部分。根据布洛克的计算，他这种更薄的新型楼板用料比传统楼板少了近三分之二。同时，由于铺设出的楼板轻薄，省出了足够的垂直空间，用常规方式只能做两层楼的空间里，他能建造出三层楼面。

布洛克对自己的构想进行了多种形式的测试，最近一次是在2016年的威尼斯建筑双年展上。他和一个团队用399块巧妙塑形的石灰岩构建了一个跨度15米的拱形“帐篷”，每块石灰岩都经过精确的切割，以满足支撑起整个拱顶所需的受力模式。这个结构称为犰狳拱（Armadillo Vault），拱顶处的厚度只有鸡蛋放大到同等大小后蛋壳厚度的一半。

下一项测试会是在一个真正的建筑中进行：苏黎世郊区一个叫NEST的样板房。布洛克的团队将为建筑物中名为HiLo的新增部分制作楼板。布洛克的结构在生产过程中面临的主要瓶颈是单个部件的打造。从大石块切割出所有所需板块，或者为每个单独板块制造传统的模具成本高昂，过程缓慢。所以布洛克和加德纳正计划在HiLo项目中合作，使用FreeFAB系统打印模具来浇筑各块楼板。一切顺利的话，该项目将于2018年年底前完成。

而这可能只是个开始。加德纳谈到使用管状混凝土在河面上建造轻巧的单跨桥。这种混凝土用钢纤维加固，比用钢条加固的混凝土更轻，但强度相同。就目前而言，这还只是一个未来才能实现的项目，但所需技术已经就绪。 ■



Free exchange

How to be wrong

To err is human. Society is suffering from an inability to acknowledge as much

A NEWSPAPER cannot publish for 174 years without some mistakes. This one has made its share. We thought Britain was safe in the European exchange-rate mechanism just weeks before it crashed out; we opined, in 1997, that Indonesia was well placed to avoid financial crisis; we noted in 1999 that oil, at \$10 per barrel, might well reach \$5, almost perfectly timing the bottom of the market; and in 2003 we supported the invasion of Iraq. For individuals, like publications, errors are painful—particularly now, when the digital evidence of failure is both accessible and indelible. But they are also inevitable. The trick, then, is to err well: to recognise mistakes and learn from them. Worryingly, humanity may be getting worse at owning up to its goofs.

Few enjoy the feeling of being caught out in an error. But real trouble starts when the desire to avoid a reckoning leads to a refusal to grapple with contrary evidence. Economists often assume that people are rational. Faced with a new fact, rational actors should update their view of the world in order to take better decisions in future. Yet years of economic research illuminate the ways in which human cognition veers from rationality. Studies confirm what is obvious from experience: people frequently disregard information that conflicts with their view of the world.

Why should that be? Last year Roland Bénabou, of Princeton, and Jean Tirole, of the Toulouse School of Economics, presented a framework for thinking about the problem. In many ways, beliefs are like other economic goods. People spend time and resources building them, and derive value from them. Some beliefs are like consumption goods: a passion for conservation can make its owner feel good, and is a public part of his

identity, like fashion. Other beliefs provide value by shaping behaviour. The conviction that one is a good salesman may help generate the confidence needed to close sales; religious asceticism can help one avoid unhealthy habits.

Because beliefs, however, are not simply tools for making good decisions, but are treasured in their own right, new information that challenges them is unwelcome. People often engage in “motivated reasoning” to manage such challenges. Mr Bénabou classifies this into three categories. “Strategic ignorance” is when a believer avoids information offering conflicting evidence. In “reality denial” troubling evidence is rationalised away: house-price bulls might conjure up fanciful theories for why prices should behave unusually, and supporters of a disgraced politician might invent conspiracies or blame fake news. And lastly, in “self-signalling”, the believer creates his own tools to interpret the facts in the way he wants: an unhealthy person, for example, might decide that going for a daily run proves he is well.

Motivated reasoning is a cognitive bias to which better-educated people are especially prone. Not all the errors it leads to are costly: preaching the superiority of Arsenal despite contradictory evidence does little harm. But when biases are broadly shared—within troubled firms, say, or financial markets or political parties—danger lurks. Motivated reasoning helps explain why viewpoints polarise even as more information is more easily available than ever before. That it is easy to find convincing demolitions of climate-change myths, for example, has not curbed misinformation on the topic. But the demand for good (or bad) information is uneven. Polling shows, for example, that Democrats with high levels of scientific knowledge are more concerned about climate change than fellow partisans with less scientific background; among Republicans, the level of scientific awareness has no effect on climate beliefs. Even, or especially, sophisticated news consumers look for what they want to find.

Work by Mr Bénabou suggests that groupthink is highest when people within groups face a shared fate: when choosing to break from a group is unlikely to spare an individual the costs of the group's errors. If an individual politician's fortunes rise and fall with his party's, breaking from groupthink brings little individual benefit (and may impose individual costs). The incentive to engage in motivated reasoning is high as a result. Even as the facts on a particular issue converge in one direction, parties can still become increasingly polarised around starkly different belief-sets. That, in turn, can make it harder still for a member of one party to derive any benefit from breaking ranks. Indeed, the group has an incentive to delegitimise independent voices, such as statistical agencies or budget watchdogs. So the unanimity of views can be hard to escape until it contributes to a crisis.

Lowering the cost of admitting error could help defuse these crises. A new issue of *Econ Journal Watch*, an online journal, includes a symposium in which prominent economic thinkers are asked to provide their "most regretted statements". Held regularly, such exercises might take the shame out of changing your mind. Yet the symposium also shows how hard it is for scholars to grapple with intellectual regret. Some contributions are candid; Tyler Cowen's analysis of how and why he underestimated the risk of financial crisis in 2007 is enlightening. But some disappoint, picking out regrets that cast the writer in a flattering light or using the opportunity to shift blame.

| *I don't want to be right*

Public statements of regret are risky in a rigidly polarised world. Admissions of error both provide propaganda for ideological opponents and annoy fellow-travellers. Some economists used to seethe when members of the guild acknowledged that trade liberalisation could yield costs as well as benefits—though economic models had always allowed for

this. In the long run, such self-censorship probably eroded trust in economists' arguments more than it built support for trade. It is rarely in the interest of those in the right to pretend that they are never wrong. ■



自由交流

如何犯错

人孰无过，但我们的社会却因为不能认识到这一点而受损

没有哪份报纸能发行174年而从不出错，《经济学人》也不例外。我们曾认为英国在欧洲汇率机制中是安全的，结果没过几周它就遭遇惨败，黯然退出该机制；1997年我们认为印度尼西亚有足够能力避免金融危机；1999年石油每桶10美元时，我们写到油价很可能会跌到每桶5美元，但在几乎同一时间，油价触底；2003年我们还曾支持入侵伊拉克。和出版物一样，个人犯错也很痛苦，特别是现在，错误都会留下数字证据，既无从掩藏又无法抹除。但错误也是不可避免的，所以关键在于要“会”犯错：认识到错误并从中吸取经验。令人担忧的是，人类可能会越来越不会承认错误。

很少有人喜欢犯错被抓现行的感觉。但是，如果一心想要避免惩罚，以致于拒绝去面对相反的事实，真正的麻烦就来了。经济学家通常都假定人是理性的，面对新的事实，理性的人应该更新自己的世界观，好在今后做出更好的决定。然而，多年的经济研究表明，人类认知存在偏离理性的情况。研究证实了经验中显而易见的情况：人们经常会无视与自己的世界观相左的信息。

为什么会这样呢？去年，普林斯顿大学的罗兰·贝纳布（Roland Bénabou）和图卢兹经济学院（Toulouse School of Economics）的让·梯若尔（Jean Tirole）提出了一个思考此问题的框架。在许多方面，信念就像其他经济产品一样。人们花费时间和资源制造信念，并从中获得价值。有些信念就如同消费品：对环境保护的热情可以让一个人感觉良好，这种热情和时尚一样，是他个人身份塑造中对外展示的一面。其他信念通过塑造行为来提供价值，比如深信自己是一名优秀的推销员可能有助于建立信心，做成生意；又比如宗教禁欲主义可以帮助人避免不健康的习惯。

不过，信念不仅仅是帮助人们做出明智决定的工具，其本身就受人珍视。因此，挑战这些信念的新信息就不受待见。人们经常通过“动机性推理”来

应付这些挑战。贝纳布将动机性推理分为三类。“策略性忽视”是指持有某种信念的人回避与其信念相抵触的证据。“否定现实”的人会把令其不安的证据合理化：看涨房价的人可能会提出稀奇古怪的理论，解释价格为什么就应该表现异常；而一个遭人唾弃的政客的支持者可能会发明阴谋论或指责假新闻。最后，“自我提示”型的人为自己创造工具，以自己想要的方式来解释事实。例如，一个病人可能会认为每天跑步就能证明自己身体健康。

动机性推理这种认知偏见特别容易出现在受过良好教育的人身上。不是所有因这种偏见而犯的错误都会付出巨大代价：无视相反证据而鼓吹阿森纳队有多出色并没什么危害。然而，偏见如果被广为接受，比如在出现问题的公司里，或者在金融市场或政党内，就会危机四伏。动机性推理可以解释为什么虽然人们现在更容易获得更多的信息，观点却仍会两极分化。例如，如今很容易就能找到令人信服的证据来推翻有关气候变化的错误观念，但关于这一问题的不实信息却并未得到遏制。不过，对优质（或不良）信息的需求是不均衡的。例如，调查显示，科学知识水平较高的民主党人比科学背景较差的民主党人更关心气候变化；而在共和党人中，科学认知水平对个人的气候观点并没有影响。就连成熟的新闻消费者也会去找那些自己想看的東西看，或者说他们尤其会如此。

贝纳布的研究表明，如果群体中的人面临共同命运，一个人并不可能靠脱离群体来免于承担群体错误的代价，那么这种情况下趋同思维的水平是最高的。如果某个政客的命运与所属党派的命运休戚相关，那么跳脱趋同思维就不会带来个人利益（而且个人还可能会付出代价）。如此一来，人们采取动机型推理的动力就会增强。即便某个问题的事实都已指向同一个方向，各方仍然会坚持迥然不同的看法而愈发两极分化。这样一来，一方某个成员就更难通过脱离群体来获得任何利益。事实上，团体有动机去消弭独立的声音，比如来自统计机构或预算监督机构的意见，所以它很难摆脱整齐划一的意见，直至这导致危机爆发。

降低承认错误的代价有助于缓解这些危机。在线杂志《经济期刊观察》（Econ Journal Watch）最新一期有一个专题研讨，请杰出的经济思

想家说出他们“最后悔的言论”。这样的活动如果定期举行，人们也许就不再那么耻于改变想法。然而，这个专题研讨也显示出，要专家们面对自己的错误判断并非易事。有些专家很坦诚：泰勒·考恩（Tyler Cowen）分析了自己如何以及为何低估了2007年金融危机的风险，富有启发性。但也有些专家令人失望。他们要么专门挑出一些实为增加自己光环的所谓错误，要么就利用这个机会来转移责任。

| 无需永远正确

在分化严重的世界中，公开表示后悔是有风险的。承认错误既落了敌对者的口实，又会惹恼同一阵营的人。一些经济学家曾在其他同行承认贸易自由化既有利益又有代价时怒火中烧，尽管经济模型一直都考虑到了这种情况。从长远来看，相比为自由贸易争取到更多的支持，这种自我审查可能会更多地削弱人们对经济学家观点的信任。有理的一方假装自己永不会犯错，这于他们自身无益。■



Schumpeter

Money mountains

Is there any rational justification for tech firms' huge cash piles?

TAKE a moment to admire—and fear—the ascent of America's big-five tech firms. Apple, Alphabet, Microsoft, Amazon and Facebook have recently become the five most valuable listed companies in the world, in that order. With a total market value of \$2.9trn, they are worth more than any five firms in history.

Elevated tech valuations used to be a sign of hysteria. Today's investors believe they are making an ice-cold judgment that these firms are the dominant oligopolies of the 21st century and will extract a vast, rising, flow of profits. There is one gnawing doubt, however: the formidable five's cash-rich balance-sheets, which are built as if they expect a crisis, not to dominate the world.

It is easy to see why investors are keen. Billions of users are tied into these firms' social-media networks, digital assistants, operating systems and cloud-computing platforms. The five firms are squeezing traditional competitors such as IBM and Macy's. Together they make \$100bn of profits. Analysts forecast this will rise to \$170bn by 2020. The rebels of Silicon Valley have evolved into slick moneymaking machines with high market shares. For investors it just doesn't get any better.

Old-economy oligopolists, such as cable, telecoms and beer companies, are confident about their ability to extract reliable rents from customers, so they finance themselves largely with debt, which is cheap but inflexible, and return most of the cash they make to shareholders. Yet, oddly, the biggest tech firms have the opposite approach. Together they have \$330bn of net cash (cash less debt), a ratio of twice their gross cashflow.

The pile far exceeds the cash buffers that tech and pharmaceutical firms traditionally carry to compensate for their lack of physical assets that debt can be secured against. For example a selection of five cash hoarders from an early generation of tech giants—Cisco, Intel, Oracle, Qualcomm and Texas Instruments—together have had an average ratio of only 1.3 times since 1996.

The money mountain will get much bigger as profits soar. The five firms have policies for returning some cash to shareholders. For example, Alphabet and Facebook will not pay dividends for the “foreseeable future” but have small buy-back programmes, albeit with no deadlines. Apple pays a meaty dividend and has a budget for repurchasing shares until 2019. Factoring in these programmes, and analysts’ profit forecasts, their total net cash will reach \$680bn by 2020, or three times gross cashflow. Even Amazon, which has a relatively small pile now, will reach \$50bn.

One reason for the cash build up is tax: 80% of the five firms’ gross cash is held abroad, allowing them to defer the levy American firms pay when repatriating profits. The bill for bringing half the cash home might be about \$50bn. That is not to be sniffed at, but being clever about tax has become an excuse for firms to obfuscate and dither about their plans for their balance sheets.

The cash cushion is far larger than is needed to absorb shocks, such as a financial crash or a hacking attack. Schumpeter has devised a tech “stress test”. It assumes that staff are paid in cash not shares, which might happen after a stockmarket collapse, and that firms pay all their contingent tax liabilities (including all repatriation levies) as well as regulatory and litigation claims. It also includes a year of contractual payments—for instance Apple has to pay \$29bn to component suppliers. Including all of these costs, the five firms would still have \$380bn of net cash by 2020.

Nor could fresh investments soak up all the cash. The five tech firms together put \$100bn last year into research and development and capital spending, three times more than half a decade ago. A torrent of money is already flowing into data centres, software, new headquarters and “moon shots” such as driverless cars and immortality drugs. In order for the firms to spend all of the cashflow they are on track to retain, annual investment would need to rise to almost \$300bn by 2020.

That is over twice what the global venture-capital industry spends each year. It is 51 times the annual cash burned up by Netflix, Uber and Tesla, three firms famous for being cash hungry. And it is 37 times the average annual amount of cash the five firms have in total spent on acquisitions to gain new technologies and products, such as Facebook’s \$19bn purchase of WhatsApp, a messaging service in 2014, or Google’s \$3.1bn acquisition of DoubleClick, an advertising firm, in 2007.

Might these firms hoard cash just because they are run by megalomaniacs who are too rich and odd to obey any rules? That seems glib and out of date. Apple and Microsoft are no longer controlled by their founders. Those behind Alphabet were pragmatic enough in 2015 to appoint Ruth Porat, the former finance boss of Morgan Stanley, as its chief financial officer, to instil more discipline. Jeff Bezos’s interest is arguably for Amazon to pay a dividend—in the absence of one he is selling \$1bn of his shares every year to raise cash to finance his space-rocket firm.

| *Valleys of death*

Maybe if the tax code is reformed the great cash build up will end. The most mature firms, Apple and Microsoft, would make a large one-off return of cash to shareholders. Amazon, Alphabet and Facebook would adopt sensible frameworks for returning cash to shareholders as their profits soar.

But perhaps these firms love their giant insurance policy. Imperious on the outside, inside they may worry about obsolescence and regulation. Anti-trust authorities are getting hostile. Only five years ago Facebook and Google were struggling with the shift from desktops to devices. Both depend on advertising for over 85% of sales. Apple's health depends on its latest iPhone, Amazon has thin margins and Microsoft's profits have yet to rise.

If earnings do soar as forecast, the big-five tech firms could be plotting giant acquisitions of media, car or hardware firms, to diversify away from their core business. But they may simply be uneasy that profits will not rise as high as Wall Street now expects. Either way, the \$330bn safety blanket that lets Silicon Valley sleep at night should lead investors to keep one eye open. ■



熊彼特

金山

科技公司现金成堆，有合理的解释吗？

我们来花一点时间，对美国五大科技公司的快速成长表示一下赞赏——还有担忧。苹果、Alphabet、微软、亚马逊和Facebook近期成了世界上最有价值的五大上市公司，座次如上。它们的总市值高达2.9万亿美元，比历史上任何五家公司的总价值都高。

科技公司估值高曾经是市场不理性的征兆，而如今投资者认为自己做出了绝对客观的判断，相信这五大公司是主导21世纪的寡头企业，将获得不断增长的巨额利润。然而，有一件事让人心存不安：这五强的资产负债表上现金充裕，不像是统治世界的架势，倒像是要为应对危机做准备。

投资者热衷五强，原因显而易见。全球数十亿用户都与这些公司的社交媒体网络、数字助理、操作系统以及云计算平台捆绑在一起。五强正在挤压IBM和梅西百货这类传统型竞争对手。这五家公司的利润总计高达1000亿美元，分析师预计到2020年将上升至1700亿美元。硅谷的反叛分子已经进化成了具有高市场份额的高明赚钱机器。对投资者而言，这再好不过了。

电视、电信和啤酒这类传统经济模式下的寡头垄断企业信心满满，自认有能力利用自身垄断地位从客户那里谋取可靠的超额利润。因此，它们主要通过债务为自己融资，成本低但不灵活，再把赚到的大部分现金返还给股东。然而奇怪的是，五强科技公司做法却恰恰相反，它们共有3300亿美元的净现金（现金减去债务），是它们总现金流的两倍。

科技和制药公司向来都会保留一些缓冲现金，以弥补举债时可抵押实体资产不足的情况，但五强的现金量远远超过一般水平。从早一代科技巨头中五家偏爱囤积现金的公司来看，1996年以来，思科、英特尔、甲骨文、高通和德州仪器这五家公司的净现金平均仅为其现金流的1.3倍。

随着利润飙升，五强企业的金山还会变得更大。它们有向股东返还部分现金的政策，例如，Alphabet和Facebook在“可预见的未来”虽不会分红，但有小规模的回购计划，尽管没有设定期限。苹果分红丰厚，还有在2019年前回购股份的预算。考虑到这些政策和分析师的利润预测，到2020年，五强净现金总额将达到6800亿美元，相当于总现金流的三倍。即使是目前现金相对较少的亚马逊，净现金金额也将达到500亿美元。

囤积现金的一个原因是税收：五强的总现金中有80%是在海外持有，这让它们可以递延美国公司在汇回海外利润时支付的税款。将其中一半现金收回国内的税款可能就高达约500亿美元。这固然无可指摘，但合理避税已成为企业对于资产负债表计划遮遮掩掩和犹豫不决的借口。

五强的现金储备远远超出应付金融危机或黑客攻击这类突发事件所需。熊彼特设计了一个科技公司“压力测试”。测试假定员工薪酬以现金而非股票支付（这种情况在股市崩溃之后可能发生），且公司会付清所有可能发生的税目（包括资金汇回本国缴纳的税款）以及监管和诉讼费用。测试还包含了一年的合同付款，例如苹果必须向零配件供应商支付290亿美元。把所有这些费用都算上，五强到2020年仍将拥有3800亿美元的净现金。

新投资也不会用尽所有现金。五强公司去年共投入1000亿美元用于研发和资本支出，比五年前多三倍。已经有大笔资金流入数据中心、软件、新总部，以及无人驾驶汽车和长生不老药这类“探月”项目。以目前的收入状况，如果公司要花光所有留存的现金，2020年之前年投资额将需要达到近3000亿美元。

这是全球风投行业每年投资额的两倍还多，是Netflix、优步和特斯拉这三家出了名缺钱的公司每年所烧掉现金的51倍，同时也是这五强为获得新技术和新产品平均每年在收购方面支出的37倍，比如Facebook在2014年以190亿美元收购了通讯应用WhatsApp，谷歌于2007年以31亿美元收购了广告公司DoubleClick。

这些公司囤积大量现金，会不会只是因为它们的管理者都是些超级有钱又

脾气古怪、不屑遵守任何规则的自大狂？这样的想法似乎太过肤浅，而且也过时了。苹果和微软已不再由创始人控制，Alphabet的掌管者也都非常务实：在2015年任命摩根士丹利前财务负责人露丝·波拉特（Ruth Porat）为首席财务官，以加强财务纪律。杰夫·贝佐斯可以说是想让亚马逊分红的——在没有分红的情况下，他每年出售自己10亿美元的股票来募集资金，资助他的太空火箭公司。

| 死亡谷

也许，如果进行税务改革，庞大的现金积累就会结束。苹果和微软这两家最成熟的公司将一次性给股东大量的现金回报。随着利润飙升，亚马逊、Alphabet和Facebook也将采取合理的方案向股东返还现金。

但也许这些公司就是喜欢有大量现金护身。它们外表看起来不可一世，内里可能还是会担心遭到淘汰或遭遇监管问题。反垄断机构态度也越来越不友善。仅在五年前，Facebook和谷歌还在为从台式机向移动设备转移而苦苦挣扎。这两家公司的销售额中有85%以上都来自广告；苹果的健康取决于最新的iPhone；亚马逊的利润空间微薄；微软的利润还有待上升。

如果收益真如预期那般飙升，那么五大科技公司可能正在计划大规模收购媒体、汽车或硬件企业，在核心业务之外实现多元化。但它们可能仅仅只是对于利润不会攀爬到华尔街现在预期的高度而感到不安。无论如何，这张让硅谷在夜晚安眠的3300亿美元的安全毯都应该让投资者保持警觉。■



Schumpeter

Good chemistry

Dow Chemical shows that American industrial firms and globalisation can mix

WHAT does it take for an American industrial champion to succeed in an age of globalisation and impatient investors? Some observers argue that it has become impossible. The world is just too nasty and unfair, they bleat. Perhaps they should take a look at Dow Chemical, a firm born in Michigan in 1897 that has hustled hard enough to be at the top of its industry 120 years later.

When Dow completes its planned \$130bn merger with DuPont, a longtime rival, probably at the end of this year, it will become the largest chemical company in the world by sales. This new colossus will keep changing—in 2018-19 the plan is for it to split into three specialised firms. “New Dow” will focus on selling chemicals to the automotive, construction and packaging industries. The other two smaller companies will concentrate mainly on the agricultural and electronics industries.

This is a good moment, before the three-way split, to take stock. Being in the chemicals business is like swimming in a vat of sulphuric acid. Of the industry’s 20 largest firms in 1996 only four remain in the ranking today. Some were dissolved, such as ICI, a British company. There has been one spectacular bankruptcy in recent memory, with LyondellBasell defaulting on \$24bn of debt in 2009. It is unlikely to be the last.

The industry is brutal. Its customers have consolidated and boosted their bargaining power in the past 20 years. Consumer-goods and car firms, for example, have completed mergers worth \$16trn. The prices of its raw materials, oil and gas, gyrate. It is capital-intensive: a “cracker”, or petrochemical plant, costs \$2bn or more and takes years to build. And

private firms must compete with state-owned ones from China and the Middle East, which have access to subsidised credit and raw materials.

That was the landscape when Dow's boss, Andrew Liveris, took over in 2004. Since then the firm has made big mistakes. After the financial crisis, in 2009, it had to cut its dividend (for the first time in 97 years) after mismanaging its finances. But three initiatives have kept its underlying business competitive.

First, Dow has ruthlessly shuffled its portfolio, ditching less profitable businesses, including its century-old chlorine operation, and buying specialised ones that have barriers to entry. When it is formed, New Dow will have \$50bn of sales, and will have bought and sold businesses with \$40bn of sales since 2004.

Second, Dow has made an effort to think hard about customers as well as chemistry. It reorganised around categories of client, and boosted research and development (R&D) in order to conjure up new ways to help them. For the automotive industry, for example, Dow used to supply rubber and polystyrene. Now it sells carmakers expensive sound-absorbing foam. Each year 5,000 products are launched, double the number of a decade ago.

The third step was to invest heavily in plant to lower costs. Dow has sunk \$8bn into complexes in the Mexican Gulf coast that have access to cheap shale gas. And it has invested about \$4bn in a joint venture in Saudi Arabia with Aramco, the state oil firm, that can take advantage of Aramco's access to low-cost oil.

Some of Dow's shareholders have been just as intractable as its industry. In 2014 Third Point, an activist fund, attacked it, calling for it to break itself up. Dow gave it two board seats out of a total of 13. Since then, with Third Point holding a gun to its head, Dow has produced steady earnings and

sped up its reinvention. Mr Liveris says he learned to have a “dual horizon”, with one eye on the one-to-two-year perspective of the stockmarket and the other on the longer time periods—a decade or more—that it takes for a cracker or R&D project to wash its face.

| *Stay paranoid*

Investors can see the results of Dow’s struggle. Gross margins have risen. Return on capital is low, partly because it overspent on acquisitions. But as the Mexican Gulf and Saudi projects come on stream over the next two years, profits are expected to increase, notes Hassan Ahmed of Alembic Global, a research firm. After the merger with DuPont, Dow’s return should rise above 15%, putting it in the industry’s first quartile. Its shares have kept pace with the S&P 500 index in the past decade and are valued on a higher multiple of free cashflow than Alphabet, Google’s parent.

Dow also shows that success can be good for employees as well as shareholders. Staff turnover has been high: a third joined in the past five years. But the number of employees has risen by over a fifth since 1996, to 56,000, about half of them in America.

Another measure to look at is the “labour share”, or the proportion of the firm’s gross cashflow that is spent on wages, as opposed to reinvestment or giving shareholders dividends and buy-backs. Across American business the share of cashflow that goes to labour has declined markedly. At Dow it has remained flat, at about 50% since 1996. In absolute terms its salary bill has soared (see chart).

If there is a grumble about the example that Dow sets, it is that consumers may lose from consolidation. Firms may be able to jack up prices. Still, this risk is biggest in agricultural chemicals, rather than the industrial ones that New Dow will specialise in. Antitrust regulators will probably allow the Dow-DuPont deal.

Chemical firms can never rest easy. Car sales are flagging in America, which could hurt demand. China's two giants, ChemChina and Sinochem, may soon merge and could eventually threaten their more sophisticated Western rivals. The cycle is not dead: a spike in gas prices, relative to oil prices, could hurt Dow's margins. But the chemical industry's capital base has grown by only 1% a year for the past half-decade: firms are being disciplined about adding new capacity. And Western ones have learned to keep adapting. The lesson from Dow is that American industrial companies can prosper in a system of open borders and capital flows. It isn't easy but it is possible. Mr Liveris leads President Trump's advisory council on manufacturing. He should pass on the message. ■



熊彼特

完美化学反应

陶氏化学证明美国工业企业和全球化可以融合

在这个经济全球化而投资者急功近利的年代，美国工业龙头企业如何才能获得成功？有观察家认为这样的成功已无可能，并抱怨这个世界太糟糕、太不公平。也许他们应该看看陶氏化学（Dow Chemical）。这家1897年于密歇根州创建的公司奋力拼搏，在120年后攀登至行业顶峰。

陶氏与长期竞争对手杜邦（DuPont）价值1300亿美元的合并计划可能会在年底完成，届时陶氏将成为世界上销售额最大的化工企业。这个新的巨型公司还会不断变化，计划在2018至2019年间拆分为三个专业公司。“新陶氏”将专注于向汽车、建筑和包装行业销售化工产品，另外两家较小的公司将主要聚焦农业和电子行业。

现在是在拆分之前进行盘点的大好时机。身处化工行业就如同在一桶硫酸中游泳。1996年位列该行业前20的公司如今只有四家仍在该排名中。有些已经“溶解”，例如英国的帝国化学工业（ICI）。近些年还发生了一次惊人的破产事件——2009年利安德巴塞尔（LyondellBasell）对240亿美元的债务违约。它不太可能是最后一家破产的化工企业。

化工行业很残酷。过去二十年里，行业客户进行了整合并提高了议价能力。比如，消费品和汽车公司已经完成了总价值高达16万亿美元的合并。作为化工原材料的石油和天然气价格起伏不定。化工是资本密集型行业：一座石化工厂耗资20亿美元甚至更多，且需建设多年。私营企业还必须同中国和中东的国有企业竞争，而后者享有国家的贷款补贴和原材料补贴。

这就是陶氏的现任老板安德鲁·利弗里斯（Andrew Liveris）2004年接手公司时的大背景。在那之后，公司屡犯大错。2009年金融危机后，由于财务管理不当，陶氏不得不削减分红，为97年来的首次。但有三项举措保住了其基础业务的竞争力。

首先，陶氏大刀阔斧地调整了业务结构，放弃了盈利相对较少的业务，包括有百年历史的氯业务，并收购了市场门槛高的特种化学品业务。到新陶氏成立之时，销售额将达500亿美元，自2004年以来买入和卖出业务的销售额总计将达到400亿美元。

第二，陶氏下了一番苦工来钻研客户和化工行业，围绕客户类别展开重组，并加强了研发，以找到帮助客户的新办法。例如，陶氏以前向汽车行业供应橡胶和聚苯乙烯，现在则向汽车制造商销售昂贵的吸音泡沫。陶氏现在每年推出5000种产品，是十年前的两倍。

第三步是大量投资建造工厂，以降低成本。陶氏斥资80亿美元，在富有低价页岩气资源的墨西哥湾兴建工厂，还投资约40亿美元，与沙特阿拉伯国家石油公司阿美（Aramco）合资建厂，借力阿美来获取便宜的石油。

陶氏的一些股东和化工行业一样不好对付。2014年，维权基金Third Point对陶氏展开攻击，要求陶氏自行分拆。陶氏共有13个董事会席位，给了Third Point两席。从那时起，在Third Point的威逼之下，陶氏产生了稳定的收益，加快了改革。利弗里斯说，自己已经练就了“双重视野”，一只眼关注一到两年的股票市场，另一只眼则聚焦更长的时间段（十年或更长），即一家石化工厂或一个研发项目实现收支平衡所需的时间。

| 保持警惕

投资者可以看到陶氏奋斗的结果。毛利率持续上升，资本回报率则偏低，部分是因为收购超支。不过研究公司阿兰必克（Alembic Global）的哈森·阿迈德（Hassan Ahmed）指出，随着墨西哥湾和沙特的项目在未来两年相继投产，预计利润将会有所增加。与杜邦合并后，陶氏的回报率应该会超过15%，从而跨入业内前四分之一的列队。在过去十年中，陶氏的股票与标准普尔500指数保持同步，对其估值的自由现金流倍数比谷歌的母公司Alphabet还高。

陶氏还证明企业的成功对员工和股东都有利。员工流动率居高不下：三分之一的员工是在过去五年内加入公司的。但是自1996年以来，员工人数已

经增加了超过五分之一，达到5.6万人，其中约一半在美国。

另一个要说的指标是“劳动收入份额”，即相比再投资或股东分红和回购，公司总现金流中用于支付工资的比例。在美国工商界，劳动力收入占现金流比例明显下降，而在陶氏则保持平稳，1996年以来一直约为50%。按绝对值计算，其工资支出已大幅上升（见图表）。

如果说陶氏这个榜样有什么可指摘之处，那就是合并后公司可能会提高价格，消费者可能因此受损。然而这种风险在农业化学品方面最大，而不是新陶氏公司将专注的工业化学品。反垄断监管机构可能会批准陶氏和杜邦的合并。

化工企业永远不可能高枕无忧。美国汽车销售在萎缩，可能会影响对化工产品的需求。中国的两大化工巨头中国化工和中化可能很快就会合并，最终可能会威胁到它们更成熟老到的西方对手。行业周期并没有结束：天然气价格相对于石油价格上涨，可能有损陶氏的利润。但过去五年，化工行业的资本基础每年仅增长1%：各家公司在增加新产能方面很克制。西方化工企业还学会了不断调整适应新形势。从陶氏那里得出的经验就是，美国工业企业可以在边界开放和资本流动的环境中繁荣发展。虽然不易，但并非不可能实现。利弗里斯正在领导特朗普的制造业咨询委员会，他应该将这一经验广泛传播。 ■



Stockpicking

Quants and the quirks

Markets and academic theories are changing in tandem

BUILD a better mousetrap, the saying goes, and the world will beat a path to your door. Find a way to beat the stockmarket and they will construct a high-speed railway. As investors try to achieve this goal, they draw on the work of academics. But in doing so, they are both changing the markets and the way academics understand them.

The idea that financial markets are “efficient” became widespread among academics in the 1960s and 1970s. The hypothesis stated that all information relevant to an asset’s value would instantly be reflected in the price; little point, therefore, in trading on the basis of such data. What would move the price would be future information (news) which, by definition, could not be known in advance. Share prices would follow a “random walk”. Indeed, a book called “A Random Walk Down Wall Street” became a bestseller.

The idea helped inspire the creation of index-trackers—funds that simply buy all the shares in a benchmark like the S&P 500. From small beginnings in the 1970s, trackers have been steadily gaining market share. They command around 20% of all assets under management today.

But the efficient-market hypothesis has repeatedly been challenged. When the American stockmarket fell by 23% in a single day in October 1987, it was hard to find a reason why investors should have changed their assumptions so rapidly and substantially about the fair value of equities. Robert Shiller of Yale won a Nobel prize in economics for work showing that the overall stockmarket was far more volatile than it should be if traders were adequately forecasting the fundamental data: the cashflows received by

investors.

Another example of theory and practice parting company is in the foreign-exchange market. When Sushil Wadhvani left a hedge fund to join the Bank of England's monetary policy committee (MPC) in 1999, he was taken aback by the way the bank forecast currency movements. The bank relied on a theory called "uncovered-interest parity", which states that the interest-rate differential between two countries reflects the expected change in exchange rates. In effect, this meant that the forward rate in the currency market was the best predictor of exchange-rate movements.

Mr Wadhvani was surprised by this approach, since he knew many people who used the "carry trade", ie, borrowing money in a low-yielding currency and investing in a higher-yielding one. If the bank was right, such a trade should be unprofitable. After some debate, the bank agreed on a classic British compromise: it forecast the currency would move half the distance implied by forward rates.

Many who work in finance still believe they can beat the market. After all, there was a potential flaw at the heart of the efficient-market theory. For information to be reflected in prices, there had to be trading. But why would people trade if their efforts were doomed to be unprofitable?

One notion, says Antti Ilmanen, a former academic who now works for AQR, a fund-management company, is that markets are "efficiently inefficient". In other words, the average Joe has no hope of beating the market. But if you devote enough capital and computer power to the effort, you can succeed.

That helps explain the rise of the quantitative investors, or "quants", who attempt to exploit anomalies—quirks that cannot be explained by the efficient-market hypothesis. One example is the momentum effect: shares

that have outperformed the market in the recent past continue to do so. Another is the “low-volatility” effect: shares that move less violently than the market produce better risk-adjusted returns than theory predicts.

A new breed of funds, known in the jargon as “smart beta”, have emerged to exploit these anomalies. In a sense these funds are simply trying to mimic, in a systematic way, the methods used by traditional fund managers who interview executives and pore over balance-sheets in an attempt to pick outperforming stocks.

Whether these funds will prosper depends on why the anomalies have been profitable in the past. There are three possibilities. The first is that the anomalies are statistical quirks; interrogate the data for long enough and you may find that stocks outperform on wet Mondays in April. That does not mean they will continue to do so.

The second possibility is that the excess returns are compensation for risk. Smaller companies can deliver outsize returns but their shares are less liquid, and thus more difficult to sell when you need to; the firms are also more likely to go bust. Two academics, Eugene Fama and Kenneth French, have argued that most anomalies can be explained by three factors: a company’s size; its price relative to its assets (the value effect); and its volatility.

The third possibility is that the returns reflect some quirk of behaviour. The outsize returns of momentum stocks may have been because investors were slow to realise that a company’s fortunes had improved. But behaviour can change; Mr Wadhvani says share prices are moving more on the day of earnings announcements, relative to subsequent days, than they were 20 years ago. In other words, investors are reacting faster. The carry trade is also less profitable than it used to be. Mr Ilmanen says it is likely that returns from smart-beta factors will be lower, now that the strategies are

more popular.

If markets are changing, so too are the academics who study them. Many modern research papers focus on anomalies or on behavioural quirks that might cause investors to make apparently irrational decisions. The adaptive-markets hypothesis, devised by Andrew Lo of the Massachusetts Institute of Technology, suggests that the market develops in a manner akin to evolution. Traders and fund managers pursue strategies they believe will be profitable; those that are successful keep going; those that lose money, drop out.

The results can be dramatic. In August 2007 there was a “quant quake” as computerised strategies briefly stopped working; the suspicion was that one manager was offloading his positions after taking losses in the mortgage market. The episode hinted at a danger of the quant approach: if computers are all churning over the same data, they may be buying the same shares. At the moment American growth stocks, such as technology companies, are as expensive, relative to global value stocks, as they were during the dotcom bubble (see chart). What if the trend changes? No mathematical formula, however clever, can find a buyer for a trader’s positions when everyone is panicking.

Internship: *The Economist* invites applications for the 2017 Marjorie Deane internship. Paid for by the Marjorie Deane Financial Journalism Foundation, the award is designed to provide work experience for a promising journalist or would-be journalist, who will spend three months at *The Economist* writing about economics and finance. To apply, write a covering letter and an original article of no more than 500 words suitable for publication in the Finance and economics section. Applications should be sent by June 2nd to deaneintern@economist.com. For more information, please visit www.marjoriedeane.com ■



选股

宽客与怪象

市场和学术理论同步改变

俗话说，发明一个更好的捕鼠器，全世界会千方百计找到你。那假如你找到了股市制胜法，人们可要把高铁都修到你家门口了。投资者为达到这个目标，纷纷向学术界取经。但在这一过程中，他们既改变了市场，也改变了学术界对市场的理解。

上世纪六七十年代，金融市场“有效运作”的理念风行学术界。该假说认为，所有关系到某一资产价值的信息都会即时反映在股价中，因此，基于这些数据来交易意义不大。影响价格的是将来的信息（即新闻），顾名思义，它们无法被提前知悉。股价遵循“随机漫步”的模式。一本名为《漫步华尔街》（A Random Walk Down Wall Street）的著作更是成了畅销书。

这一理念促使人们创造了指数基金——这些基金将标普500这类基准指数里的股票全部买下。上世纪70年代，指数基金从小规模起步，之后市场份额稳步上升，目前约占资产管理总额的20%。

但“有效市场假说”一再受到挑战。1987年10月，美国股市单日跌幅达23%，很难解释为何投资者会如此迅速地大幅改变他们对股票公允价值的假设。诺贝尔经济学奖得主、耶鲁大学的罗伯特·希勒（Robert Shiller）的获奖成果表明，假如交易员对基本数据（即投资者收到的现金流）做了充分预测，整体股市的波动幅度应该不会如此之大。

理论与实践分离的另一个例子出现在外汇市场。1999年，苏希尔·瓦德瓦尼（Sushil Wadhvani）离开对冲基金公司，加入英国央行的货币政策委员会（MPC），当时英国央行预测货币走势的方式令他大吃一惊。该银行遵循所谓的“无抛补利率平价理论”，即两国的利率差反映其汇率的预期变化。实际上，这意味着货币市场的远期汇率是汇率变化的最佳预测指标。

瓦德瓦尼对这种方法感到诧异，因为他知道许多人会进行“利差交易”，即以低收益货币借款，然后投资高收益货币。假如英国央行是对的，这样的交易应该无利可图。经过一番辩论，英国央行作出经典的英式妥协：预测货币汇率变化幅度会达到与远期汇率差距的一半。

许多金融界人士仍旧相信自己能打败市场。毕竟，“有效市场理论”的核心可能存在缺陷。信息要反映在价格上，就必须有交易。但若努力注定无利可图，人们又怎么会交易呢？

曾是学者的安提·伊尔曼宁（Antti Ilmanen）如今在基金管理公司AQR任职，他表示，有一种想法认为市场是“有效地低效”。换言之，普通人是无望打败市场的。但如果能为此投入足够的资本和运算能力，你就能成功。

这有助解释量化投资者（即“宽客”）的兴起，他们尝试利用“有效市场假说”无法解释的异常现象进行投资。一个例子是动量效应：最近表现优于大市的股票会继续表现突出。另一例子是“低波动性”效应：波动性低于大市的股票，其风险调整后收益会高于理论预测的水平。

一种利用这些怪象的新型基金已经出现，行话叫作“智能贝塔”（smart beta）。从某种意义上说，这些基金只是试图以系统的方式模仿传统基金经理的做法——通过与高管对谈和仔细研读资产负债表来挑选绩优股。

这些基金能否取得佳绩，要看这些怪象以往获利的原因。有三种可能，第一种是，这些异常现象属于统计学上的巧合。捣鼓数据足够久后，你可能会发现，四月里股价每逢下雨的周一便会飙升。但这并不意味着这种情况会继续。

第二种可能是，超额收益实为风险补偿。较小型的公司可带来超额回报，但其股票流动性较差，因此在需要卖出时较难出手；这些公司也更有可能会破产。尤金·法玛（Eugene Fama）和肯尼思·法兰奇（Kenneth French）这两位学者认为，多数异常情况均可用三个因素来解释：公司规模、其股价相对资产的高低（价值效应），以及其波动性。

第三种可能是，回报反映了一些行为怪癖。股票动量效应带来高额回报，可能是因为投资者反应迟缓，没有意识到公司的盈利已有所改善。但行为是会改变的。瓦德瓦尼表示，相比20年前，股价在盈利公告发布当日的波动与之后几日相比，变得更加剧烈了。换言之，投资者的反应变快了。利差交易的利润也比以前少。伊尔曼宁说，随着智能贝塔策略日益流行，这类基金的回报可能会下降。

市场在变，研究市场的学者也在变。许多现代研究论文开始着眼可能导致投资者做出明显非理性决策的市场异象或行为怪癖。麻省理工学院的罗闻全提出了适应性市场假说，认为市场的发展类似于人类进化。交易员和基金经理追随他们认为有利可图的策略，成功的会继续，亏钱的会退出。

结果可能是戏剧性的。2007年8月，计算机量化策略短暂失灵，引发“量化地震”，怀疑是缘于某基金经理在抵押贷款市场遭受损失后的减仓行动。这一事件显示了量化策略的一个潜在危险：假如所有计算机都在分析同样的数据，就可能购入相同的股票。目前，相对于全球价值型股票来说，像科技公司这类美国成长型股票的价格跟当年网络泡沫时期一样昂贵（见图表）。假如势头一转，情况又会如何？当众人陷入恐慌时，没有任何数学公式（无论有多巧妙）可以为交易员的减仓找到买家。





Scientific publishing

Review and prosper

Peer review is a thankless task. One firm hopes to change that

AS SCULPTURES go, it is certainly eye-catching. On May 26th a small crowd gathered outside Moscow's Higher School of Economics to watch the unveiling of a 1.5-tonne stone cube shaped like a six-sided die. Its five visible sides are carved with phrases such as "Minor Changes", "Revise and Resubmit" and "Accept". Called the "Monument to the Anonymous Peer Reviewer," it is, as far as anyone can tell, the first such tribute anywhere in the world.

Peer review underpins the entire academic enterprise. It is the main method of quality control employed by journals. By offering drafts of a paper to anonymous experts, poor arguments or dodgy science can be scrubbed up or weeded out.

That is the theory. In reality, things are murkier. Anonymity makes peer review unglamorous, thankless work. That matters, for these days scientists are under relentless pressure from universities and funding bodies to publish a steady stream of papers. Anything that distracts from that goal—including reviewing the research of others—could mean forfeiting grants or career advancement. Perhaps unsurprisingly, studies suggest many reviewers do a poor job of spotting shortcomings in the papers they are critiquing.

One solution is to make peer review more desirable and less of a duty. That is the idea behind Publons, a firm which allows scientists to track and showcase their peer-reviewing contributions. It has just been bought for a tidy sum by Clarivate Analytics, which runs Web of Science, an index that tracks how often researchers cite each others' papers. Scientists who sign

up will get a verifiable, trackable measure of their contributions. Their reviews will even be given their own “DOI” numbers, unique identifiers currently used for keeping track of papers.

The hope is that once scientists can quantify their reviewing work and boast about it on their CVs, universities and funding bodies will take it into account when handing out promotions or cash. Making scientists keener to review papers could also speed up publishing, says Andrew Preston, one of the firm’s founders. At the moment, much of a journal editor’s time is spent tracking down potential peer reviewers, then badgering them to contribute. By making reviewing more attractive, hopes researchers might start volunteering instead. Since Publons’s founding in 2012, more than 150,000 researchers have signed up, writing more than 800,000 reviews.

The firm hopes to shake up the system in other ways. Reviewers can choose how much information to reveal, and in what context. So a review of a colleague’s paper might appear anonymously in the journal concerned. But reviewers’ names could be reattached when it is time for performance appraisals, giving their bosses proof of the extra work. And while traditional peer review is done before publication, Publons also allows reviewers to assess a paper after it has been published.

Such “post-publication” peer review is already common on websites such as arXiv, where physicists and mathematicians post early versions of papers that will later be published in journals. The extra scrutiny may catch problems other reviewers have missed. Mr Preston points to a paper published in October in *Nature* called “Evidence for a limit to human lifespan”. It passed traditional peer review. It has a very high “Altmetric” score, which measures how much attention it has gathered in the press and on social media. But Publons’s reviewers do not rate it. Six post-publication reviews give the paper an average score of 4.7 out of 10, claiming concerns with the way it analysed its data.

Another goal is to fight fraud. In April Springer, a big American publishing firm, retracted 107 papers from *Tumor Biology* after discovering that the authors had tricked the journal's editors into soliciting reviews from fake e-mail addresses, which invariably offered glowing reviews. Having acquired Publons, Clarivate hopes that linking researchers' citation records with their records as reviewers will make it easier for journal editors to select reliable reviewers and harder for duplicitous authors to deceive them. (Such services are how Publons, which is free for researchers to use, hopes to make money.)

The Moscow sculpture honouring peer reviewers was paid for by an online crowd-funding campaign. On its tongue-in-cheek website, it quotes Andre Geim, a physicist who won a Nobel prize in 2010, saying that peer reviewers are "unsung heroes of science" who do their work "out of a sense of responsibility". That is admirable. But as any student of the Higher School of Economics could tell you, self-interest can be an even stronger motive. ■



科研出版

审稿勤勉，事业高升

同行评议是个费力不讨好的活儿。一家公司希望能改变这一状况

就雕塑而言，这一件无疑算夺人眼球。5月26日，一小群人聚集到莫斯科的高等经济学院（Higher School of Economics）校园外，观看一个立方体大石块的揭幕。这块大石头重1.5吨，形状像一个六面的骰子，看得到的那五个面刻着“小改动”、“修订并重新提交”以及“接受”等字词。就目前所知，这个名为“匿名同行评议人纪念碑”是全世界第一个向评议人致敬的纪念碑。

同行评议构成了整个学术研究活动的基础，是期刊用来把控论文质量的主要手段。将论文稿件交给匿名的专家来评审，能够加强薄弱的论述，剔除可疑的科研成果。

理论上是这样，但在现实中情况并不那么简单。由于匿名的性质，同行评议是一项不起眼又费力不讨好的工作。这不是件小事情。如今，科学家们受到来自高校及资助单位的严酷压力，必须持续不断地发表论文。任何让人偏离这一目标的工作，包括评议他人的研究，也许都会令自己失去经费或职业发展的机会。说来也许并不令人意外：研究显示，很多评议人在评审时都不大能点出不足之处。

一种解决方法是增强同行评议这项工作的吸引力，使之不再纯粹是一项义务。Publons背后的理念便是如此。这家公司能让科学家们追踪并展示自己给出的同行评议意见。运营Web of Science（一个追踪研究人员引用彼此论文频率的检索工具）的科睿唯安（Clarivate Analytics）不久前以非常可观的价格收购了Publons。在该平台注册后，科学家就有办法衡量自己在评议方面做出了多少贡献，既可证实又可追踪。他们的评议甚至还会有专属的数字对象识别码（DOI），即如今用来追踪论文动态的唯一标识码。

Publons希望，一旦科学家们的评议工作得以量化并可为他们的简历增色，高校及资助单位在决定提拔或分拨资金时便会将这个因素考虑在内。该公司的联合创始人安德鲁·普雷斯顿（Andrew Preston）称，提高科学家评议的积极性还有望加速论文的发表。眼下，期刊编辑的大部分时间都用来寻觅可充当评议人的专家，然后缠着他们提供评议。提高评议工作的吸引力，研究者们也许就有望自告奋勇来审稿。自2012年创立以来，Publons已吸引超过15万名研究人员注册，收到80多万份评议。

这家公司还希望在其他方面改革这一体系。审稿人可以决定信息披露的程度，以及在什么情形下披露。这样，对同僚一篇论文的评议也许会以匿名的形式出现在相关期刊的评审流程中。但是到了做绩效评估的时候，便可以在相关论文上加上评议人的名字，以此向他们的领导证明他们所做的额外工作。传统的同行评议都在文章发表之前进行，而Publons还允许审稿人评估已经发表的文章。

这种“发表后”同行评议在arXiv等网站上已经很常见。物理学家和数学家会将论文初稿发布在这些网站上，之后再发表于期刊。额外的审阅也许会捕捉到其他评议人漏掉的问题。普雷斯顿以去年10月发表在《自然》上的一篇文章为例。这篇题为《关于人类寿命极限的证据》的文章通过了传统的同行评议，还得到了非常高的替代计量评分（Altmetric score，用于衡量文章在出版界及社交媒体上的关注度）。但Publons上的审稿人并不买账。六份发表后评议为该论文打出了4.7/10的平均分，称文章分析数据的方式令人存疑。

另外一个目标是打击欺诈。4月，美国大型出版公司斯普林格（Springer）发现一些作者蒙骗了期刊编辑，令其向假冒的电子邮件地址征询评议——毫无例外，收到的都是溢美之词。随后，斯普林格将107篇论文从《肿瘤生物学》（*Tumor Biology*）上撤下。收购了Publons后，科睿唯安希望，一旦将研究人员的被引用记录及审稿记录联系起来，期刊编辑在选择可靠的评议人时就会变得更容易，狡猾的作者也更难骗过他们。（Publons供研究人员免费试用，不过它希望能以这些服务向期刊编辑收费。）

莫斯科这个向同行评议人致敬的雕塑，资金来自一项网络众筹活动。这个带有玩笑性质的活动网站引用了安德烈·盖姆（Andre Geim）的话。这位在2010年获得诺贝尔奖的物理学家说道，同行评议专家是“科学事业的无名英雄”，他们之所以做这份工作是“出于责任感”。这令人钦佩，不过正如任何一名高等经济学院的学生都会告诉你的那样，利己之心会是更强大的动力。■



Helping blind people navigate

White cane 2.0

Modern technology can help guide those with poor eyesight

FOR centuries, canes have served blind and partially sighted people well by giving them a means to negotiate the world around them. The only serious upgrade they have undergone dates back to 1921, when a Briton called James Biggs, who had recently lost his sight, painted his own cane white in order to make it easily visible and to alert others to the presence of someone unable to see nearby obstacles. In the opinion of Daniela Rus of the Massachusetts Institute of Technology (MIT), however, the white cane has had its day. Dr Rus would like to replace it with a system that scans its user's environment and communicates back to him what it sees.

Dr Rus's device, of which she demonstrated a prototype on June 1st at the International Conference on Robotics and Automation in Singapore, consists of a camera worn on a lanyard around the neck, and a belt. A computer inside the camera creates a three-dimensional image of the area ahead of the wearer, processes it to extract relevant information, and uses the results to pass on appropriate signals via the belt.

Dr Rus knew from previous attempts to build devices of this sort that what might seem the obvious way of manifesting those signals, namely as sounds with specific meanings, was not, in fact, a good approach. Blind people depend a lot on their hearing and do not like it when newfangled devices hamper this sense with beeps and clicks. Hence the belt, which has five vibrating motors installed in it. One sits over the centre of the wearer's abdomen. The others flank this central motor, with two spaced out on either side of it.

That configuration permits the computer to warn a wearer when he is on a

collision course with an obstacle. It does so by telling the motor pointing most closely in the direction of the obstacle to vibrate. If the wearer is walking towards a wall, for example, the central motor vibrates softly when he comes within a couple of metres of it. If he ignores this, perhaps because he actually wants to reach the wall, the computer increases the amplitude as he closes in, giving him a good idea of exactly how far away he is. Similarly, if he is in danger of bumping, say, his right shoulder on a door frame while walking from one room to another, the right-most motor on the belt will warn him of the impending collision. And it works. When compared with navigation by white cane in one of MIT's famously crowded hallways, it reduced blind students' collisions with others by 86%.

The new system can, however, do more than just help someone walk around without collisions, for the belt incorporates a touchpad that is inscribed with instructions in Braille. This permits the user to program it to perform specific tasks.

For example, Dr Rus knew that blind students often struggle to find an empty seat in a crowded lecture theatre. Adding an appropriate algorithm to the computer's software helps get around this by enabling it to recognise chairs, and also whether or not a chair is occupied. In this case, the motors are used to indicate a direction to be travelled in, rather than one to be avoided. Activating the algorithm using the touchpad causes the motor pointing most closely towards an empty chair to vibrate when the system spots one.

| *Good vibrations*

In trials involving a room that contained an empty chair, an occupied chair and also a recycling bin, the algorithm directed the belt-wearer straight to the empty chair 80% of the time. Cane users presented with the same arrangement always found the empty chair eventually, but in doing so came into contact with objects other than their target more than five times

as often as those using the camera and belt.

Whether a camera (ideally, smaller than the one in the prototype) and a belt could replace a cane completely remains to be seen. In particular, Dr Rus's system does lack one important feature of Biggs's innovation. A white cane not only helps a blind person to navigate, it also signals his condition to the rest of the world, allowing others to adjust their behaviour accordingly. As a supplementary aid, however, her approach seems most promising. ■



为盲人导航

导盲杖2.0版

现代技术可为视力不佳的人指路

几百年来，拐杖很好地服务了盲人和弱视者，给了他们探索周围世界的途径。它们唯一一次真正的升级还是在1921年，当时刚刚失明的英国人詹姆斯·比格斯（James Biggs）把自己的拐杖漆成了白色以让它变得更醒目，提醒别人这里有一个看不到障碍物的人。不过，在麻省理工学院的达妮埃拉·鲁斯（Daniela Rus）看来，导盲杖的辉煌期已经到头了。鲁斯博士想用一套新设备取代它。这个系统可以扫描用户所在的环境，并把所见反馈给用户。

在6月1日于新加坡举办的机器人和自动化国际会议上，鲁斯展示了这种设备的原型。它包括一台挂在脖子上的摄像机和一根腰带。摄像机内部的计算机会生出一个描绘用户前方区域的三维影像，处理该影像以提取有用的信息，并将结果转化为信号，通过腰带向用户传输。

从过往开发这类设备的尝试中，鲁斯已经明白了一点：呈现这类信号的一个似乎显而易见的方式——表达特定含义的声音——实际上不是一个好办法。盲人非常依赖听觉，不喜欢新奇设备发出的哔哔和嘀嘀声干扰这一知觉。所以她设计了腰带，上面装有五台振动电动机。其中一台位于佩戴者腹部的正中央，其余分布两侧，一边两台，彼此隔开些距离。

这种设置使得计算机可以在用户快要撞到障碍物时发出警告。计算机会让距离障碍物最近的电动机振动起来。比如，假如用户正走向一面墙，在距离两三米远时中央电动机就会开始轻微振动，如果他不为所动继续向前——也许是因为他本来就是想走到墙边——计算机会逐渐增加那台电动机振动的幅度，让他能清楚了解到自己离墙还有多远。同样，假如他从一个房间走向另一个房间时右肩可能要撞上门框，那么腰带上最右边的那台电动机就会对他发出警告。这还真管用——在麻省理工学院某条出了名拥挤的走廊里，和使用导盲杖相比，这套设备让盲人学生撞到其他人的次数减

少了86%。

不过，这套新系统能做的不仅仅是让盲人走路时避免碰撞。腰带上还嵌有一块触控板，上面刻有盲文指令。这让用户可以给这块触控板编程来执行特定的任务。

例如，鲁斯知道盲人学生常常很难在拥挤的阶梯教室里找到座位。在计算机的软件里加入恰当的算法，让它能够识别座位并确定座位上是否有人，就可以解决这个问题。在这种情况下，发动机将用以指示使用者要前往的方向，而不是要躲避的方向。通过触控屏激活算法后，一旦系统找到一个空位，就会让最靠近空位的发动机开始振动。

| 找到目标

在试验中，一个房间里摆放着一张空椅、一张坐了人的椅子和一个垃圾桶。在算法的引导下，佩戴腰带的用户径直走向空椅的几率是80%。在一模一样的环境里，那些持导盲杖的人最后都会找到空椅，但是相比使用摄像机和腰带组件，他们触碰到其他物体的次数增加了五倍。

摄像机（最好能比原型机中的那台小一些）和腰带的组合能否完全取代导盲杖还需拭目以待。特别是鲁斯的系统缺少了比格斯发明的一项重要功能。白色的手杖不仅仅能帮助盲人行路，也向其他所有人表明了其主人的状况，让他们可以相应地调整自己的行为。不过，作为导盲杖的一种补充，鲁斯的方法看来很有前途。■



Schumpeter

Crossing the river

Chinese companies have a weak record abroad. They must do better

CONSIDERING the size of China's economy, it seems inevitable that its firms will eventually play a huge role on the world stage. Yet China Inc's adventures abroad in the past 15 years have been a mixed bag. Thousands of small deals have taken place, some of which will succeed. But of the mergers and acquisitions that have been worth \$1bn or more, it is a different story. There have been 56 abandoned deals, 39 state-backed acquisitions of commodities firms at frothy prices, and, lately, wild sprees by tycoons scooping up trophies such as hotels and football clubs.

Some deals defy any conventional logic. Last month HNA, an airlines-and-tourism conglomerate from Hainan, said it had bought a 10% stake in Deutsche Bank, having earlier considered buying a Landesbank. The Chinese firm, which runs a beach-volleyball tournament in Beijing, appears to think it can consolidate Germany's fragmented banking industry—the financial equivalent of bringing peace to the Middle East. If China Inc is to realise its potential abroad, it needs a more credible approach.

The experience of Britain, and then America, in the 20th century suggests that economic hegemons control a disproportionate share of the world's stock of cross-border corporate investment. Today China's slice is only 4%, below its 15% share of global GDP and its 13% share of total stockmarket value. Its leaders want firms to go faster. If companies don't globalise, China won't become powerful, argues Wang Jianlin, boss of Dalian Wanda, a property firm, and China's richest tycoon, in his autobiography.

In their hurry, Chinese firms have made mistakes. Deals worth \$1bn or

more account for two-thirds of activity by value since 2005. Of these about half fall into three problematic categories. First, acquisitions by state-controlled groups of natural-resources firms. The aim was to secure access to raw materials but many deals were badly timed, with high prices paid at the peak of the commodity cycle between 2010 and 2014. CNOOC, an oil firm, for example, has written off part of its \$17bn acquisition in 2012 of Nexen, a Canadian oil firm.

The second difficult category consists of acquisition sprees by leveraged conglomerates, financed by debt or by the funds that policyholders entrust to these firms' insurance subsidiaries. Four such companies—HNA, Dalian Wanda, Fosun (based in Shanghai) and Anbang—have spent \$100bn on assets that include luxury hotels, a Portuguese bank, a Russian gold mine and a yachtmaker. It is hard to see industrial logic behind the purchases. Fosun and HNA, which disclose their accounts, have eye-watering ratios of debt to gross operating profit of 8 and 13 times respectively. In the last category are outright flops: \$230bn of deals worth \$1bn or more have collapsed because the buyer or the Chinese government got cold feet, or because of a hostile reception abroad. As a result Chinese buyers are seen as unreliable.

Other countries have been on foreign M&A benders: in 1989-90 Japanese companies bought a Hollywood studio and the Rockefeller Centre and in 2005-15 Indian firms splurged overseas. But China is different. It is much bigger. And its firms' weaknesses abroad reflect the unique problems of its economy at home.

State-controlled firms are the most financially undisciplined. They are also more likely to provoke opposition abroad from private rivals and from politicians who can argue that China's government is meddling in their economy. As for the country's entrepreneurs, cheap loans from state banks and a reluctance to issue equity leads them to assume too much debt and to

speculate. They need to be politically connected to get bank loans and get around currency controls, but such connections can be fickle. In 2015 Fosun's boss was arrested and then released. This month Anbang has had to deny that its chairman is banned from leaving the country. China's outbound foreign investment dropped by 49% year on year in the first quarter of 2017, with an official clampdown on such speculative deals partly to blame.

More sensible ways of going global may be emerging, however. State-backed firms are using new mechanisms to persuade foreign countries that they will operate on a largely commercial basis. ChemChina has just bought Syngenta, a Swiss chemicals firm, for \$46bn. It has promised to keep Syngenta's headquarters and research in Switzerland. China Investment Corporation (CIC), a sovereign-wealth fund, is to spend \$14bn buying Logisor, a European warehousing business. CIC will presumably argue that it is a financial buyer and won't meddle. China's one-belt-one-road initiative is partly aimed at reassuring foreign countries that do business with state-backed firms, by putting contracts and activity under a bilateral, diplomatic umbrella.

| *M&A with Chinese characteristics*

For China's private firms the focus must be on deals that contain industrial logic, rather than those with a strongly speculative or trophy-hunting flavour. Last year Haier, which makes white goods, bought General Electric's appliances business. Even these deals are hit and miss. Geely, a carmaker, has made a success of Volvo, which it bought in 2010, but Lenovo, a computer firm, has struggled since buying Motorola's handset business in 2014. Yet, over the long term they have a better chance of succeeding than almost anything else. As China's internet firms accumulate cash they will go abroad; they have much to offer in terms of expertise. Last year Tencent paid \$9bn for Supercell, a Finnish gaming firm.

In the past, each economic superpower has created its own corporate form abroad, reflecting its national character and the state of the world it sought to bestride. British firms used managing agents in the 19th century to run remote businesses. From the 1970s American firms perfected the multinational, taking advantage of technology and open borders to run things on an integrated basis. China's firms are emerging out of a state-led economy into a more protectionist world. They must find their own ways to adapt to this environment if they are to fulfil their destiny. ■



熊彼特

摸着石头过河

中国企业在海外战绩不佳，必须改进

鉴于中国的经济规模，有一件事似乎无可避免，那就是中国企业终将在世界舞台上扮演极为重要的角色。然而，过去15年里中国企业在海外市场上的商业冒险成果各异。发生的小型交易成千上万，其中有一部分会成功。但至于价值10亿美元或以上的并购，情况就不同了。已有56笔交易终止；另外39笔交易中，国企以虚高的价格收购了大宗商品企业；最近，各路大亨正在疯狂搜罗酒店和足球俱乐部等战利品。

有些交易完全不符合任何常规逻辑。上个月，航空旅游集团海南航空公布已经收购德意志银行10%的股权，在此之前还曾考虑收购一家德国州立储蓄银行。这家在北京赞助了沙滩排球巡回赛的中国公司似乎认为自己有能力整合德国分散的银行业，但要在金融领域里完成此举，难度堪比实现中东和平。中国企业要在海外发挥潜力，需要更靠谱的做法。

英国及后来的美国在20世纪的经历表明，经济霸主国家在全球跨国公司投资总存量中所占比例往往偏高。今天，中国的这一占比仅为4%，低于其占全球GDP15%和总市值13%的比例。中国领导人希望中国企业加快行动。中国首富、房地产公司大连万达的老板王健林在自传中指出，企业如果不全球化，中国就不会变强大。

但急于走出去的中国企业已经犯了不少错误。2005年以来，价值10亿美元或以上的交易占了中国企业海外并购总额的三分之二，其中约有一半分属三个有问题的类型。第一类是国有控股公司对自然资源企业的收购。此类收购的目的是要确保原材料来源，但许多交易的时机都很糟糕，是在2010年至2014年间大宗商品周期的高峰期以偏高的价格完成的。例如，石油公司中海油在2012年以170亿美元收购了加拿大石油公司Nexen，现在已经减记了其中部分价值。

第二个问题类别是企业集团运用杠杆，通过举债或利用集团保险子公司客户的保险资金进行收购。四家这样的企业（海航、大连万达、上海复星和安邦）已经花费了1000亿美元收购各类资产，包括豪华酒店、一家葡萄牙银行、一个俄罗斯金矿和一家游艇制造商。这些收购背后的行业逻辑很难看明白。复星和海航披露了账目，负债与总营业利润比分别为8倍和13倍，高得令人咋舌。最后一个类别完全是败笔：由于买方或中国政府临阵退缩，或者由于在国外遭到敌视，价值10亿美元或以上的交易中有总计2300亿美元的交易告吹。结果使得中国买家如今被认为是不可靠的。

其他国家也经历过海外并购狂潮：1989至1990年间，日本企业收购了一家好莱坞电影公司和洛克菲勒中心。2005至2015年，印度企业在海外大肆挥霍。但中国不同，它的经济规模要大得多，其企业在海外市场上暴露出的弱点反映了国内经济的独特问题。

国有控股企业财务管理最不严格，也更有可能在海外引起私营竞争对手和政客的反对——这些政客可能会称中国政府干预本国经济。中国的企业家则有着来自国有银行的廉价贷款，而又不愿意发行股票，这让他们承担了过多的债务，并进行投机。他们需要有政治关系才能获得银行贷款及绕过货币管制，但这种关系有时并不牢靠。2015年，复星的老板被捕，后来又被释放。本月，安邦不得不对外界报道作出回应，否认其董事长被禁止出境。2017年第一季度，中国对外投资同比下降49%，部分原因是官方对这种投机性交易的打压。

然而，更明智的走出去的方式可能正在浮现。国资支持的企业正在使用新机制来说服国外市场和政府，使其相信自己的运作会主要基于商业方式。中国化工刚刚以460亿美元收购了瑞士化学品公司先正达（Syngenta），承诺将先正达公司的总部和研究部门留在瑞士。主权财富基金中国投资有限责任公司将斥资140亿美元收购欧洲仓储公司Logicor。中投想必会说自己只是财务收购，不会干预公司业务。中国的一带一路倡议把合同和商业活动放在双边外交的大伞之下，一定程度上是为了让与国资支持的企业做生意的国家安心。

| 中国特色的并购

中国的私营企业必须注重有产业逻辑的交易，而不是具有强烈投机性或有虏获战利品意味的交易。去年，生产白色家电的海尔收购了通用电气的家电业务。但即使是这类交易也有成有败。汽车制造商吉利在2010年收购了沃尔沃后获得了成功，但电脑企业联想自2014年收购了摩托罗拉的手机业务以来一直陷于困境。然而，长远来看，这些交易比其他任何商业活动都有更大的成功机会。中国互联网企业攒够了现金，就会走出去，它们有很多专长做筹码。去年，腾讯就以90亿美元的价格收购了芬兰游戏公司Supercell。

过去，每个经济超级大国都在国外建立了自己的公司形式，反映了其民族特性和所想征服的世界的状态。英国公司在19世纪使用代理经理人的形式管理山长水远的企业。20世纪70年代起，美国企业完善了跨国公司的形式，利用技术和开放的边界来综合运作。中国企业正从国家主导型经济中崛起，进入一个更具保护主义色彩的世界。想要夙愿得偿，它们必须找到自己的方式来适应这种环境。 ■



Air travel

Roger, Tango Romeo...ump

The president wants to privatise air-traffic control

IN JUNE 1956 a TWA Constellation collided with a United Air Lines DC-7 over the Grand Canyon in Arizona, killing all 128 people on both aircraft. At the time it was the worst ever airline disaster. Struggling with outdated technology and a post-war boom in air travel, overworked air-traffic controllers failed to spot that the planes were on a collision course.

That crash led to the creation of a new body, which became the Federal Aviation Administration (FAA), in charge of running and modernising the world's biggest air-transport system. With that system again struggling to keep pace with demand, Donald Trump thinks it is time to privatise America's air-traffic control service. In June the president outlined a plan to turn air-traffic control into a separate non-profit entity financed by user fees, instead of the present patchwork of taxes and grants. Shorn of its air-traffic responsibility, the FAA would become a safety body.

America's air-traffic system is vast, consisting of 14,000 controllers working in 476 airport-control towers that handle take-offs and landings, as well as in 21 "en route" centres looking after flights along the nation's airways. It has a good safety record, but elderly technology limits the number of flights that can be handled. This leads to delays and frustrated flyers. With passenger numbers set to grow from 800m a year to almost 1bn by 2026, the problem will only get worse.

Mr Trump believes that, no longer mired in a federal bureaucracy, the air-traffic service will become more efficient and better able to invest in technology. Many countries, including Australia, Britain and Canada, have privatised air-traffic services or turned them into state-owned firms. Nav

Canada, a non-profit firm that has long managed Canadian airspace, has costs per flight hour of \$340 compared with the FAA's \$450.

Replacing old radar-based methods with accurate satellite navigation and better digital communications is a particular priority. Aircraft using satellite navigation can be safely spaced more closely together, which permits many more planes to be in the air at the same time. Digital systems also provide data links to control centres and to other planes by regularly broadcasting an aircraft's identification sign, its position and course. This would allow "free routing", which means pilots can fly directly to a destination, rather than follow established airways, which often zigzag around.

The president's proposal might even speed a move towards "virtual" control towers in low-rise buildings, which can replace towers physically located at airports. The virtual versions are fed live video from airfield cameras. Proponents argue that they are both safer and around 30% cheaper to operate. Virtual towers can look after more than one airport. One in Norway is set to supervise 32 airports, some of them in remote areas.

The European Union reckons such innovations will allow three times as many flights to be handled in the region and save airlines some €9bn (\$10bn) a year. It also, optimistically perhaps, predicts that on average aircraft will land within one minute of their scheduled arrival time. That would count as a miraculous improvement for anyone, let alone America's weary airport warriors.

Mr Trump, though, may struggle to get the proposal through Congress. A similar plan got stuck last year, despite being backed by most airlines and the air-traffic controllers' union. At least the president can dodge the queues: Air Force One flights get special clearance. ■



航空旅行

收到，特朗普！

美国总统想要将航空交通管制私有化

1956年6月，美国环球航空公司一架超级星座（Constellation）客机与美国联合航空公司一架DC-7客机在亚利桑那州的大峡谷上空相撞，两架飞机上的128人全部遇难。这在当时是历史上最严重的一次空难。由于技术过时，又正值战后的航空旅行高峰期，超负荷工作的空管员未能发现两架飞机将要相撞。

那次事故促使政府成立了一个新机构，即后来的联邦航空管理局（FAA），负责管理世界最大的航空运输系统并实现其现代化。如今该系统再次难以满足需求，美国总统特朗普认为是时候把美国的空管服务私有化了。6月，他概述了一项计划，把航空交通管制交由一家非营利的独立机构负责，经费由用户提供，而不是像现在这样依靠税收和拨款。卸去空管职责后，FAA将变成安全监督机构。

美国的航空交通管理系统规模庞大，包括14,000名空管员，分别在476座机场塔台及21个“航途”中心工作，前者管理飞机的起飞着陆，后者管理在美国航线上飞行的飞机。这个系统有着良好的安全记录，但技术老化限制了系统可处理的航班数量。这导致了延误，令乘客深感沮丧。预计到2026年，每年的乘机人数将从目前的八亿增至近十亿，这个问题只会进一步恶化。

特朗普认为，空管服务摆脱联邦政府的官僚体系后将变得更高效率，更有能力投资新技术。包括澳大利亚、英国和加拿大在内的许多国家已将空管服务私有化或将其转为国有企业。加拿大空管服务提供商Nav Canada是一家非盈利公司，一直在管理加拿大的航空交通。该公司每飞行小时的管理成本为340美元，而FAA为450美元。

首要任务是以精确的卫星导航和更好的数字通讯替代依赖雷达的老式系

统。使用卫星导航的飞机可以安全地缩短彼此间的距离，这样，更多飞机就能同时在空中飞行。数字系统还可以向控制中心及其他飞机传输数据，定时发布飞机的识别标志、位置及航道。这使得飞行员可以“自由选择路线”，即直接飞往目的地，而不必遵循那些往往曲折迂回的既定航道。

特朗普的计划甚至可能加速推进另一项改变——在低层建筑物上设置“虚拟”塔台，替代机场里的实体塔台。虚拟塔台从机场的摄像机获取实时视频。支持者认为它们更安全，还可节省约30%的运营成本。虚拟塔台可同时兼顾多个机场。挪威的一个虚拟塔台可管理32个机场，其中一些位于偏远地区。

欧盟认为这类创新将让欧盟境内可容纳的航班数量提升至原来的三倍，每年可为航空公司节省约90亿欧元（100亿美元）。欧盟还预计，航班降落实际时间与预定时间的偏差将平均控制在一分钟以内，当然这可能太过乐观了。对任何人来说，这样的进步都堪称奇迹，更别说美国机场那些疲惫的空管斗士了。

然而，特朗普的这项提案可能难以获得国会通过。去年，一份类似的计划得到了大多数航空公司和空管员工会的支持，却仍止步国会。不过，至少总统可以不用排队：空军一号拥有优先起降权。 ■



Ride-hailing wars

Lyft's big lift

America's number two ride-hailing firm has benefited from Uber's struggles

ONE firm's bad news is often another's good fortune. For years Lyft, an app that offers on-demand rides, was outdone by its seemingly unstoppable rival, Uber, which zoomed into new markets and grabbed a near-\$70bn valuation, the largest of any private American tech firm in history. Uber does not report a share price that would register its recent troubles, which include one investigation into alleged intellectual-property theft and another into its workplace culture. But that Lyft's market share in America has risen from 18% five months ago to 25% now (according to TXN Solutions, a data provider) is a gauge of the larger firm's crisis.

Lyft is far from a typical Silicon Valley company. Unlike Uber, it does not lust for world domination and it operates only in America. Nor does it take itself especially seriously. For years it identified its drivers by pink, fuzzy moustaches fastened to the front of cars, and encouraged riders to fist-bump their drivers and sit in the front seat (though it has now relaxed this etiquette to attract more customers).

Its founders, Logan Green and John Zimmer, put an early emphasis on being nice to drivers, for example by allowing people to tip through the app. Many in Silicon Valley viewed such cuddly behaviour as a sign that Uber would trounce it. The two do not just compete for passengers; each also tries to woo the other's drivers. In 2014 Uber's boss, Travis Kalanick, attempted to buy Lyft.

But Lyft's culture has turned out to be an asset. Uber's controversies, including Mr Kalanick being caught on video berating a driver, have helped its rival—particularly on America's liberal-minded west coast, where

people are more squeamish about using a brand associated with sexism. Half of those who have switched to Lyft in America say that company reputation was the chief reason, says Survey Monkey, an online-polling firm.

On June 6th Uber said it had fired 20 employees after the conclusion of an investigation into sexual harassment (the result of a broader probe, led by a former attorney-general, is due soon). One venture capitalist who has backed Uber says he is embarrassed to be seen getting into its cars. It seems no coincidence that in April Lyft said it had raised another \$600m from investors, valuing the firm at \$7.5bn, around a third more than its previous mark.

That also reflects a change of mind among investors over the ride-hailing business. Having thought of it as a winner-takes-all market, in which one big company has a near-monopoly in each country, plenty now believe people will spend enough on transport for more than one player to prosper. Mr Zimmer, Lyft's co-founder, compares ride-hailing to the wireless-carrier market, in which several companies boast high-quality coverage and plenty of customers.

Offering good "coverage" in ride-hailing so that rides can arrive within a few minutes, of course, requires resources. "We're at the stage of building cell towers. That's expensive," says Brian Roberts, Lyft's chief financial officer. But it may help the firm that it remains geographically and strategically focused. It has fewer distractions than Uber, which in addition to expanding globally is pushing into new business lines, like food delivery and trucking.

Lyft's strategy on self-driving cars is also distinctive. Uber is investing heavily to build its own autonomous technology, guarding against the chance that another service could come in without drivers and undercut it

on price. But Lyft has opened up its network to other firms, including Waymo, a self-driving car unit that is Google's sister company (and which has accused Uber of stealing trade secrets).

Collaborating with others is better than building expertise in-house, Lyft reckons, because so much uncertainty surrounds the evolution of autonomous technology. In June Lyft announced another relationship, with an autonomous-driving startup called nuTonomy, which will start testing cars in Boston. There is a risk that Waymo and other partners may try to perfect their own self-driving technology with Lyft's data and then launch a competing ride-hailing network, but that seems a distant possibility.

In the immediate future Lyft may find it harder to keep differentiating itself. Uber has mimicked some of its successful tactics, such as tipping, and is overhauling its culture. Many ride-hailing drivers now work for both services, which means travelling in a Lyft car is no longer unique.

The fact that Lyft has won a quarter of the American market could help both firms' profits. In 2016 it lost around \$600m and Uber \$2.8bn. They formerly seemed likely to spend money fighting to the point of "mutually assured destruction", says Vincent Letteri of KKR, an investment firm that recently put cash into Lyft (after declining to join in two previous funding rounds). Uber now accepts that Lyft is there to stay; it will have to rein in promotional spending if it wants to achieve healthy profits in America to pay for expansion abroad and to reassure nervous investors, says Mr Letteri. Lyft will have less need to spend heavily on subsidies for drivers and riders. It has stopped its practice of offering new customers \$50 in free trips to sign up. Lyft still wants to be nice, but has no wish to be taken for a ride. ■



网约车之战

Lyft大提升

美国第二大网约车公司从优步的困境中受益

一家公司的坏消息常常是另一家公司的好运气。多年来，叫车应用Lyft都被它看似不可阻挡的对手优步（Uber）压制。优步开拓新市场，取得了近700亿美元的估值，成为美国历史上估值最高的私营科技公司。优步没有公开上市的股价，如果有的话，股价也一定会反映出公司近来的麻烦：被控侵犯知识产权，职场文化也受到调查。但据数据提供商TXN Solutions称，Lyft在美国的市场份额已从五个月前的18%升至现在的25%，这从侧面证实了优步的危机。

Lyft一点也不像典型的硅谷公司。和优步不同，它并不渴望统治全球，而是只在美国运营。它也没有特别把自己当回事。多年来，Lyft一直把毛茸茸的粉色大胡子贴在车前，方便乘客认出Lyft的司机。公司还鼓励乘客和司机碰一碰拳头并坐在前排（不过它现在放松了这套礼仪规范，以吸引更多顾客）。

Lyft的创始人罗根·格林（Logan Green）和约翰·齐默（John Zimmer）把早期的重点放在善待司机上，比如乘客可以通过应用给司机小费。硅谷有很多人把Lyft这种讨喜的行为视为会被优步打败的迹象。这两家公司不仅在争乘客，也在努力争取对方旗下的司机。2014年，优步的老板特拉维斯·卡兰尼克（Travis Kalanick）曾试图收购Lyft。

但Lyft的文化却成为了一种资产。优步引发的争议，包括卡兰尼克某次被拍到痛骂一位司机，都为它的竞争对手提供了助力，尤其是在思想开明的美国西岸，那里的人要更不能忍受涉嫌性别歧视的品牌。在线调查公司Survey Monkey称，美国转用Lyft的人里有一半都说公司声誉是主因。

6月6日，优步称，性骚扰调查结果出炉后，公司已经解雇了20名员工（由前司法部长牵头的另一项更大范围的调查即将得出结果）。一位投资了优

步的风险资本家说，被人看见自己上优步的车，他感到很难为情。4月，Lyft称已从投资人那里又融得6亿美元，公司估值达到75亿美元，比上一轮融资提高了约三分之一，看来这一切并非偶然。

这也反映出投资人对网约车业务的观念变化。以前很多人认为这是个赢家通吃的市场，一家大公司在每个国家都有近乎垄断的地位，但现在他们相信，人们在交通上的花费足以让不止一家公司成功。Lyft的联合创始人齐默将网约车服务比作无线通讯市场，在这个市场上，几家公司各自拥有高质量的覆盖率和大量客户。

当然，在网约车服务中提供良好的“覆盖率”，让车辆在几分钟内就能到达乘客所在的位置，这需要资源。Lyft的首席财务官布莱恩·罗伯茨（Brian Roberts）说：“我们还处在建造‘手机基站’的阶段。这很费钱。”但是，精力仍然集中在地理区域和战略上也许对公司有利。Lyft的注意力不像优步那样分散。优步不仅在向全球扩张，还在拓展新的业务线，如送餐和货运。

Lyft对自动驾驶汽车的策略也与众不同。优步不惜投入重金研发自己的自动驾驶技术，以防范有朝一日另一种不需要司机的服务介入，以更低的价格削弱优步的竞争力。而Lyft却对其他公司开放自己的网络，包括谷歌的姊妹公司、开发自动驾驶汽车的Waymo（这家公司指控优步盗取商业机密）。

Lyft认为，齐心协力胜过闭门造车，因为发展自动驾驶技术有太多的不确定性。6月，Lyft宣布还会和一家名为nuTonomy的自动驾驶创业公司合作，nuTonomy的无人车将在波士顿展开测试。有一种风险确实存在：Waymo和其他合作伙伴可能会用Lyft的数据完善自身的无人驾驶技术，然后推出与Lyft竞争的网约车服务。但这种可能性看起来还很遥远。

在不远的将来，Lyft可能会发现，让自己保持与众不同变得更难了。优步已经开始模仿它的一些成功的策略，比如给小费，而且还在彻底改革自己的企业文化。很多开网约车的司机现在都同时接两家公司的单，这意味着

乘坐Lyft的车已不再是件独特的事。

Lyft已经赢得四分之一的美国市场，这有助于两家公司都转向盈利。2016年，Lyft亏损约6亿美元，优步亏损28亿美元。投资公司KKR的文森特·莱特瑞（Vincent Letteri）说，之前它们看起来像是要竞相砸钱，直到“同归于尽”。在拒绝参加Lyft前两轮融资后，KKR最近投资了这家公司。莱特瑞认为，优步现在已经接受了要与Lyft共存的现实。要想在美国达到健康盈利，从而为海外扩张买单并且稳住紧张的投资人，优步将不得不控制促销支出。这样，Lyft也就不再那么需要花费重金补贴司机和乘客了。它现在已经不再向新注册的客户提供50美元免费乘车券了。Lyft依旧想与人为善，但也不会想做冤大头。 ■



Carbon dioxide emissions

Global CO₂ emissions from energy use remained roughly flat in 2016

Global CO₂ emissions from energy use remained roughly flat in 2016, according to a report from BP, a big oil firm. A year-on-year increase of 0.1% was well below the ten-year average growth rate of 1.6%. Improved energy efficiency and a slowing global economy were partly responsible. China also played a part: the country remains the world's largest source of CO₂ but its emissions fell by 41m tonnes in 2016, partly thanks to weakness in some energy-intensive industries. In contrast, India's emissions increased by 114m tonnes last year. The landscape has changed over the past quarter-century. In 2016 the Asia-Pacific region produced almost half of global emissions, up from 25% in 1990. ■



碳排放

2016年，全球因能源消耗而造成的二氧化碳排放量大致持平

大型石油公司BP的一份报告称，全球因使用能源而造成的二氧化碳排放在2016年大致持平，同比增长0.1%，远低于过去十年1.6%的平均增长率。这在一定程度上是因为能源效率提高和全球经济放缓。中国也起了一定作用：中国仍然是世界最大的二氧化碳排放国，但在2016年排放量下降了4100万吨，一些能源密集型产业疲软是原因之一。相比之下，印度去年的排放量增加了1.14亿吨。过去25年间，全球二氧化碳排放格局已经发生变化。2016年，亚太地区的排放量几乎占到全球的一半，而1990年还是25%。 ■



Regulation

Rules and tools

Regulation and technology will have to evolve together to ensure safety

MOVING bits around the internet is one thing; moving atoms around in the real world is something else entirely. In the two decades of the internet era, many world-changing technologies—web-publishing, file-sharing, online auctions, internet telephony, virtual currencies, ride-hailing—have raised new legal and regulatory questions. In each case, regulators had to work out the rules after the event: figuring out how libel law applies to the web, banning the sale of Nazi memorabilia, deciding whether Bitcoin is a currency, determining whether Uber drivers are employees or contractors, and so on. But drones are a different matter, because of the danger that flying robots pose to life and limb, and the existence of strict rules that govern the use of physical airspace. Their future will depend as much on decisions made by regulators as it does on technological advances. How will it play out?

Global policymakers are currently engaged in a “very interactive process of competition and co-operation”, says Greg McNeal, a law professor at Pepperdine University who advises the Federal Aviation Administration (FAA) on drone regulation and is co-founder of Airmap, a drone-software startup. Before the introduction of America’s “part 107” rules last August, Google’s Project Wing tested drones in Australia and Amazon in Canada, where the regulatory regimes were more accommodating. France’s relatively permissive regulation put it at the forefront of the agricultural use of drones. And in Britain a drone cluster has sprung up around an airport in Aberporth, in Wales, where drone-friendly regulations and facilities have been put in place. Now regulators in different countries are working closely together, attending each other’s meetings and learning

from each other, while also competing to attract drone startups. “It’s very good for the industry, because every nation wants to be a leader,” says Mr McNeal.

The FAA’s part 107 rules, providing for certification of commercial drone operators, are generally seen as a model by other countries. These rules, a decade in the making, allow operators with a remote-pilot certificate (obtained by passing a test costing \$150) to fly a drone for commercial purposes during the day, within line of sight, in uncontrolled airspace, and without flying over people who are not involved in operating the drone. Other countries have since followed America’s lead, and some are already going further: France and Switzerland allow some operation beyond visual line of sight, says Mr McNeal, and from 2018 Japan will permit it for delivery drones. In America the next set of proposed rules from the FAA, expected later this year, will deal with flight over people and remote identification of drones. Next year there will be proposals for the control of multiple drones by a single operator, “extended visual line of sight” operation over longer distances, and night operation. In 2019, says Mr McNeal, the FAA will propose its first rules governing flights without a visual line of sight, a crucial requirement for delivery drones.

Drone companies can already go beyond part 107 by obtaining special waivers from the FAA, provided they can show that the proposed operation can be conducted safely and meet some additional requirements. This offers a way to test new regulations before they are formalised. Such waivers impose additional safety requirements on drone operators: getting a waiver for night-time operation, for example, requires mounting a light on the drone that is visible three miles away, and providing night-flight training for operators. If all goes well, this could form the basis of a new rule, says Brendan Schulman, head of policy at DJI.

Flying over people raises additional problems. The FAA’s proposed rule, due

out later this year, is expected to ask drone operators to show how they would mitigate the risk of injury to bystanders. The best way to do this, explains Mr Schulman, is to specify an acceptable level of risk, and then require dronemakers to show that their vehicles meet that standard. This might involve adding cushioning or parachutes to drones, or ensuring that they can still operate if some parts fail, or making them so small and light that they would cause little injury if they fell on someone.

An idea from Australia also deserves to be more widely adopted, he suggests: the creation of a special category for very small drones, allowing commercial operation without any certification. In Australia's case this applies to drones weighing less than 2kg. Similar rules apply in Mexico and Canada, and are being considered in India and several European countries. In America all drones weighing less than 25kg are still treated the same. But broadly speaking, regulators are learning from a variety of approaches being tried in different countries.

| *Traffic lights in the clouds*

To operate drones beyond visual line of sight and in large numbers, particularly in densely populated areas, will take not just extra rules but the establishment of new traffic-management systems, akin to air-traffic-control systems, to prevent drones crashing into each other or veering off course. Around 80% of consumer drones, including those made by DJI, Yuneec and Intel, already support "geo-fencing", using technology provided by Mr McNeal's company, Airmap. Its database of where drones are and are not allowed to fly is built into the software used to control them, working with satellite positioning to prevent an operator from flying a drone too close to an airport, for example. Airmap's database can be updated in real time to keep drones away from unexpected events such as fires and other incidents.

But once drones are flying beyond their operators' line of sight, a more

elaborate system will be needed to track large numbers of them and ensure they avoid each other and stay away from manned aircraft, says Parimal Kopardekar of NASA's Ames Research Centre. He is leading the development of a system called Unmanned Aerial Systems Traffic Management (UTM), an automated traffic-management system for drones. Existing air-traffic-control systems are operated manually, with human controllers co-ordinating with human pilots during flight, but that will not work for unmanned drones flying in much larger numbers. The UTM system will be automatic, with drones filing requests to use particular flight paths with a local data exchange, which then co-ordinates all the movements. "The regulator only sets the rules and defines the exchanges, so it's a very different way of doing things from air-traffic control," says Dr Kopardekar.

Last year NASA carried out a trial of its UTM architecture across the United States which revealed several challenges, notes Dr Kopardekar. In particular, it turned out that fixed-wing and multirotor drones respond very differently when they encounter rising columns of air, called thermals. Fixed-wing drones "bounce around quite a bit, by a few hundred feet", says Dr Kopardekar, which means drones cannot be stacked too closely together. Route planning will, in short, require a detailed understanding of microclimates and of the behaviours of different types of drones. Building the necessary systems will take a few years.

| *Where are you going?*

The FAA plans to introduce the first rules around UTM from 2019. Drones will need to be equipped with "sense and avoid" systems and long-range radio to communicate with each other and with the data exchange. That also poses a challenge, says Jane Rygaard of Nokia, a maker of network equipment, because existing mobile networks are designed to work with users on the ground, not in the air. Networks will have to be augmented with antennae that point towards the sky. This technology already exists to

provide in-flight connectivity to aircraft, but will have to be extended more widely to take in drones as well.

And even once all these rules and tools are in place, not everyone will respect them. Some people may want to use drones for nefarious purposes. A range of anti-drone technologies is already being tested. Police forces in some parts of the world have trained birds of prey to attack small drones. Nets can also be used to trap them, either fired from bazooka-like launchers or dropped by other drones. America's Department of Defence holds an annual event called Black Dart at which various anti-drone technologies are evaluated. "The biggest surprise to military folks was how difficult it was to combat small drones," says Grant Jordan, the founder of SkySafe, an anti-drone startup, who worked on Black Dart a few years ago when he was in the air force. When the target is "tiny, very light and relatively slow", the assumptions of traditional air defence are all wrong, he says.

Big laser systems worked pretty well, he recalls, but are expensive and complex. Israel has used Patriot missiles to shoot down fixed-wing drones operated by Hamas, Mr Jordan says. By contrast, his firm disables drones by intercepting their control signals and video feeds. Examining the radio traffic to and from a drone makes it possible to determine what type it is, track it and if necessary take it over to disable it or force it to land. Anti-drone systems made by SkySafe, and rivals such as Dedrone and DroneShield, are being evaluated for military and government use and to police airspace around airports, stadiums and prisons (to prevent smuggling of phones, drugs and other items to inmates). But it is unclear who has the legal authority to stop drones that pose a threat to public safety, says Mr Jordan. Existing air-safety rules aim to protect passengers in aircraft; for drones, "the logic of these laws falls apart."

It is clear that the complexities of operating drones in large numbers have barely begun to be understood. As the first widely deployed mobile robots,

drones already offer many exciting possibilities today, and no doubt other, as yet undreamed-of uses will follow in the future. Frank Wang, the founder of DJI, pictures people being followed around by tiny personal drones, like fairy sidekicks. Astro Teller of Google foresees delivery drones that can come up with any item on demand. And passenger drones might some day act as magic carpets, whisking people across cities from rooftop to rooftop.

Drones make the extraordinary power of digital technologies physically incarnate. But because they operate in the physical rather than the virtual world, exploiting the many opportunities they offer will depend just as much on sensible regulation as on technological progress. ■



监管

规则与工具

监管和技术必须同步发展以确保安全

在互联网上移动比特是一回事，在现实世界中移动原子则是完全不同的另一回事。进入互联网时代二十年来，许多改变世界的技术——网络发布、文件共享、在线拍卖、网络电话、虚拟货币、网络叫车——都曾引发新的法律和监管问题。在以上每个例子中，监管机构都必须在事后制定规则：弄清楚诽谤法如何适用于网络，禁止出售纳粹纪念品，确定比特币是否是一种货币，判定优步司机是雇员还是承包商等。但无人机可不一样，因为会飞的机器人会对人身安全造成危险，并且对于物理空域的使用已有严格的规则。它们的未来依赖技术进步，同样也取决于监管方做出的决定。它将何去何从呢？

佩珀代因大学的法律教授格雷格·麦克尼尔（Greg McNeal）表示，全球决策者目前正在进行“互动频繁的竞争与合作”。麦克尼尔向联邦航空管理局（FAA）提供有关无人驾驶监管的建议，也是无人机软件创业公司Airmap的联合创始人之一。在美国于去年8月推出“第107部分”规则之前，谷歌的Project Wing项目选择在澳大利亚测试无人机，亚马逊则选择了加拿大，这些地方的监管制度更为宽容。法国相对宽松的监管让其跻身农业无人机应用的前沿。而在英国，一群无人机在威尔士阿博波恩的一个机场附近涌现出来，因为这里设立了对无人机友好的法规和设施。现在，不同国家的监管机构正在密切合作，互相参加会议并相互学习，同时也在争相吸引无人机创业公司。“这对行业来说是非常好的，因为每一个国家都想成为领导者。”麦克尼尔说道。

美国联邦航空局（FAA）的第107部分规则为商业无人机操作员提供认证，通常被其他国家视作典范。这些规则花了十多年才制定出来，允许具有远程驾驶员证书（可在通过一项花费150美元的考试后获得）的操作员在日间、视线范围内、未管制空域中出于商业目的操作无人机，但不得在与无人机操作无关的人员上方飞行。自此之后，其他国家已经跟随了美国的脚

步，有些国家更有了进一步发展：麦克尼尔称法国和瑞士允许某些操作超出视线范围；而从2018年起，日本也将允许一些送货无人机超出视线范围飞行。在美国，预计今年早些时候FAA还会提出下一组拟议规则，解决在人员上方飞行和无人机远程识别等问题。明年将会有关于一位操作员控制多架无人机、在“超越视距”的距离以及夜间操作的提案。麦克尼尔说，FAA将在2019年提出第一条超视距飞行规则，而这一要求对于送货无人机而言至关重要。

无人机公司已经可以从FAA获得特别豁免，从而超越第107部分法规，只要它们能够证明其提出的操作可以安全进行并满足一些额外的要求。这提供了一种在法规正式颁布前对其进行测试的方法。此类豁免对无人机操作员提出了额外的安全要求，例如，获得夜间操作豁免要求在无人机上加装三英里外可见的灯，并为操作员提供夜航训练。大疆的政策主管布兰登·舒尔曼（Brendan Schulman）说，如果一切顺利，这可能会成为新规则的基础。

飞越人员引发了更多的问题。FAA预计于今年早些时候提出新法规，据悉会要求无人机操作员展示将如何降低对旁观者造成伤害的风险。舒尔曼解释说，最好的方法是指定可接受的风险水平，然后要求无人机生产商证明其产品达到了这个标准。这可能包括为无人机增加缓冲或降落伞，或者确保在某些部件失效时仍可以运行，或者使其小巧轻盈，即使落在人身上也不会造成什么伤害。

他建议，澳大利亚的一个思路也应该得到更广泛的采纳：为非常小的无人机设立一个特殊类别，允许其无需任何认证而进行商业运作。这在澳大利亚适用于重量小于2千克的无人机。墨西哥和加拿大都实施了类似的规则，印度和几个欧洲国家也在考虑。在美国，对所有重量小于25千克的无人机仍然一视同仁。但整体而言，监管机构也在从不同国家尝试的各种方法中不断学习。

| 云上交通灯

要在视距外操作大量无人机，特别是在人口稠密地区，就不仅仅需要额外

的规则，还要建立类似于空中交通管制系统的新交通管理系统，以防止无人机相互碰撞或偏离航向。约80%的消费级无人机，包括大疆、昊翔和英特尔的产品，都使用了麦克尼尔的公司Airmap所提供的技术，支持“地理围栏”。关于无人机可以在哪里飞、不可以在哪里飞的数据库已经嵌入了控制软件，并和卫星定位共同运作，防止操作者把飞机飞到某些区域，比如离机场太近的地方。Airmap的数据库可以实时更新，使无人机远离火灾等意外事件。

然而一旦无人机飞到操作员的视线之外，就需要一套更为复杂的系统来跟踪大群无人机，并确保它们相互避让并远离载人飞机，NASA埃姆斯研究中心的帕里莫·科帕德卡（Parimal Kopardekar）说道。他正在领导开发一种称为“无人机系统流量管理”（UTM）的系统，这是一种自动化无人机交通管理系统。现有的空中交通管制系统是手动操作的，飞行时由人类空管与人类飞行员进行协调，但对于数量大得多的无人机来说这可行不通。UTM系统将是自动的，无人机向本地数据交换所提出使用特定飞行路径的请求，数据交换所再来协调所有运动。科帕德卡博士说：“监管机构只制定规则并设立交换所，所以这种方式和空中交通管制相去甚远。”

科帕德卡指出，去年NASA在全美各地对UTM架构进行了一次试验，发现了几点困难。突出的一点是，他们发现固定翼和多旋翼无人机在遇到称为“上升暖气流”的上升空气柱时的响应差异很大。科帕德卡说，固定翼无人机“到处飘来飘去，有几百英尺远”。这意味着无人机不能堆叠得太紧密。总而言之，路线规划要求对微气候和不同类型无人机的行为有详细的了解。建立必要的体系需要几年时间。

| 你要去哪里？

FAA计划从2019年开始引入第一个关于UTM的规则。无人机需要配备“感知和避让”系统及远程无线电，以便它们相互之间以及它们与数据交换所之间进行通信。网络设备制造商诺基亚的简·瑞加德（Jane Rygaard）表示，这也提出了一个挑战，因为现有的移动网络设计针对的是地面而非空中的用户。网络必须添加指向天空的天线。这种技术已经存在，可为飞机提供飞行时的网络连接，但是必须进一步扩展以容纳无人机。

而且就算有朝一日所有这些法规和工具都到位，也并不是每个人都会尊重它们。有些人可能想把无人机用于邪恶的目的。一系列反恐技术已经在测试中。世界一些地方的警察部队已经训练了猛禽来攻击小型无人机。也可以用火箭筒式发射器发射网，或者用其他无人机投放网来捕捉它们。美国国防部每年举办一项名为“黑色飞镖”（Black Dart）的活动，对各种反无人机技术进行评估。“最令军方震惊的一点是要打击小型无人机有多难，”反无人机创业公司SkySafe的创始人格兰特·乔丹（Grant Jordan）说道。几年前他在空军服役时曾参与“黑色飞镖”工作。他说，当目标“小而轻且相对缓慢”时，传统的防空假设全都是错误的。

他回忆说，大型激光系统十分奏效，但却昂贵又复杂。乔丹说，以色列曾使用爱国者导弹击落哈马斯操作的固定翼无人机。相比之下，他的公司通过拦截无人机的控制信号和视频流来使其失效。检查无人机发送和接收的无线电通信可以确定它是什么类型，进行跟踪，并在必要时接管以使其失效或强制着陆。SkySafe以及Dedrone和DroneShield等竞争对手所生产的反无人机系统正在接受军事和政府用途评估，并对机场、体育场馆和监狱附近的空域进行警戒（以防止手机、毒品和其他物品被偷运给囚犯）。乔丹说，目前还不清楚谁拥有合法权力来制止对公共安全构成威胁的无人机。现行的航空安全法规旨在保护飞机上的乘客，对于无人机，“这些法律的逻辑崩溃了。”

很明显，操作大量无人机的复杂性几乎还不为人所知。作为第一种被广泛部署的移动机器人，无人机在今天已经提供了许多令人兴奋的可能性，未来无疑还将带来其他我们尚未想见的应用。大疆创始人汪滔构想了人们被微小的个人无人机环绕的场景，就像是童话中的小精灵一样。谷歌的阿斯特罗·泰勒（Astro Teller）设想送货无人机可以按需交付任何物品。载人无人机有一天可能会变成阿拉丁的魔毯，横穿城市，将人们从一个屋顶送到另一个屋顶。

无人机使数字技术的非凡力量有了物理的化身。但由于它们在物理世界而不是虚拟世界中运作，要利用其无限可能，既取决于技术进步，更要依靠合理的监管。■



Brain scan

Dario Floreano

A pioneer of evolutionary robotics borrows drone designs from nature

THE drones that most people are familiar with today are “very boring”, declares Dario Floreano, head of the Laboratory of Intelligent Systems at the Swiss Federal Institute of Technology in Lausanne. He thinks that drones will come in a much wider range of shapes and sizes in future, and that nature will provide the inspiration needed to make them more agile, safer and more capable. “There is space for an enormous range of morphologies and sensing capabilities,” he says, giving a slightly worrying example: vampire bats. As well as flying, they can also walk, jump and even run along the ground. Dr Floreano and his colleagues have built bat-like drones with folding wings, and locust-like ones that can jump and fly.

A pioneer in the field of evolutionary robotics, which borrows ideas from nature, Dr Floreano became interested in drones as a result of his work on insect-inspired vision systems. Curved compound “eyes”, which (like insect eyes) can “see” in many directions, turn out to be useful in helping a drone sense its surroundings, navigate and avoid obstacles, for example. Dr Floreano’s work on fixed-wing drones, with stabilisation and autopilot systems inspired by the way bees navigate, was spun off into a startup called SenseFly, now part of Parrot, a French drone company. SenseFly’s main product is a black-and-yellow fixed-wing mapping drone called eBee.

Birds are another inspiration. Dr Floreano’s team recently published research on the benefits of adding artificial feathers to fixed-wing drones. By spreading its feathers, the drone can increase the surface area of its wing, letting it trade speed for manoeuvrability. But not everything needs to be borrowed from nature. Flyability, another spin-out from Dr Floreano’s lab, makes a “collision-tolerant” drone that resembles a flying spherical

cage, for mapping and inspection in confined spaces.

These sorts of unconventional approaches enable drones to do things that existing designs cannot. Dr Floreano imagines search-and-rescue drones capable of perching on walls or landing on power lines, like birds, to survey their surroundings. This “multi-modal” approach could also increase the safety of delivery drones by allowing them to glide, land or perch if something goes wrong. Multirotor drones can carry a maximum of 30% of their total mass as payload, he notes, so to carry useful amounts of cargo they will have to be quite large and heavy.

At very small scales, fixed-wing and multirotor designs become less efficient, and insect-like drones with flapping wings may make more sense. Tiny drones could be used for virtual tourism, letting remote users “fly” around with the aid of virtual-reality goggles. In short, today’s drone designs barely scratch the surface. “There is a huge range of shapes and sizes that we have to explore,” says Dr Floreano. “Future drones may look very different.” ■



人物

达里奥·弗洛雷亚诺

进化机器人领域的先驱向自然界取经设计无人机

今天大部分人熟悉的无人机都“非常无趣”，瑞士洛桑联邦理工学院智能系统实验室主任达里奥·弗洛雷亚诺（Dario Floreano）说。他认为，未来无人机的形状和尺寸都会比现在丰富得多，而大自然会给我们灵感，使其变得更敏捷、安全和强大。“无人机仍有空间演变出大量不同的形态和感知能力。”他说。他举的例子让人略感不安：吸血蝙蝠。这种蝙蝠不仅能飞，还能走、跳，甚至能在地面上跑。弗洛雷亚诺和他的同事们已经发明了机翼可开合的仿蝙蝠无人机以及能跳能飞的仿蝗虫无人机。

弗洛雷亚诺是进化机器人领域的先驱，该领域从自然界汲取创意。他对仿昆虫视觉系统的研究激起了他对无人机的兴趣。比如，弧形复“眼”（像昆虫眼睛一样）能“看到”多个方向，弗洛雷亚诺发现它们能帮助无人机感知和探索周遭环境并避开障碍物。他研发的固定翼无人机借鉴了蜜蜂的导航方式来设计稳定系统和自动驾驶系统，这项工作已经分离出一家名叫SenseFly的创业公司，如今是法国无人机企业Parrot的一部分。SenseFly的主打产品是黑黄相间的固定翼测绘无人机“电子蜜蜂”（eBee）。

鸟是另一个灵感来源。弗洛雷亚诺的团队最近发表了一篇研究论文，论述在固定翼无人机上添加人工羽毛的好处。无人机展开羽毛时，机翼的面积增加，可降低速度来换取操控性能。不过并非样样都要向自然界取经。弗洛雷亚诺的实验室分离出的另一家公司Flyability制造的“耐撞”无人机形似会飞的球形笼子，可在狭窄空间里进行测绘和勘查。

这些非常规设计能让无人机完成现有设计无法做到的事。弗洛雷亚诺还设想了一种能够像鸟一样停在墙上或电线上俯瞰周围的搜救无人机。这种“多模式”设计也能提高送货无人机的安全性，让它们可以在发生故障时选择滑翔、着陆或“栖息”。他指出，多旋翼无人机的最大有效载荷是其自重的30%，所以它们得要相当大和重才能真正帮忙送货。

假如尺寸很小，固定翼和多旋翼无人机的效率会比较低，而仿昆虫的拍翅设计可能更为合理。微型无人机可用于虚拟旅行，让远程用户借助虚拟现实眼镜“飞来飞去”。总而言之，今天的无人机设计还只是些皮毛。“我们必须探索千奇百怪的形状和尺寸，”弗洛雷亚诺说，“未来无人机的长相可能大为不同。”■



Future uses

Can drones deliver the goods?

The wait for cargo-carrying drones may be longer than expected

THERE is a striking disparity between the commercial applications drone companies are pursuing in fields like construction, inspection or agriculture and the public perception of commercial drones. Media coverage is dominated by one particular application: delivery.

Experimental deliveries of parcels, pizzas and other items conjure up visions of skies abuzz with drones ferrying packages to and fro. But although delivery and logistics companies are interested in drones, many drone companies are not interested in deliveries. “It’s not on our immediate radar,” says Paul Xu of DJI.

Astro Teller, the boss of X, Google’s semi-secret research laboratory, is one of the lucky few to have received a delivery by drone. It was dispatched last September as part of a test carried out in Virginia by Project Wing, Google’s drone-delivery programme. Its machines come in a variety of shapes: some are “tail-sitters”, flying wings capable of flipping upright and hovering; others are fixed-wing drones augmented by vertical-axis rotors like those on a quadcopter. Both designs combine the benefits of a fixed-wing aircraft for efficient long-distance flight with those of a multicopter for hovering and vertical take-off and landing. When delivering a package the drones do not actually land but float above the recipient and use a winch to lower their cargo: in Dr Teller’s case, a freshly prepared burrito.

Receiving something by drone is “kind of magical”, he says, launching into an impassioned case for drone delivery. Imagine you had a magic elf that could bring you anything you asked for within a minute or two, provided it could fit in a breadbin. You would no longer worry about what to take with you when going out. Nor would you keep common items, like batteries or

perishable foodstuffs, on hand at home just in case you needed them. You might not need to own some rarely used objects at all if you could summon them when needed. Rapid drone delivery could thus accelerate the trend from ownership to access in the “sharing economy”, says Dr Teller. He claims delivery drones could be faster, quieter and more environmentally friendly than large delivery trucks. Project Wing now carries out experimental flights daily.

The technology giant most closely associated with delivery drones is Amazon. When its boss, Jeff Bezos, revealed his plans for drones in December 2013 on “60 Minutes”, an American television programme, they were widely assumed to be a publicity stunt. But Amazon is quite serious: it carried out its first trial delivery to a customer near Cambridge, England, last December—“13 minutes from click to delivery,” says Gur Kimchi, the head of Amazon’s drone effort. In March 2017 it conducted its first delivery demonstration in America, at a conference in Palm Springs. Like Google, Amazon is evaluating a range of different designs, all of which involve the drone lowering its package onto a target in the recipient’s garden or backyard. Logistics firms such as DHL and UPS, as well as some startups, are also looking at drone delivery.

But if widespread drone delivery is to become a reality, many technical and regulatory hurdles must be overcome. These include ensuring that drones do not fall and cause injury, and can land safely if something goes wrong; and preventing collisions with power lines, trees and other aircraft. Moreover, small drones have limited cargo-carrying capacity; not everyone has a garden or backyard; and deliveries require beyond-line-of-sight, autonomous operation, which requires special permission. So at least for now, many drone firms are steering clear. “It’s very challenging, and we do not want to promise something we can’t deliver,” says Mr Xu. “Delivery just bundles together all the hard problems,” says Mr Bry, who worked on Project Wing before leaving to found Skydio. He thinks it could take a

decade to solve these problems.

One application where drone delivery may make more sense, and is already in use, is ferrying medical supplies to remote areas that are hard to reach by road. Zipline, an American startup staffed by veterans of Google, SpaceX, Boeing and NASA, began delivering medical supplies in rural Rwanda using fixed-wing drones in October 2016. It has an agreement with the government to deliver blood products to 21 transfusion clinics from two bases, the first of which is already serving five clinics. Zipline's drones can fly 150km on a single charge and work in rain and winds of up to 30km an hour. They are launched using a catapult, fly below 150 metres (500 feet) and drop cargo packages weighing 1.5kg by parachute.

Rolling out the service means mapping the best routes for the aircraft, which fly autonomously, co-ordinating with military and civilian authorities, training clinic staff to receive cargo and reassuring the local communities along the route. Whether all this is economically viable, or just a publicity stunt by Rwanda's tech-loving government, is unclear. But the company is talking to governments in other countries about operating similar services, focusing on medical deliveries outside urban areas. It hopes to change public perceptions of the word "drone". Zipline's Justin Hamilton says one of the firm's engineers once told him that he used to work on drones that drop bombs, "and now he builds drones that drop blood."

Other startups say that drone delivery in urban areas is already possible—but using drones moving on the ground rather than in the air. Starship Technologies, based in Estonia, and Dispatch, based in California, have both developed wheeled, coolbox-sized drones that trundle along pavements to make local deliveries. Starship's drones are being tested in several cities around the world, and Dispatch is about to begin tests in the San Francisco Bay Area. Both firms use a "partial autonomy" model,

meaning that their drones can be remotely piloted for some or all of a route. As the drone approaches its destination, the recipient receives a smartphone alert, and when it arrives he uses his phone to pop open a lockable compartment to retrieve the cargo.

What if people steal the drone? Anyone who tries, says Stav Braun of Dispatch, has “just stolen a homing beacon”. A bigger concern, she says, is ensuring that the robot is courteous and people feel safe around it. But so far the response has been positive.

| *Instant gratification*

Clement Jambou of Unsupervised.ai, a French delivery-drone startup, thinks the steps and kerbs of urban environments will be too difficult for wheeled robots to navigate, so his firm’s delivery drone has legs instead and resembles a dog. He may disagree with Dr Teller on the best way to set about it, but Mr Jambou has a very similar vision for fast, cheap drone delivery. For example, he imagines people renting rather than buying clothes, tools and other household items, dispatched by drone from a neighbourhood depot when needed.

Dr Teller, for his part, is confident that the technical and safety obstacles to flying delivery drones can be overcome. But it will be a gradual process involving “lots of data and demonstration” to satisfy regulators. “The magical elf won’t change the world unless it can go beyond visual line-of-sight, fly over people and have a small number of operators responsible for a large number of vehicles,” he says, none of which is allowed under current regulations. Google is working on making its drones resilient to the failure of a single rotor, battery or motor, the loss of GPS coverage and other potential problems. “We are building up evidence that we can do this safely,” he says. That will take a while, but Google expects its “moonshots” to take up to a decade to pay off. Work on Project Wing began in 2012.

The disagreement over the viability of delivery drones, then, is mostly a matter of timing. For companies that wish to put drones to work now, delivery is not a good bet. But for logistics companies it makes sense to start exploring the possibilities. The end result may well be a hybrid system of delivery trucks that arrive in a neighbourhood and disgorge flying and wheeled drones.

Deliveries are just one of the proposed uses of drones that seem speculative or impractical now but may become significant in future. Facebook, like Google and Amazon, is also investing in drones, but not for delivery: instead its drone, called Aquila, is a huge solar-powered machine intended as a communications relay, to extend internet access to parts of the world that lack connectivity. This will have health and educational benefits, the social-media giant says, but will also help it sign up more users. Aquila made its first test flight in June 2016. Facebook's boss, Mark Zuckerberg, explained in a blog post afterwards that his goal is "a fleet of Aquilas flying together at 60,000 feet, communicating with each other with lasers and staying aloft for months at a time", beaming internet access over wide areas.

Making all this work is a lofty goal. In November it emerged that the prototype Aquila had been substantially damaged on landing, triggering an investigation by flight-safety inspectors. And getting permission to fly such aircraft over any populated areas will not be easy. In January Google scrapped its own high-altitude communications-relay drone, Titan.

Dr Teller says that Google now sees more promise for extending internet access in high-altitude balloons; they are easier to keep airborne and much more lightly regulated than drones. Military drones such as the Global Hawk can already act as telecoms relays, so that part of the technology is proven; the challenge is to harness solar power to keep drones aloft for weeks or months, not just a day or two. Large, lightweight UAVs can

theoretically use solar power to remain in the air for weeks at a time; a prototype Zephyr drone, built by Airbus, Europe's aviation giant, stayed aloft for 14 days during a test flight in 2010.

High-altitude drones have also been proposed as a way to generate electricity, because strong winds blow more reliably well above the ground. Known as wind drones or energy kites, such drones are tethered so that cables can deliver the electricity back to the ground. Makani, a startup acquired by Google in 2013, reckons a single energy kite can generate 50% more electricity than a single wind turbine while using only 10% of the materials. Each Makani drone, which resembles a wing with eight propellers, weighs 11 tonnes, compared with about 100 tonnes for a comparable 600kW turbine. This approach is being pursued by other firms too, including Ampyx Power and Kite Power Systems, both backed by E.ON, a German utility. Tethered drones on a smaller scale are also being considered for indoor use in warehouses, where they might help with stocktaking. Flying indoors neatly sidesteps many regulatory problems, and supplying power via tethers does away with the need for recharging. But GPS cannot be used for positioning.

At the lowest end of the spectrum are insect-like drones, just a few centimetres across, that could be used for surveillance inside buildings, search and rescue, or even pollinating plants. Building very small drones is hard because the technology used in larger drones cannot simply be scaled down; different approaches are needed. In a paper published in February in the journal *Chem*, Japanese researchers explained how insect-sized drones covered in hairs coated with a special gel picked up pollen from one plant and deposited it on another. They concluded that robotic pollinators might offer a remedy for the decline in honeybee populations.

Perhaps the most far-out proposal to date is to use drones to carry human passengers in self-flying taxis. This is harder than using drones for package

delivery, because it raises safety concerns for people in the air, not just on the ground. EHang, a Chinese drone firm, hopes to test its one-person drone, which resembles a giant quadcopter with a passenger compartment, in Dubai in July. Other companies, including Airbus, Uber and Kitty Hawk, have proposed similar “flying car” drones. Dario Floreano, a robotics professor at the Swiss Federal Institute of Technology (see next article), has been thinking about passenger drones as part of the European Union’s “myCopter” project. Packages, he says, can withstand sudden accelerations during flight that humans cannot, which makes path-planning and obstacle avoidance more difficult. And the limited energy density of batteries may restrict the range of passenger drones to intra-city hops.

It is a big leap from today’s drones to these sorts of uses. Trying to imagine how drones will evolve, and the uses to which they will be put, is a bit like trying to forecast the evolution of computing in the 1960s or mobile phones in the 1980s. Their potential as business tools was clear at the time, but the technology developed in unexpected ways. The same will surely be true of drones. ■



未来应用

无人机能送货吗？

对货运无人机的等待可能要长于预期

无人机公司在建筑、检验或农业等领域追求的商业应用，与商业无人机的公众印象之间存在着显著的差异。媒体报道几乎全都是一个特定的应用：送货。运送包裹、披萨饼和其他物品的试验激起了人们对于空中遍布着往返运送包裹的无人机的想象。然而，虽然运输和物流公司对无人机感兴趣，许多无人机公司对送货的热情却不高。“这不是我们近期要考虑的。”大疆公司的徐华滨说。

谷歌半秘密研究实验室X的老板阿斯特罗·泰勒（Astro Teller）是少数收到过无人机送货的幸运儿之一。此次送货是去年9月，谷歌无人机送货项目Project Wing在弗吉尼亚进行测试时完成的。当时所用的机器形状五花八门：有些是“坐式”，可以直立起来并悬停；有些则是固定翼再加上类似于四翼直升机的垂直轴旋翼。这两种设计将固定翼飞机的高效长距离飞行的优点与多旋翼飞机的悬停和垂直起降结合起来。在交付包裹时，无人机实际上并没有落地，而是悬在接收者所在位置的上空，用绞绳把货物放下来。给泰勒送的是一个新鲜的墨西哥卷饼。

他说，拿到无人机送来的东西确实“有点神奇”，并开始发表对无人机送货的激情演说。想象一下，一个魔法精灵可以在一两分钟内拿来任何你所要的东西，只要它能塞进一个面包盒。你再也不用担心外出时要带什么，也用不着在家里囤积电池或易腐食品以备不时之需。如果那些不常用的东西可以召之即来，你甚至根本就不需要拥有它们。泰勒说，快速无人机送货可能由此加速从所有权转向“共享经济”使用权的趋势。他声称送货无人机可以比大型运输卡车更快、更安静、更环保。Project Wing现在每天都要进行实验飞行。

与送货无人机关系最密切的技术巨头是亚马逊。当它的老板杰夫·贝佐斯（Jeff Bezos）在2013年12月的《60分钟》电视节目上公布无人机计划时，

人们还普遍认为这是个噱头。但亚马逊是很认真的：去年12月它首次试验送货给英国剑桥附近的一位客户——“从下单到送货共用了13分钟。”亚马逊公司无人机项目的负责人古尔·金姆齐（Gur Kimchi）说。2017年3月，亚马逊在美国棕榈泉举行的一次会议上首次演示了送货。和谷歌一样，亚马逊正在评估一系列不同的设计，所有设计都需要无人机把包裹放到收件人的花园或后院的某个目标物上。DHL和UPS等物流公司以及一些创业公司也在关注无人机送货。

但是，大规模无人机送货要想成为现实，还必须克服许多技术和监管障碍，包括确保无人机不会坠落并造成伤害，在出现问题时能够安全着陆，并防止与电线、树木和其他飞机碰撞。此外，小型无人机承载能力有限；不是每个人都有花园或后院；交付要求超视距自主操作，而这需要特别许可。所以至少到目前为止，很多无人机公司都避开这一领域。徐华滨说：“这很有挑战性，我们不想对交付不了的东西作出承诺。”亚当·布莱（Adam Bry）曾在Project Wing工作，之后离职创办了Skydio。他说：“送货把所有这些困难的问题都绑在了一起。”他认为解决这些问题可能需要十年时间。

无人机送货可能有一个更有意义的用途，那就是将医疗用品运送到陆路难以到达的偏远地区。这已经发生了。由谷歌、SpaceX、波音和NASA的老员工组建的美国创业公司Zipline从2016年10月开始使用固定翼无人机向卢旺达农村提供医疗用品。该公司与卢旺达政府达成协议，从两个基地向21个输血诊所提供血液制品，其中第一个基地已经为五个诊所提供了服务。Zipline无人机充电一次可飞行150公里，并可在雨中及风速高达每小时30公里的情况下工作。它们使用弹射器发射，飞行高度低于150米，并用降落伞投放重1.5公斤的货物包裹。

要开展这项服务，就要将最佳路线告诉自主飞行的飞机，与军方和政府协调，培训诊所工作人员接收货物，并让沿线社区放心。这一切是真的在经济上可行，还是仅仅是热爱科技的卢旺达政府的噱头，尚不得而知。但是，该公司正在与其他国家的政府进行关于提供类似服务的沟通，重点关注城市以外的医疗递送。它希望改变公众对“无人机”这个词的看法。

Zipline的贾斯汀·汉密尔顿（Justin Hamilton）说，公司的一名工程师曾经告诉他，自己以前造的是投掷炸弹的无人机，“现在他造的是投放血液的无人机了。”

其他创业公司表示，在城市中用无人机送货已经成为可能——但使用的是在地上移动而非空中飞行的无人机。总部设在爱沙尼亚的Starship Technologies公司和位于加州的Dispatch公司都开发了手提箱大小的轮式无人机，在人行道上颠簸着做小范围送货。Starship的无人机正在世界各地的几个城市进行测试，Dispatch则即将在旧金山湾区开始测试。两家公司都使用“部分自治”模式，这意味着它们的无人机可以在部分路线或全程接受远程操控。无人机接近目的地时，收件人会在智能手机上收到提示；到达后，收件人可以用手机打开一个可锁定的货舱来收取货物。

如果有人把无人机偷走了怎么办？Dispatch的斯塔夫·布朗（Stav Braun）说，任何试图偷走它的人“只是偷走了一个追踪器”。她说，更大的问题在于确保机器人有礼貌，人们在它身边会感到安全。不过到目前为止，反响都还不错。

| 即时满足

法国送货无人机创业公司Unsupervised.ai的克莱芒·让布（Clement Jambou）认为，轮式机器人难以应付城市环境中的台阶和路沿，所以他的公司的送货无人机有腿，看起来就像一只狗。让布未必同意泰勒关于最佳送货方式的看法，但对于快速、廉价的无人机送货前景却所见略同。例如，他想象人们会租借而不是购买衣物、工具和其他家庭用品，无人机会在需要时从临近的仓库里为他们发货。

泰勒博士则对于克服飞行送货无人机的技术和安全保障信心满满。但这将是一个渐进的过程，涉及“大量数据和演示”以满足监管机构的要求。他说：“这个魔法小精灵不会改变世界，除非它能超越视距，在人们头顶上方飞过，并让少数操作员负责大量飞行器。”而现行规定下，这些都不被允许。谷歌正在努力使其无人机能够克服单个旋翼、电池或电机故障、失去GPS信号等潜在问题。“我们正在积累证据，证明我们能够安全地做这件

事。”他说。这需要一段时间，但谷歌预计其“登月计划”需要十年才能得到回报。Project Wing的工作始于2012年。

因此，对无人机送货可行性的分歧主要是时间问题。对于那些希望让无人机现在就服役的公司而言，送货不是一个好的赌注。但对于物流公司来说，开始探索这种可能性是有意义的。最终的结果很可能是一个混合系统：送货卡车开到一个社区附近，然后分发出飞行和轮式无人机。

有些无人机应用目前看似投机或不切实际，但未来可能变得重要，送货就是其中一种。和谷歌和亚马逊一样，Facebook也投资于无人机，但不是为了送货：它名为“Aquila”的无人机是一个由太阳能供电的巨大机器，将作为通信中继站，将互联网提供给世界上尚未通网的地方。这家社交媒体巨头表示，这将有益于健康和教育，也能为Facebook吸引更多新用户。Aquila于2016年6月首次试飞。Facebook的老板马克·扎克伯格事后在一篇博文中解释说，他的目标是“一队Aquila飞行在六万英尺的高空，相互之间使用激光通信，一次可飞行数月”，为广大地区发射互联网连接。

让这一切变成现实是一个崇高的目标。11月，Aquila原型在着陆时严重损坏，招致飞行安全检查员的调查。要获得许可在任何人口稠密地区放飞这种飞行器也非易事。谷歌于1月份放弃了自己的高空通信中继无人机“Titan”。

泰勒称，谷歌如今认为通过高空气球扩展互联网接入更有希望：它们更容易保持飞行，监管也比无人机宽松很多。“全球鹰”这样的军用无人机已经可以充当电信中继站，所以这部分技术已得到证明。挑战在于利用太阳能来保持无人机飞行数周或数月，而不仅仅是一两天。庞大而轻量的无人机在理论上可以使用太阳能一次滞空数周。2010年，欧洲航空巨头空中客车公司建造的Zephyr无人机原型在一次试飞时在空中停留了14天。

也有人提出使用高空无人机来发电，因为高空的强风更为可靠。这种无人机被称为风力无人机或电力风筝，连有系索以便电缆将电力送回地面。Makani是谷歌于2013年收购的一家创业公司，它估算，一个电力风筝的发

电量比一个风力涡轮多50%，但使用的材料仅为后者的10%。每个Makani无人机有八个螺旋桨，重11吨，而同样的600千瓦涡轮机则重约100吨。其他公司也在追求这种方法，包括Ampyx Power和Kite Power Systems，两家公司都得到了德国公用事业公司E.ON的支持。还有人考虑将较小的有线无人机用于仓库中的室内应用，比如用它们来帮助盘点。室内飞行漂亮地回避了许多监管问题，且通过系绳供电免除了充电的需求，不过就不能用GPS来定位了。

整个无人机谱系最低端的是昆虫般的无人机，只有几厘米大小，可用于建筑物内的监视、搜救甚至为植物授粉。制作非常小的无人机并非易事，因为大型无人机使用的技术并不能简单地按比例缩小，而是需要不同的手段。日本研究人员2月份在《Chem》杂志上发表了一篇论文，文中解释了昆虫大小、表面覆盖毛发（毛发上涂有一种特殊的凝胶）的无人机如何从一棵植物中采集花粉再投放到另一棵植物上。他们得出结论称，传粉机器人也许可以为蜜蜂数量的减少提供一种补救措施。

也许迄今为止最奇怪的提议是把无人机作为自驾空中出租车来运送乘客。这比使用无人机递送包裹更困难，因为除了地面人员的安全，它还引发了空中人员的安全问题。中国无人机公司亿航希望7月份在迪拜测试其单人无人机，这个机器像是一个带座舱的巨型四翼直升机。其他公司，包括空中客车、优步和Kitty Hawk都提出了类似的“飞行车”无人机设想。瑞士联邦理工学院的机器人学教授达里奥·弗洛雷诺（Dario Floreano）一直在考虑将载客无人机作为欧盟“myCopter”项目的一部分。他说，包裹可以承受人类所不能承受的飞行时突然加速，这使得规划路径和避让障碍的任务变得更加艰巨。电池能量密度有限，可能会将载客无人机的运作范围限制在城市内。

从今天的无人机到此类用途还需要一个巨大的飞跃。要想象无人机将如何演变、将会有什么用途，就有点像是在20世纪60年代预测计算能力的演化，或是在20世纪80年代预测手机的变化。它们作为商业工具的潜力在当时已经很清楚，但技术的发展却出乎意料。无人机的发展必定也是如此。





Commercial applications

Seeing is believing

Today's drones are mostly flying cameras. They are already being put to a wide range of business uses

PHOENIX DRONE SERVICES, operating from a business park on the outskirts of Phoenix, Arizona, is typical of the small firms that have sprung up in recent years to pursue the commercial opportunities around drones. Its founders, Mark Yori and Brian Deatherage, started off by building radio-controlled planes. To stream live video, they modified a baby monitor and attached its camera to a fixed-wing drone. These were the days of “crash, smash, rebuild and try again”, Mr Deatherage recalls. Then in 2011 they used a drone-mounted smartphone to take some pictures, for which they were paid \$200. “That’s a business,” Mr Yori concluded, and their company was born, one of the first permitted to operate drones commercially under a “section 333 exemption” granted by the Federal Aviation Administration.

In the company’s offices, fixed-wing and multirotor drones of various shapes and sizes hang on the walls like hunting trophies. A technician surrounded by tools and components tends to a half-built drone in a workshop area; a black DJI hexacopter sits on a table, poised like some giant insect. For years Mr Deatherage and Mr Yori built their own drones, and still use custom-built aircraft for some types of work. “In the beginning you had to be able to build and repair your own aircraft,” says Mr Deatherage, who has a computing degree and taught himself how to use the various tools to process the data from his drones.

Mr Yori likens the fast-moving drone business to surfing: “You always have to be ready to catch the next wave,” he says. There have already been several waves of enthusiasm for drones, as various industries have woken up to their potential and small firms have rushed to meet their needs. The

introduction of the “part 107” rules in America last year has removed the previously formidable barrier to entry for commercial-drone operators. The industry is now looking for the most promising applications and trying to gauge how the market will evolve.

The first commercial use of drones (and still their main use for consumers) was to act as flying cameras. Over the past 150 years cameras have changed shape from bulky wood-and-brass contraptions to handheld devices and then smartphones. In many ways drones are the logical next step in their evolution. It is telling that GoPro, a company known for its indestructible action cameras, recently launched its first drone; and that DJI, the dominant maker of consumer drones, has acquired a majority stake in Hasselblad, an iconic Swedish camera firm. Using drones for photography is much cheaper than using manned helicopters. Aerial shots have proliferated on television in recent years, and are also popular with property agents and for dramatic wedding videos.

| *Eye in the sky*

Paul Xu of DJI lists photography as one of five areas of opportunity for commercial drones, along with agriculture, construction, inspection, and public safety and other civil-government uses. Once you have a flying camera, there are lots of things you can do with it. Agriculture, and measuring the health of crops in particular, was identified early on as a promising market for commercial drones. Crop health can be assessed by taking pictures using special multispectral cameras which “see” more than the human eye. By measuring the relative intensity of colour in particular frequency bands, they can identify undernourished or diseased crops. This can be done by satellite, or by sending people into fields with clipboards, but drones can do it more cheaply. A GPS-equipped tractor can then precisely spray water, fertiliser or pesticides only where needed, increasing yields and reducing chemical run-off.

In a report published in 2013 the Association for Unmanned Vehicle Systems International (AUVSI), an industry body, identified precision agriculture as by far the most promising market for commercial drones. But enthusiasm for drones in agriculture has cooled lately. In part, that is because at the time of the AUVSI report most civilian drones were of the fixed-wing variety, ideally suited to flying over large areas; the rapid progress made since then by multirotor drones, which have a shorter range but can hover, opened up other markets that are now seen as more promising.

Encouraging farmers to adopt drones also proved harder than expected, notes Chris Anderson of 3D Robotics. The agricultural use of drones sounds good in theory—feed the world, save the planet—but is difficult in practice. The market is very fragmented and conservative, with many subsidies and distortions, and some of the social goods that flow from using drones, such as reducing run-off of chemicals, do not benefit farmers directly. The agricultural market “is littered with struggling technology companies that have tried to break in”, says Jonathan Downey of Airware.

Mr Anderson believes that the most immediate opportunity lies in construction and related industries. Most big construction projects go way over budget and end in a lawsuit, he says. Mistakes made early on in a project may not be noticed until much later, and cost time and money to rectify. Buildings are designed in a flawless digital environment but must be constructed in the much messier real world. “It’s all an information problem,” says Mr Anderson. So the industry has been pursuing the idea of “reality capture”, using technology to measure buildings precisely during construction and track the use of raw materials on site to ensure that everything is going according to plan. Drones are ideally suited to the task. Thousands of aerial photographs are crunched into a 3D site model, accurate to within a few centimetres, called a “point cloud”, which can be compared with the digital model of the building. And safety worries that

hamper the use of drones in other fields are kept to a minimum because construction sites are closed areas, workers wear hard hats, and drones fly within line of sight.

Andrew Kahler of John Deere, a maker of agricultural and construction machinery, explains how drones can also streamline the process of grading—preparing the ground for constructing a building, road or railway. This involves measuring the original topography, which by conventional methods might take several weeks for a large site; using bulldozers and other equipment to move large quantities of earth; then “fine grading” the site to within an inch or two of the desired final shape. The great benefit of drones, says Mr Kahler, is that they can carry out a topographic survey in half an hour, and the 3D model is ready the next day. That makes it possible to resurvey the site frequently and make any necessary changes. Mr Kahler’s company recently struck a partnership with Kespry, a startup, to provide drones and related software and services.

| *Keep away from the cliff edge*

Drones are also useful farther up the construction supply chain, in mining and aggregates, says George Mathew, Kespry’s boss. Working out how much material is sitting in a stockpile in a mine or quarry usually involves taking a few dozen measurements with manual surveying equipment and then calculating the volume. A drone can measure the volume of dozens of stockpiles in a single flight, taking thousands of measurements that are turned into an accurate point cloud within an hour. As well as being far quicker and more accurate, it is also much safer. Falling off stockpiles is one of the industry’s biggest occupational hazards. Using drones to survey quarries and building sites also means human surveyors do not need to venture close to dangerous sheer drops.

Such is the interest in drones, says Mr Kahler, that he is asked about them at every site he visits. Customers are “ready and willing to jump into this

technology”, he says. Sarah Hodges of Autodesk, which makes software used to design and model buildings, notes that drones are making it possible to digitise the construction industry, which has been relatively slow to adopt new technology. With a complex building like a hospital, being able to check that plumbing, heating and electrical systems are being installed correctly “is really transforming—it’s eliminating a lot of errors”. In China, she says, drones are being flown over building sites at night (which current American rules forbid) to measure progress made during the previous day and ensure that everything is going precisely to plan. Autodesk and others are also starting to use virtual reality and augmented reality to overlay digital models with real-world views.

Drones are attracting interest in a related field, too: the inspection of buildings and other infrastructure, such as pipelines, wind turbines, electrical pylons, solar farms and offshore platforms. At the moment, inspecting a roof for storm damage or checking the state of an electrical pylon involves sending someone up a ladder, which can be dangerous. “We are working with a lot of power companies,” says Mr Xu of DJI. His company has developed the Matrice 200, a drone specially equipped for use in harsh environments by adding features like backup batteries and GPS systems, magnetic shielding and weatherproofing.

But for utilities and other large companies to make the most of drones, they need to be able to integrate them smoothly with their existing computer systems and workflows. A single drone flight can generate as much as 100 gigabytes of data, says Anil Nanduri of Intel. Airware, which is working with large insurance companies in Europe and America, has developed a system that handles the whole process. The insurance company specifies what data it wants, and in what format, and Airware’s software generates a suitable flight plan. This is sent to an operator who uploads it into the drone, which gathers the required data completely autonomously. The results are then sent back, converted into the form needed by the claims

assessor and a summary is delivered into the insurance company's systems. What makes the insurance industry particularly attractive, says Mr Downey of Airware, is that it is highly concentrated: "By working with the top ten players you can target a pretty big proportion of the market."

Inspection by drone will get even better with further automation, says Mr Xu. Some dream of "drone in a box" systems, where drones sit charging in weatherproof boxes in remote areas, popping out when needed to gather data entirely autonomously. The use of machine-learning systems to identify anomalies could automate the process even further. Kespry, which is also targeting the inspection and insurance market, has built a machine-learning system that can count hail strikes on a roof. "It's mind-blowing for people in property and casualty insurance," says Mr Mathew.

After a flood or an earthquake, drones are already used in search-and-rescue operations to sweep large areas for people who need help. By enabling relief workers to see the bigger picture, they allow relief efforts to be co-ordinated more effectively. After flash floods in Chennai, India, in December 2015, for example, the police used drones to locate and rescue around 200 people. A trial carried out in 2016 by Donegal Mountain Rescue in Ireland found that a drone could sweep an area for a missing person more than five times faster than a ground-based team of rescuers. In February four skiers in British Columbia, who got lost and ended up in the dark, were spotted and rescued with the help of an infra-red camera mounted on a DJI Matrice drone.

For police use, drones are a cheaper and quieter alternative to helicopters for monitoring crowds and can be used to create detailed 3D models to help investigators of traffic accidents. Journalists and environmental groups are also experimenting with drone-based photography. Fixed-wing drones monitor animal populations and detect and deter poachers in Kenya, Namibia, South Africa, Tanzania, Zambia and Zimbabwe; multirotor drones

keep an eye out for sharks off Australian beaches.

As drones expand into all these areas, what shape will the industry take? Some drone startups took a “vertical” approach, focusing on specific industries and creating integrated drone hardware, software and services for particular applications, as Kespry does in mining. Others, like Airware, bet that hardware from different makers would become standardised around a single drone operating system that would run on a wide range of designs from different vendors, just as Google’s Android operating system powers most of the world’s smartphones. Some companies focused on making specific components, such as sensors, complete drone airframes, or software tools to analyse data from drones.

For the moment the commercial drone industry does not look remotely like the smartphone industry; instead, it is a mirror image of it. DJI so dominates the hardware side that its on-board software has emerged as the industry’s main platform. The leading software platform for drones thus belongs to a single company and is tied to its own hardware; it is what the smartphone industry would look like if Apple’s market share were 80% rather than 20%. An equivalent of Android for drones does exist—a free, open-source platform called Dronecode, used by 3D Robotics, Yuneec, Intel, Parrot and others—but DJI’s platform is more widely used.

Once it became apparent that DJI’s hardware and software was emerging as the standard, many drone companies switched their focus to building enterprise-grade software and services for specific industries—an area that DJI seems happy to leave to others, given that some companies might prefer not to hand over their data to a Chinese company. For software providers the vertical model is winning, as startups target clients in particular industries.

| *Start here*

But how, in practice, will companies adopt drones? Initially, they may choose to pay drone-services companies to work for them on a job-by-job basis. Matchmaking services like Measure, DroneBase, Fairfleet and Airstoc have already sprung up to connect companies that want to get a particular task done by drones with small firms and individuals who can do it for them. DJI has a stake in DroneBase, and some makers of drone software, including Airware and DroneDeploy, operate similar services. But this may just be an interim solution. “Companies usually want to start by hiring a service provider,” says Mr Downey, “and then they see how easy it is, and realise they can do it themselves.”

Drone companies, for their part, have been forming partnerships with incumbent suppliers, notably in the construction industry, which already have access to a large customer base. Hence partnerships have been formed (many of them underpinned by an equity stake) between Kespry and John Deere, 3D Robotics and Autodesk, Airware and Caterpillar, and Skycatch and Komatsu.

Mr Xu of DJI reckons that more needs to be done to promote growth in the industry over the next five to ten years, so his company is fostering insurance, repair and financing services for drones that corporate customers are likely to want. With full automation some years away, it is also encouraging the training of drone operators. “We are transforming this from a hobby to a profession,” says Mr Xu. So far DJI’s training schemes, launched in June 2016 and outsourced to third parties, are available only in China. Each month 500-600 people are certified for particular kinds of drone operation, such as photography, pesticide spraying or infrastructure inspection. The company is also trying to assist startups that act as “UAV systems integrators”, helping companies in particular industries integrate drones into their business.

Thus many overlapping models and initiatives are competing to shape the future of the drone business. Mr Downey thinks that consolidation over the next five years will leave a couple of dominant providers in each industry. But in essence, all the commercial applications being pursued today use drones to gather data. As the machines become more capable, they will start moving things around, which will give rise to a vast range of new uses. ■



商业应用

眼见为实

今天的无人机大多是飞行的摄像机，已被用于广泛的商业用途

近年来，追逐无人机商业机遇的小公司迅速涌现，凤凰城无人机服务公司（Phoenix Drone Services）就是这样一个典型。这家公司坐落于亚利桑那州凤凰城郊区的一个商业园区内。创始人马克·约里（Mark Yori）和布赖恩·迪塞里奇（Brian Deatherage）最初制作无线遥控飞机。为拍摄视频直播，他们改造了一台婴儿监视器，将它的摄像头安装到一架固定翼无人机上。那是不断“坠毁、摔坏、改造、再飞”的日子，迪塞里奇回忆道。2011年，他们用无人机搭载的智能手机拍摄了一些照片，拿到了200美元的报酬。约里得出结论：“这是门生意啊。”他们的公司就这样诞生了，并成为了首批获得联邦航空管理局授予“第333条豁免权”而可以开展无人机商业运作的公司之一。

在这家公司的办公室里，形状和大小各异的固定翼及多旋翼无人机像狩猎战利品一样悬挂在墙上。在一个加工区内，被工具和零件环绕着的一位技师正在拾掇一架无人机的半成品。桌上摆放着一台黑色的大疆六翼无人机，好似一只巨型昆虫。多年来约里和迪塞里奇自己制造无人机，而在某些类型的任务里仍使用订制的飞行器。“一开始你得能够制造和修理自己的飞行器。”迪塞里奇说。他持有计算机学位，自学如何用各种计算工具来处理无人机收集到的数据。

约里将迅速发展的无人机产业比作冲浪：“你永远都要准备好迎接下一个浪头。”随着各行各业纷纷认识到无人机的潜力，小企业争先恐后地迎合无人机发展的需求，无人机领域已经出现过几轮热潮。美国去年颁布的“第107部”法规破除了商用无人机巨大的入行门槛。该产业如今正在寻找最有前途的应用，并试图研判市场将如何演变。

无人机的首个商业用途是充当会飞的相机（到现在为止仍是无人机在消费者中的主要用途）。过去150年里，照相机的外形从木头和黄铜制成的笨

重设备演变为手持设备，再演变为智能手机。从很多方面来看，无人机是照相机进化过程中合情合理的下一步。有几个例子很说明问题。一个是以生产牢固的运动相机闻名的GoPro公司最近推出了第一款无人机。另一个是消费无人机领域里最大的制造商大疆创新科技公司已经成为瑞典著名相机生产商哈苏（Hasselblad）的最大股东。用无人机摄影比使用有人驾驶的直升机便宜得多。近年来，电视上的航拍镜头大增，在房产广告和一些声势浩大的婚礼视频中也很常见。

| 天空中的眼睛

大疆的徐华滨把摄影列为商用无人机的五大机会领域之一，其余为农业、建筑业、检验、公共安全等民用和政府用途。一旦你拥有了一台会飞的相机，就可以用它来做很多事。农业，尤其是检查谷物的健康状况，此前已被认为是商用无人机一个充满前景的市场。使用能比人眼“看到”更多东西的特殊多光谱相机可以评估作物的健康状况。这些相机可以测量特定光谱频段的色彩的相对强度，以识别营养不良或遭受病害的作物。用人造卫星也可以做到，还可以派人拿着书写板到田里检查，但使用无人机要便宜得多。检查完毕后，装有GPS导航系统的拖拉机可以在需要的位置精确地喷洒洒水、肥料或杀虫剂，从而增加产出，同时减少化学品径流。

2013年，行业组织国际无人载具系统协会（AUVSI）发表的一份报告认为，精细农业是迄今为止最具潜力的商用无人机市场。但最近人们对农用无人机的热情却冷却了下来。在某种程度上，这是因为上述报告发布时，大部分民用无人机都属于固定翼这一大类，非常适合大面积飞行，但之后航程更短但能悬停的多旋翼无人机快速发展，打开了如今人们眼中更具潜力的新市场。

3D Robotics公司的克里斯·安德森（Chris Anderson）指出，鼓励农民采用无人机也比预期的要难。无人机的农业应用在理论上听起来很棒——供养人类、拯救地球——但实践起来很难。这一市场非常零碎且保守，又有很多补贴和扭曲，而且使用无人机的某些社会益处，比如减少化学品径流，并不会直接造福农民。农业市场“到处都是苦苦挣扎的技术企业，它们努力想要取得突破”，Airware公司的乔纳森·唐尼（Jonathan

Downey) 说。

安德森相信最触手可及的机遇在于建筑及相关产业。他说，大型建筑项目大多会严重超支，然后以打官司收场。在项目初期犯下的错误可能要到很后面才被注意到，而纠正起来又费钱耗时。建筑都是在零失误的数字环境里设计的，但却必须在一个混乱得多的真实世界里建造。“这完全是信息问题。”安德森说。因此，这个行业一直在追求“实境捕捉”这一目标，在建筑过程中运用技术来精确测量建筑物，并实地追踪原材料的运用，以确保一切都按计划推进。无人机极适合执行这项任务。成千上万张航拍图经分析处理后形成一个叫做“点云”的工地三维模型，误差在几厘米以内，可以和建筑的数字模型做比对。其他领域里阻碍了无人机应用的安全顾虑在这里被降到了最低，因为建筑工地是一个封闭的空间，工人们都戴着安全帽，而无人机只在视线范围内飞行。

农业和建筑机械设备制造商约翰迪尔公司 (John Deere) 的安德鲁·卡勒 (Andrew Kahler) 解释了无人机如何简化“整地”的过程。整地是为建造房子、道路或铁路准备好土地，步骤包括测量原始地形（在一个大型工地用传统方式测量可能需要几周时间）、用推土机等设备移走大量土石，然后进行“精确整地”，使之与计划的最终形状误差仅为一二英寸。卡勒说，无人机最大的好处是能在半小时内完成地形测绘，并在第二天给出三维模型。这样一来，就可以频繁地勘测工地以做出必要的调整。卡勒的公司最近和创业公司 Kespry 达成合作关系，共同提供无人机和相关软件及服务。

| 远离悬崖

在建筑业的供应链上，无人机同样有用，Kespry 的老板乔治·马修 (George Mathew) 说。要弄清楚矿场或采石场里的矿堆中有多少材料，通常需要手动测量仪器做几十次测量，再计算出体积。而一架无人机可以在单次飞行中就测完几十个矿堆的体积，在一小时内把成千上万个测量结果聚合成一个准确的点云模型。除了大大提升速度且更为准确外，这种方法也安全得多。从矿堆上跌落是这个行业最大的职业危害之一。用无人机勘测采石场和建筑工地意味着勘测人员不需要冒险靠近落差巨大的危险地带。

卡勒说，人们对无人机很有兴趣，自己每到一个工地都有人问起无人机的事，客户们“已经准备好也愿意尝试这项技术”。制造建筑设计和建模软件的欧特克公司（Autodesk）的莎拉·霍奇斯（Sarah Hodges）指出，一直以来，建筑这个行业采纳新技术相对较慢，无人机使得向数字化的转变成为可能。能在医院这类综合建筑群里检查管道、暖气和电力系统是否安装正确“是一种真正的革新，消除了大量错误”。她说，在中国，夜间无人机在建筑工地上方飞行（目前在美国是禁止的），以测量前一天取得的进展，并确保方方面面都严格按计划进行。欧特克等公司也开始运用虚拟现实和增强现实技术，在真实景象上叠加数字模型。

无人机在一个相关领域也引发了兴趣：检查建筑和其他基础设施，比如管道、风力涡轮机、电力高压线塔、太阳能发电厂、近海平台，等等。目前，检查屋顶被暴风雨毁坏的严重程度或检查电力高压线塔的状况需要派人爬上梯子，可能有危险。“我们和许多电力公司合作。”大疆的徐华滨说。大疆已经开发出经纬M200（Matrice 200）系列，这种无人机上添加了备用电池、导航、磁屏蔽和防风雨等功能，专门用于严酷的环境。

但是，公用事业公司和其他企业若想最大程度地利用无人机，还需要将它们和现有计算机系统及工作流程无缝融合。单次无人机飞行就会生成多达100GB的数据，英特尔的阿尼尔·南杜里（Anil Nanduri）说。和欧美大型保险公司合作的Airware已经研发了可处理整个流程的系统。保险公司说明自己想要什么数据、什么格式，Airware的软件就会生成一个合适的飞行计划，将它发送给一名操作员，再由操作员上传给无人机，然后无人机会全自动收集所需的数据。随后将结果发送回来，转换成保险人需要的格式，再将概要传送到保险公司的系统中。Airware的唐尼说，保险业特别有吸引力，因为这个行业高度集中：“和前十强企业合作，你就可以锁定相当大的一部分市场。”

自动化程度的提升还会让无人机检验变得更高效率，徐华滨说。一些人设想“盒子中的无人机”系统：无人机会栖息在偏远地区的防风雨盒子内充电，在有需要时会飞出来收集数据，整个过程完全自动化。而利用机器学习来识别异常会增加这一过程的自动化程度。同样进军检验和保险市场的

Kespry已经打造了一个机器学习系统，能够统计一个屋顶遭冰雹击打的次数。“这让做财产和意外保险的人大为震撼。”马修说。

在洪灾或地震发生后，搜救行动中已使用无人机来大范围搜索需要帮助的人。它让救援人员能够看到更大范围里的状况，以便更高效地协调救援行动。比如，2015年12月印度金奈发生洪灾后，警方用无人机找到并营救了近200人。爱尔兰多尼戈尔山间救护团队在2016年开展的一次测试发现，一架无人机在某个区域搜寻一名失踪人士的速度要比地面援救队快五倍。今年2月，加拿大不列颠哥伦比亚省有四名滑雪者迷路，被困在夜晚漆黑的雪地里，最后在一架载有红外线摄像机的大疆经纬无人机的帮助下被找到和救出。

对警方来说，无人机在监控人群时比直升机更安静，成本也更低。它也能用来建造细致的三维模型，帮助调查交通事故。新闻工作者和环保团体也在尝试无人机摄影。在肯尼亚、纳米比亚、南非、坦桑尼亚、赞比亚和津巴布韦，固定翼无人机用于监测动物的数量，搜索并阻遏非法捕猎者。在澳大利亚的海滩附近，多旋翼无人机会监视鲨鱼的行踪。

随着无人机扩张至所有这些领域，无人机产业会发展出怎样的形态？一些无人机创业公司选择“垂直”模式，专注于特定行业，为特定应用创造一体化的无人机硬件、软件和服务，就像Kespry在采矿业里所做的那样。像Airware这类公司则押注不同制造商生产的硬件会围绕某个单一的无人机操作系统变得标准化，该操作系统会运行来自不同供应商千差万别的设计，就像谷歌的安卓操作系统驱动了世界上大部分智能手机那样。有的企业专注于制造特定的部件，比如传感器、完整的无人机机架，或分析无人机生成数据的软件工具。

目前，商用无人机产业看起来和手机产业没有一丁点相似，简直可以说是完全相反。大疆在硬件领域的主导地位使其机载软件成为行业里的主要平台。这样一来，最大的无人机软件平台属于单个公司并与它的硬件相连接。假如苹果公司的市占率是80%而非20%，那么手机产业也会是这副模样。无人机领域里的安卓确实存在：免费开源平台Dronecode。3D

Robotics、昊翔（Yuneec）、英特尔、Parrot等公司都使用该平台。但大疆平台的应用更为广泛。

在大疆的硬件和软件成为行业标准这件事变得明朗后，许多无人机企业都转移了注意力，为特定行业打造企业级软件和服务。考虑到一些企业可能不大愿意将自己的数据交给一家中国公司，大疆似乎乐意将这一块留给别人做。对于软件供应商而言，随着创业公司纷纷瞄准特定行业的客户，垂直模式正在胜出。

| 从这里起步

但是，在实际操作中，企业会采用无人机技术吗？一开始它们可能会选择向无人机服务公司购买按项目计费的服务。Measure、DroneBase、Fairfleet和Airstoc这类中介服务已大量涌现，给那些需要无人机执行特定任务的企业和能完成任务的小公司和个人牵线搭桥。大疆投资了DroneBase，而一些无人机软件制造商，包括Airware和DroneDeploy，也经营此类服务。但这可能只是一种临时解决方案。“企业通常一开始都会雇用一家服务供应商，”唐尼说，“然后它们会发现这有多容易，并意识到它们自己就能做。”

而在无人机企业这一边，它们已经和现有的行业供货商建立了合作关系，尤其是建筑业的供货商。这些供货商已经拥有大型客户基础。Kespry和约翰迪尔、Robotics和Autodesk、Airware和Caterpillar，以及Skycatch和Komatsu就建立了这样的合作关系，其中许多以股权合作为基础。

大疆的徐华滨认为，未来五到十年需要做更多努力来推动无人机产业的发展，所以大疆正在培育保险、维修和金融服务——这应该也是企业客户所乐见的。实现完全自动化还需要几年的时间，所以大疆也在推动无人机操作员培训。“我们正在把一项爱好转变为一个职业。”徐华滨说。大疆于2016年6月推出的外包给第三方的培训项目目前还只限于中国本地。每月有五六百人获得某项无人机操作的资格认证，比如摄影、喷洒杀虫剂，或检验基础设施。该公司还在尝试扶助那些充当“无人机系统整合者”的创业公司，帮助特定行业里的企业将无人机技术整合到自己的业务运作中。

由此可见，许多相互有重叠的模式和方案正在竞相打造无人机业务的未来。唐尼认为，未来五年的行业内整合会使得每个行业只留下两三家主导公司。但从本质上说，目前所追求的所有商业应用都使用无人机来收集数据。而随着这些机器变得更加强大，它们将会开始搬运物品，而这又会带来一大批新鲜的用途。 ■



A tale of two tech hubs

Silicon Valley North

Two of America's most inventive regions are growing closer

WOULD your region care to be the next Silicon Valley? In most of the world's technology hubs, local leaders scramble to say "yes". But ask the question in and around Seattle, the other big tech cluster on America's west coast, and more often than not the answer is "no"—followed by explanations of why the city and its surrounds are different from the San Francisco Bay Area. The truth may be more complex: in recent years the Seattle area has become a complement to the valley. Some even argue that the two regions, though 800 miles (1,300km) apart, are becoming one.

They have similar roots, notes Margaret O'Mara, a historian at the University of Washington (UW). Each grew rapidly during a gold rush in the 19th century. Later both benefited from military spending. Silicon Valley ultimately focused on producing small things, including microprocessors, and Seattle on bigger ones, such as aeroplanes (Boeing was for decades the city's economic anchor). This difference in dimension persists. The valley has plenty of giant firms, but its focus is mainly on startups and smartphones. In contrast, Seattle is still more of a company town, with Amazon and Microsoft, both builders of big data centres, looming large.

That, and the fact that Seattle and its suburbs are less than a fifth the size of Silicon Valley, has created a different business culture. In Seattle, for example, job-hopping is less common, as is swapping full-time employment for the uncertain life of an entrepreneur. Seattle has spawned firms such as Avvo, an online marketplace for legal services, and Zillow, a real-estate site, but the startup scene is underdeveloped. UW is a good gauge: it now has one of America's best computer-science departments but produces nowhere near as many new firms as Stanford University.

Local politics differ, too. Seattleites don't want their city to become like San Francisco, which is dominated by affluent, techie types. Their city council has just approved a new programme requiring property developers to include cheap units in their projects or to pay a fee. The aim is to ensure that Seattle remains America's second-most economically integrated city (as defined by RedFin, a data provider). San Francisco ranks 14th. "In the playground parents don't just talk about the next big thing," says Ed Lazowska, a professor of computer science at UW.

That is one reason, besides nature's attractions, cheaper housing and no state income tax, why exhausted Valleyites flock north. "You get better quality of life for half the cost," says Simon Crosby, co-founder of Bromium, a computer-security firm, who has made the move from California. Bromium is based in Cupertino, also the home of Apple, and he regularly takes the "nerd bird", as flights between the two tech clusters are called (they are full of geeks who live in Seattle and work in the valley). Venture capitalists often make the two-hour commute, too. Most money invested in Seattle startups comes from California; the north-western city only has a handful of VC firms, such as Ignition Partners and the Madrona Venture Group.

Another link between the two cities is cloud computing. Most startups in and around San Francisco run their business on Amazon Web Services, the e-commerce giant's cloud-computing platform. Its momentum is such that some in Silicon Valley have started to fret that it will one day become as dominant as Windows, the operating system made by Microsoft, once was.

For now it is Seattle that is more worried about being dominated by its neighbour to the south. The city hosts nearly 90 engineering offices that firms have opened to find new talent to hire. A third have a Californian parent. John Cook, who co-founded GeekWire, which covers the local tech industry, argued recently that, although the new offices add to Seattle's tech

scene, they had taken “a lot of oxygen” out of the startup ecosystem by hoovering up highly qualified staff. That triggered a debate about the disadvantages of outside investment. Other effects of tech migration are equally contentious: home values have increased by a tenth in the past 12 months, according to Zillow.

Complaints about being overrun by Californians have a long tradition in Seattle, but the risk that the area becomes a Silicon Valley overflow zone preoccupies many. “We have to choose to remain different,” says Tren Griffin, a Microsoft veteran. Chris DeVore, an angel investor who runs the Seattle branch of Techstars, a chain of accelerators, says more needs to be done to grow local startups. “Microsoft and Amazon were a bit of an accident,” he says.

Regardless, Seattle and Silicon Valley are now joined at the hip. The best approach is to make that connection as efficient as possible, says Rich Barton, a serial entrepreneur. He not only started Zillow and Expedia, a giant online travel site, among other Seattle firms, but is a partner at Benchmark, a leading VC firm in the valley. Rather than relying on flights, which are often delayed or cancelled due to bad weather, he says, someone should build a high-speed rail line. Together, he quips, that old west-coast dream, popular again after the election of Donald Trump, would be within reach: “We could form our own country and secede.” ■



技术双城记

硅谷以北

美国最具创造力的两大地区联系日益紧密

你所在的地区希望成为下一个硅谷吗？在全球大部分技术中心，当地的领导人都会争相说“是”。但要是美国西海岸另一个大型技术集群西雅图及其周边问这个问题，答案多半会是“不”，跟着便是一堆解释，讲为什么这座城市及其周边不同于旧金山湾区。而事实可能更加复杂：近年来西雅图地区已经成为硅谷的一个补充。有些人甚至认为，尽管这两个地区相隔1300公里，但正在成为一个整体。

华盛顿大学的历史学家玛格丽特·奥玛拉（Margaret O'Mara）认为，西雅图和硅谷有着相似的起源。二者都是在19世纪淘金热中迅速发展起来，之后又都受益于军费开支。硅谷最后专注于制造微处理器这样的小东西，而西雅图则专注于飞机这样的大家伙（波音几十年来都是该市的经济支柱）。这种规模上的差异如今依然存在。硅谷有很多巨头公司，但它的重点主要是在创业公司和智能手机上。相反，西雅图还是更像个企业城，亚马逊和微软在其中巍然耸立，这两家公司都在建造大型数据中心。

上述特点，连同西雅图及其周边的面积还不到硅谷五分之一这个事实，创造出了另一种商业文化。例如，在西雅图，跳槽不那么常见，也没有很多人会放弃全职工作而选择创业这种充满不确定性的生活。在西雅图诞生了法律服务在线市场Avvo和房地产网站Zillow等公司，但创业公司还不成气候。华盛顿大学是个很好的判断标准：它的计算机科学系在美国位居前列，但产生的新公司数量远远比不上斯坦福大学。

两地的政治环境也不同。西雅图人不希望他们的城市变得像旧金山那样，由富裕的技术型人才掌控。该市议会刚刚通过一项新计划，要求房地产开发商必须将廉价房列入开发项目，否则就要缴纳额外的费用。此举是为了确保西雅图能保持它在全美城市中“经济整合度”第二高的地位。所谓的“经济整合度”排名是由数据供应商RedFin发布【它评估的是一个城市中房价

水平的多样化程度，RedFin认为它关系到一个城市的包容性和经济机遇】，旧金山在其中排名第14位。“在游乐场，父母们不会只谈论下一个科技大事件。”华盛顿大学计算机科学系教授艾德·洛索斯卡（Ed Lazowska）说道。

这就是让筋疲力尽的硅谷人涌向北方的一个原因。除此之外，那里有吸引人的自然环境、较便宜的房价，还不需缴纳州所得税。计算机安全公司Bromium的联合创始人西蒙·克罗斯比（Simon Crosby）刚从加州搬来，他说：“你只要花一半的成本就能得到更高质量的生活。”Bromium的总部位于库比蒂诺（Cupertino），那里也是苹果公司总部的所在地。克罗斯比定期搭乘来往于两大技术中心的航班，即所谓的“技术宅班机”（机上满是住在西雅图、在硅谷上班的技术宅）。风险投资家也常常花上两个小时通勤于两地。西雅图创业公司获得的大部分投资都来自加州；这个西北部城市只有零星几家风投公司，如Ignition Partners和Madrona Venture Group。

这两个城市之间的另一个纽带是云计算。旧金山及其周围的大部分创业公司都利用电子商务巨头亚马逊的云计算平台AWS来经营自己的业务。亚马逊的势头如此锐不可当，有些硅谷公司已经开始担心，有朝一日它会拥有微软的操作系统Windows曾经那般的主导地位。

但就目前而言，还是西雅图更担心自己会受其南方邻居的支配。各种公司在该市开设了近90间工程办公室用来招兵买马，其中有三分之一母公司在加州。约翰·库克（John Cook）是GeekWire的联合创始人，该网站报道当地科技产业的消息。近期他指出，尽管这些新设的办事处壮大了西雅图的科技圈，但它们大肆网罗高素质员工，从创业公司生态系统中抽走了“大量氧气”。这触发了一场关于外部投资缺点的辩论。技术移民的其他影响同样颇具争议：根据Zillow的数据，过去12个月当地住房已经升值了十分之一。

抱怨被加州人占领在西雅图已经是一种传统，但是该地区成为硅谷溢流区的风险仍令很多人担忧。微软老员工特兰·格里芬（Tren Griffin）说：

“我们必须选择保持与众不同。”负责加速器连锁公司Techstars西雅图分部的天使投资人克里斯·德沃尔（Chris DeVore）称，还需要做出更多努力来扶持本地的创业公司。“微软和亚马逊的出现多少有些偶然的成分。”他说道。

无论如何，如今西雅图和硅谷已密不可分。“最好的方式就是让它们之间的联系尽可能高效。”创立了一系列公司的里奇·巴顿（Rich Barton）说。他不但创办了Zillow、大型在线旅行网站Expedia以及其他一些西雅图公司，还是硅谷领先的风投公司Benchmark的合伙人。他说，应该建一条高速铁路，而不是依赖常常因坏天气而延误或取消的航班。他打趣道，我们要是联手，那么特朗普当选后再度风行的旧日西海岸之梦将近在咫尺，“我们可以成立自己的国家，脱离（美利坚）”。■



Economic outlook

The Economist's latest poll of forecasters, June



经济前景

《经济学人》对各机构六月全球经济增长预期的最新调查



Blockchain

Land grab

Tech firms are selling crypto tools to governments

IN THE hills overlooking Tbilisi, Georgia's capital, sits a nondescript building housing rows of humming computer servers. The data centre, operated by the BitFury Group, a technology company, was built to “mine” (cryptographically generate) bitcoin, the digital currency. But now it also uses the technology underlying bitcoin, called the “blockchain”, to help secure Georgian government records. Experts are eyeing the experiment for proof of whether blockchain technology could alter the infrastructure of government everywhere.

While the blockchain originally sought a foothold in financial services, and digital currencies attracted early attention from investors, now interest in using the technology in the public sector is growing. Brian Forde, a blockchain expert at the Massachusetts Institute of Technology, argues that governments will drive its adoption—an ironic twist for something that began as a libertarian counter model to centralised authority. Backers say it can be used for land registries, identity-management systems, health-care records and even elections.

The blockchain and similar distributed ledgers are databases that are not maintained by a single entity, such as a bank or government agency, but collectively by a number of their users. All changes are encrypted in such a way that they cannot be altered or deleted without leaving a record of the data's earlier state. In theory, all sorts of information, from birth records to business transactions, can be baked into a blockchain, creating permanent and secure records which cannot be tampered with, for instance by corrupt officials.

Fans argue that, if properly implemented, distributed ledgers can bring improvements in transparency, efficiency and trust. Naysayers respond that wider adoption may reveal security flaws. It is certainly early days for the blockchain: some compare it to the internet in the early 1990s, so growing pains are sure to follow. And blockchains can always be only part of the solution: no technology can turn crooked leaders straight and keep them, for instance, from feeding in spurious data.

Creating robust standards will also take time. And integrating databases across vast and complex bureaucracies will need huge investment. Yet governments do not seem fazed. According to a recent IBM survey of government leaders (conducted by the Economist Intelligence Unit, our sister company), nine in ten government organisations say they plan to invest in blockchain technology to help manage financial transactions, assets, contracts and regulatory compliance by next year.

Valery Vavilov, BitFury's head, says blockchains are not merely a business opportunity, but a way to change how governments serve their citizens. Born in Latvia, Mr Vavilov watched as his parents "lost everything" after the Soviet Union collapsed. He then spent his early professional life writing software for the new Latvian government. He came to believe that blockchains could become the "foundation to build a trusted, transparent and auditable system".

Elsewhere, Sweden is testing a blockchain-based land registry and Dubai wants distributed ledgers to power its entire government by 2020. The most active early adopters, however, have been former Soviet republics. Estonia, recognised as a pioneer in e-government, has long used blockchain-like technologies to secure health records and undergird its shared government database system, X-Road. Being a young country has its advantages. "It can be much easier to build a digital society if there are no legacy systems and you can start from scratch," says Kaspar Korjus, head of

Estonia's e-residency programme.

With BitFury's help, Georgia's National Agency of Public Registry has recently moved its land registry onto the blockchain. Some 160,000 registrations have already been processed. Thea Tsulukiani, the country's Minister of Justice, believes that the blockchain will mean Georgian citizens can "sleep quietly" when it comes to property rights. The main barrier to introduction, officials say, has not been technical, but educational. Even Ms Tsulukiani did not know what the blockchain was when her deputies first proposed to use the technology. "We want to move slowly in terms of explaining to society, and quickly in terms of implementation," she says.

BitFury has also signed a memorandum of understanding with the government of Ukraine, which wants to become "one of the world's leading blockchain nations". The country's e-governance agency sees the technology as a way to address "historic distrust of government," says Aleksey Vyskub, its deputy head. The agency has plans for all kinds of blockchain-based registries, including of land and businesses. As with most reforms in Ukraine, efforts to launch these projects have faced resistance from the entrenched bureaucracy. Yet, explains Mr Vyskub, the technology's novelty and complexity have provided some cover: "Most officials don't understand what we're doing, so they don't sense the threat." ■



区块链

争夺地盘

科技公司正向政府出售加密工具

在格鲁吉亚的首都第比利斯（Tbilisi），俯瞰全城的山丘上有一座不起眼的建筑物，里面是一排排嗡嗡作响的计算机服务器。这个数据中心专为“挖掘”（即加密生成）比特币这一数字货币而建，由科技公司BitFury集团经营。而现在，BitFury还利用比特币的底层技术“区块链”来为格鲁吉亚政府加密档案。专家们正密切关注该实验，以推断区块链技术能否改变各地政府的基础设施。

区块链最初的目标是立足金融服务业，各种数字货币最初吸引到的也是投资者的关注，但现在，政府部门对使用该技术的兴趣也在增加。麻省理工学院的区块链专家布莱恩·福德（Brian Forde）认为，政府将推动采纳该技术——这一转变颇具讽刺意味，毕竟区块链最初是作为一种反中央集权的自由主义模式而诞生的。支持者表示，这一技术可应用于土地登记、身份管理系统、病例，甚至选举。

区块链及类似的分布式分类帐是一种数据库，并不是由单一实体（如银行或政府机构）维护，而是由多方使用者共同管理。帐上所有变更都经过加密处理，令人无法更改或删除数据而不留下先前状态的痕迹。理论上，从出生记录到商业交易，所有信息都可以写成区块链，创建永久而安全的记录，无法被贪官污吏或其他任何人篡改。

支持者称，假若妥善实施，分布式分类帐能提高透明度和效率，并增强信任。反对者回应说，更广泛地采用这一技术可能会暴露安全漏洞。区块链目前无疑尚处于早期阶段——有人将其比作上世纪90年代初的互联网——因而成长中的阵痛将在所难免。而且区块链永远只是解决方案的一部分：没有任何科技能让不诚实的官员变得正直，也无法保证他们不输入虚假数据。

制定稳健的标准也需要时间。在庞大复杂的官僚体系中整合数据库也将需要巨大的投资。但看起来各国政府并不担忧。据最近IBM对政府官员的一次调查（由我们的姊妹公司经济学人智库主持进行），九成受访政府机构表示计划在明年年底前投资区块链技术，用于辅助管理金融交易、资产、合同和合规事宜。

BitFur的负责人瓦列里·瓦维洛夫（Valery Vavilov）表示，区块链不仅是商机，也会改变政府服务公民的方式。出生于拉脱维亚的瓦维洛夫亲眼目睹父母在苏联解体后“失去了一切”。他在职业生涯之初为拉脱维亚新政府编写软件。他逐渐相信，区块链能够“奠定一个可信、透明且可审计的体系”。

其他地区也在行动。瑞典在测试基于区块链的土地登记系统，迪拜则希望到2020年能利用分布式分类帐支持整个政府系统的管理。不过，该技术最积极的早期采用者是一些前苏联国家。被视为电子政务先驱的爱沙尼亚一直采用类似区块链的技术来保护医疗记录、加强政府的共享数据系统X-Road。年轻国家有其优势。“如果没有遗留系统，一切都可以从头开始，要建立数字化社会就容易得多。”爱沙尼亚“电子公民项目”的负责人卡斯帕·科耶斯（Kaspar Korjus）说道。

在BitFury的协助下，格鲁吉亚国家公共注册局（National Agency of Public Registry）最近把土地登记转移到区块链上进行，到目前已处理了约16万件登记事项。该国司法部长特娅·楚卢基阿尼（Thea Tsulukiani）相信，区块链可以让格鲁吉亚公民在产权问题上“高枕无忧”。官员们表示，一直以来，采用该技术的主要障碍并非技术问题，而是在教育上。她的副手第一次提议使用区块链技术时，连楚卢基阿尼自己也不懂那是什么。她说，“我们希望慢慢向社会大众解释，但在实施上则要尽快。”

乌克兰政府也与BitFury签署了一项谅解备忘录，希望成为“世界领先的区块链国家之一”。该国电子政务局副局长阿列克谢·维斯库布（Aleksey Vyskub）表示，该局已视区块链为解决“传统以来民众对政府不信任”问题的一种手段，并已计划推出各种基于区块链的注册，包括土地及商业登

记。与乌克兰的大多数改革措施一样，启动这些项目的努力受到了根深蒂固的官僚体制的抵制。不过，维斯库布解释道，区块链技术新颖复杂，这在一定程度上提供了掩护：“大多数官员都不懂我们在做什么，所以感觉不到威胁。”■



Schumpeter

General Eclectic

The reign of Jeff Immelt, GE's boss, shows that capital allocation is hellishly difficult

BOSSSES come in all shapes and sizes. One way to categorise them is to split them into two types: polishers and pickers. Polishers put their energy into products, improving and reimagining their design and production in a quest for perfection. Long after Apple had become one of the planet's most valuable firms, its boss, Steve Jobs (who died in 2011), obsessed over "the finish on a piece of metal, the curve of the head of a screw, the shade of blue on a box", writes his biographer, Walter Isaacson.

Pickers, by contrast, are capital allocators, who stand back and decide un sentimentally how the firm should deploy resources. An example of this approach is Jeff Immelt, who runs General Electric (GE), the world's most valuable industrial firm. Mr Immelt's record since taking over in 2001 shows that capital allocation is far harder than you might think.

Most chief executives would say they are more pickers than polishers. The task of creating the iPhone, devising a new drug or honing a manufacturing process is best left to geniuses such as Mr Jobs or to internal experts. By contrast capital allocation happens to a CEO, like it or not. Consider a firm that reinvests 10% of its net worth every year. By their tenth year in charge the CEO's choices about deploying cash—including a decision to just sleepwalk—will explain 60% of the firm's book value.

Taking firm control of the process makes obvious sense. In the 1970s the logic of starving lousy businesses and feeding good ones was spread by management-consulting firms. BCG told firms to split portfolios into four buckets: cash cows worth milking, stars, dogs that should be shot and question-marks. Today the consultancy reckons that businesses shift

between the buckets twice as fast as they did in the 1990s.

Mr Immelt has remade GE partly because he had a tricky inheritance. GE's shares were overvalued, its earnings were inflated by gains from its pension scheme, and it had overexpanded its financial arm, which later blew up during the banking crisis. He has globalised GE: 57% of sales now come from abroad, up from 29% in 2001. And he has loosened up its culture. Its old head office, in Connecticut, sat amid suburbs and golf courses. Its new digs in Boston are next to an art institute.

But the main legacy of Mr Immelt will be as a capital allocator. He has shrunk or sold businesses that are mature or under margin pressure, such as plastics and kitchen appliances, or where GE has no advantage, such as media. He has killed off most of its financial arm. And he has bought in areas with promising growth stories where tech is becoming more important, such as aviation, power systems and medical devices. The scale of change has been huge. Outside the financial arm, looking just at industrial operations, since 2001 GE has traded businesses worth \$126bn, or 167% of the capital employed in its industrial divisions. Counting capital expenditures, too, Mr Immelt has redirected resources worth a colossal 227% of GE's capital base.

The results are less impressive than you might expect. Annual free cashflow from GE's industrial business was around \$10bn in 2001 and the figure has not risen even as its capital employed has increased from below \$30bn to \$75bn (see chart). Cash returns on capital have fallen to about 12%. Partly reflecting this, GE's shares have lagged behind the S&P 500 index over most periods.

Why does a logical strategy, methodically implemented by competent people, not succeed better? Active capital allocation carries a danger: it can be procyclical, magnifying the swings in sentiment that most industries

face. Businesses that are performing well often have profits that are at cyclical highs and that are valued at inflated levels. As Warren Buffett puts it, “What is smart at one price is dumb at another.”

In “The Outsiders”, a cult business book, William Thorndike studies eight bosses whose firms on average have outpaced the S&P 500 by a factor of 20. They may have been obsessed with capital allocation, but they bought into deeply unfashionable things, from decrepit cable-TV networks in rural America (John Malone at TCI), to the makers of Twinkies (Bill Stiritz at Ralston Purina). Bucking accepted wisdom is, however, extraordinarily hard for CEOs of big, iconic firms, who must build a consensus among executives, directors and shareholders.

| *Spit and polish*

The cost of churning capital in predictable ways can be significant. Schumpeter estimates that GE has paid a multiple of 13 times gross operating profits for the businesses it has bought and got 9 times for those it sold. Some nine-tenths of its industrial capital is now comprised of goodwill, or the premium that a firm paid above book value for its acquisitions. A company’s capital expenditure can also be procyclical. For example, in 2010-14 GE ramped up investment in its oil and gas business, at a point when energy prices were high, then cut back after they slumped in 2015.

For businesses in aggregate, and their investors, churning portfolios brings some benefits. Firms must respond to changes in customer tastes and technology. They may be able to boost their market shares for some products, allowing them to raise prices. But it seems unlikely that hyperactive capital allocation greatly enhances wealth overall. Deals are often a zero-sum game. It is impossible for every firm to own only outperforming businesses. And the fees lawyers and bankers charge are a tax on corporate activity that corrodes value.

For Mr Immelt the jury is still out. GE's profits are rising even as its cash flows stall, as it books the gains it expects to make on long-term infrastructure projects and servicing contracts. It has launched a new jet engine, called Leap, and is investing heavily in Predix, an open data platform that it hopes will become an operating base for a host of industrial digital applications. And it is buying new assets at the bottom of the cycle, with a planned merger of its energy business with Baker Hughes, an oil-services firm. Mr Immelt will probably retire soon. His successor will surely come under pressure to undertake another massive reshuffle of what GE owns. Far better now to polish what it has. ■



熊彼特

兼收并蓄的GE

杰夫·伊梅尔特在GE的作为显示资本配置难度骇人

老板各式各样。有一种分类方式将他们分为两类：打磨型和拣选型。打磨型老板将精力倾注到产品中，不断改进和重新设计，力求完美。为苹果公司老板史蒂夫·乔布斯（2011年去世）写传记的作家沃尔特·艾萨克森（Walter Isaacson）写道，苹果早已成为地球上最有价值的公司之一，乔布斯却仍痴迷于“一块金属的光泽、一个螺丝头的曲线弧度、一个盒子的蓝色色调”。

相比之下，拣选型的老板是资本分配者，他们置身事外，审时度势，冷静客观地决定企业的资源配置。杰夫·伊梅尔特（Jeff Immelt）就是这样一个例子，他执掌着世界上最有价值的工业企业通用电气（GE）。伊梅尔特2001年接任后的成绩显示，资本配置可能比我们想象的要困难得多。

大多数首席执行官都会认为，比起打磨者，自己更像是拣选者。创造iPhone、设计新药或完善制造流程的任务最好留给乔布斯这样的天才或公司内部的专家。而资本配置则是首席执行官的份内事，不管他们喜欢与否。假设一家企业每年把10%的净资本用于再投资，到CEO任职的第十个年头，公司账面价值的60%都取决于他们在配置资金方面做出的选择（哪怕他们只是决定按部就班）。

牢牢掌控资金配置的重要性显而易见。经营不善的业务要断奶，经营得当的要多投资，这是20世纪70年代管理咨询公司广为传播的逻辑。过去，波士顿咨询公司（BCG）建议企业将投资组合分到四个篮子里：值得维持的现金牛业务、明星型业务、应当果断抛弃的瘦狗型业务，以及问号型业务。现在，波士顿认为企业在不同篮子之间转换的速度是20世纪90年代的两倍。

伊梅尔特重塑了GE，原因之一是他接过了一个烫手的山芋。当时GE的股

价被高估，盈利因年金计划的收益而虚高，金融部门又扩张过度（后来在银行业危机期间遭到重创）。伊梅尔特把GE打造成了全球化的企业：现在有57%的销售额来自国外，而2001年为29%。他让企业文化变得更轻松，GE在康涅狄格州的旧总部位于郊区，周围都是高尔夫球场，在波士顿的新总部旁边则是一所艺术学院。

但是，伊梅尔特的主要作为是在资本配置方面。他压缩或出售了饱和或面临利润压力的业务（如塑料和厨房电器），或GE不具优势的业务（如媒体）。他放弃了大部分金融业务，引入了增长潜力大、技术重要性高的业务（如航空、电力系统和医疗设备）。GE的转变规模巨大，撇开金融业务只看工业业务的话，2001年以来，GE已经买卖了价值1260亿美元的业务，相当于其工业业务资本的167%。包括资本支出在内，伊梅尔特重新调配过的资源总值巨大，相当于GE基础资本的227%。

但效果可能不像你想象的那么好。2001年，GE工业业务的年度自由现金流约为100亿美元。虽然其投入的资本已从当时的不到300亿美元增至如今的750亿美元，现金流却并未上升（见图表），而资本现金回报率已下降至约12%。GE的股价在大多数时间里已经落后于标准普尔500指数，这在一定程度上反映了现金流的问题。

GE采取的策略合乎逻辑，又有能人有条不紊地执行，为什么没有获得更大的成功呢？积极的资本配置本身就有风险：它可能顺周期进行，放大大多数行业面对的市场情绪波动。业绩好的企业的利润往往处于周期性高点，而且估值虚高。正如沃伦·巴菲特所说：“（在决定收购或回购时）在某一个价格时你是明智的，在另一个价格时你就是愚蠢的。”

威廉·桑代克（William Thorndike）在备受追捧的商业书籍《商界局外人》（The Outsiders）中研究了八位企业老板，他们领导的公司回报率平均高出标准普尔500指数20倍。他们可能执着于资本配置，但收购的业务都相当冷门，从美国农村破旧的有线电视网络（TCI的约翰·马龙）到奶油夹心蛋糕的制造商（普瑞纳的比尔·思特瑞斯）。然而，那些大型标志性公司的CEO要逆普遍接受的观点而动是异常困难的，他们必须在高管、

董事和股东之间建立共识。

| 精打细磨

以可预测的方式来调动资本，成本可能很高。本专栏估计，GE在收购上的花费相当于其总营业利润的13倍，出售业务所得为营业利润的9倍。现在GE约十分之九的工业资本为商誉，即公司为收购而支付的超过账面价值的溢价。一个公司的资本支出也可以顺周期进行。例如在2010至2014年，GE在能源价格高企的时候加大了对石油和天然气业务的投资力度，在2015年价格下滑后又削减了投资规模。

对于企业整体和它们的投资者来说，频繁调整资产组合能带来一些好处：公司必须迎合客户喜好和技术的变化；他们或许能够提高部分产品的市场份额，从而提高价格。但是，过于活跃的资本配置似乎不太可能大幅增加企业的财富总额，买卖交易通常是零和游戏，不可能每家公司都只拥有势头强劲的业务。而且律师和银行家收取的费用是企业活动的一项重负，侵蚀了交易的价值。

伊梅尔特的功过还未有定论。GE已把长期基础设施项目和服务合同的预期收益记入账面，即使现金流动停滞不前，利润也仍在上升。GE推出了新型喷气发动机Leap，还在大力投资开放数据平台Predix，希望它能成为大量工业数字应用的操作基础。GE正在周期底部购入新资产，计划将其能源业务与石油服务公司Baker Hughes合并。伊梅尔特可能很快就会退休，他的继任者一定会受到压力要再度对GE的资产大洗牌，不如现在就对已有业务细细打磨。■



American monetary policy

Check yourself

The Federal Reserve should respond to lower inflation by holding interest rates steady

NO STATEMENT from the Federal Reserve is complete without a promise to make decisions based on the data. In each of the past two years, a souring outlook for the world economy prompted the Fed to delay interest-rate rises. And quite right, too. Yet if the Fed raises rates on June 14th in the face of low inflation, as it has strongly hinted, it would bring into question its commitment both to the data and also to its 2% inflation target.

The central bank has raised rates three times since December 2015 (the latest rise came in March). It is good that monetary policy is a little tighter than it was back then. The unemployment rate, at 4.3%, is lower than at any time since early 2001. A broad range of earnings data show a modest pickup in wage growth. The Fed is right to think that it is better to slow the economy gradually than be forced to bring it to a screeching halt later, if wage and price rises get out of hand. The rate increases to date have been reasonable insurance against an inflationary surge.

But no such surge has yet struck. Unexpectedly low inflation in both March and April has left consumer prices no higher than they were in January. According to the Fed's preferred index, core inflation—that is, excluding volatile food and energy prices—has fallen to 1.5%, down from 1.8% earlier this year. It is now well below the 2% target.

Nor does a surge seem imminent. For a while, Donald Trump's promises to cut taxes and spend freely on infrastructure made higher rates appear all the wiser. But fiscal stimulus looks less likely. Tax cuts are stuck in the legislative queue behind health-care reform, and Mr Trump's administration has tied itself in knots over whether it will increase the

deficit. Meanwhile, the current “infrastructure week” in Washington may generate more headlines than proper plans.

Even so, the Fed is expected to go ahead and raise rates this month. The markets think there is a 90% probability of an increase of 25 basis points (hundredths of a percentage point).

It is possible that more inflation is coming. An economy that is stimulated will eventually overheat. The central bank may believe that low unemployment is about to cause inflation. But the truth is that nobody is sure how far unemployment can fall before prices and wages soar. Not many years ago some rate-setters put this “natural” rate of unemployment at over 6%; the median rate-setter’s estimate is now 4.7%.

The only way to find the labour market’s limits is to feel them out. Falling inflation and middling wage growth both suggest that these limits are some way off, for two possible reasons. First, higher wage growth could yet tempt more of the jobless to seek work (those who are not actively job-hunting do not count as unemployed). The proportion of 25- to 54-year-olds in employment is lower than before the recession, by an amount representing almost 2.4m people. By this measure, which fell in May, joblessness is worse in America than in France, where the overall unemployment rate stands at 9.5%. Second, even the moderate pickup in wage growth to date might encourage firms to invest more, lifting productivity out of the doldrums and dampening inflationary pressure.

| *I like hike*

Jobs growth in America has already slowed from a monthly average of 187,000 in 2016 to 121,000 in the past three months. That is enough to reduce slack in the economy, but only just. Slowing it still further is needless so long as inflation remains quiescent. It makes still less sense when you consider the asymmetry of risks before the Fed. If tighter money

tips the economy into recession, the central bank has only a little bit of room to cut rates before it hits zero. But if inflation rises, it can raise them as much as it likes.

This asymmetry of risks extends to the Fed's credibility. Inflation has been below 2% for 59 of the 63 months since the target was announced in January 2012. Continuing to undershoot the goal would cast more doubt on the central bank's commitment to it than modest overshoots would.

For too long, hawks have made excuses for the persistence of low inflation. The latest is to blame new contracts offering unlimited amounts of mobile data, as if cheaper telecommunications somehow should not count. The Fed should keep its promise to base its decisions on the data, and leave interest rates exactly where they are. ■



美国的货币政策

自己核查好

在通胀水平较低的情况下，美联储应保持利率稳定

美联储的所有声明都会加上一个承诺：会依据数据做决定。过去两年里，前景黯淡的世界经济每年都促使美联储延迟了加息。这么做也确实恰当。然而，假如6月14日美联储不顾当前的低通胀，如之前强烈暗示的那样决定加息，那么它关于数据以及2%的通胀目标的承诺就都难以使人信服了。

自2015年12月以来，美联储已加息三次（最近的一次是在今年3月）。货币政策比那时要稍微收紧一些，这是好事。4.3%的失业率为2001年年初以来的最低水平。一系列薪资数据显示，工资增长状况略有改善。美联储认为，逐步让经济放缓，总比日后工资和价格上涨水平失控、只能猛踩刹车要好。这么想是对的。此前的几次加息便是防范通胀水平激增的合理保障措施。

不过这种激增的状况尚未发生。3月和4月的通胀水平都出人意料地低，消费者价格也并未高过1月的水平。根据美联储较偏爱的一个指标，核心通胀率（一个剔除多变的食品及能源价格的指数）已从今年早些时候的1.8%降至1.5%。眼下，核心通胀的水平远低于2%的目标。

通胀水平激增的状况似乎也并非近在眼前。特朗普减税及大笔投资基建的承诺一度令提高利率显得格外明智。不过不太可能推出财政刺激政策。减税计划继医保改革之后也卡在了立法这一关，而且特朗普政府本身也在是否增加赤字这一点上莫衷一是。与此同时，华盛顿推进的“基建周”爆出的头条新闻可能不少，但是很难推出像样的计划。

即便如此，预计美联储还是会采取行动，于本月上调利率。市场认为加息25个基点（一个基点等于0.01%）的概率达90%。

通胀水平会提升，这是有可能的。经济经过刺激后，终将出现过热的情况。美联储可能相信，处于低位的失业率将会引发通胀。然而事实是，在价格和工资猛增之前，没人能说得准失业率会降到什么程度。就在几年前，一些利率制定者得出的“自然”失业率还超过6%，而现在利率制定者估算的中位数是4.7%。

要找出劳动力市场的极限，只能去摸索。通胀水平下降以及不温不火的工资增长均显示，劳动力市场要达到极限还有很长的光景。有两个可能的原因，首先，更高的工资增长可能会吸引更多的失业人员去找工作（不积极求职的人不算失业者）。25岁到54岁的人就业的比例比经济衰退之前要低，总数少了约240万人。以此为衡量标准（5月有所下降），美国的失业状况比法国要严重，后者的整体失业率为9.5%。第二，即便目前为止工资增长仅略微有所好转，仍有可能促使企业增加投资，从而提高生产率并抑制通胀压力。

| 我喜欢大幅上升

美国的就业增长放缓，每月平均新增工作岗位从2016年的18.7万个降至过去三个月的12.1万个。这对降低经济中的闲置劳动力来说已足够，但也仅此而已。只要通胀水平保持不变，就没必要进一步放缓就业增长。考虑到美联储面临的不对称风险，这么做就更不合理了。如果货币紧缩引发经济衰退，在将利率降至0之前，美联储只有一点点降息的空间。相反，如果通胀上升，它就可以想加息多少就加多少。

这种不对称风险还会影响到美联储的可信度。自2012年1月公布2%的通胀目标以来，63个月中有59个月的通胀水平都低于这一目标。相比（因为保持利率不变）而导致通胀利率略超这一目标，（加息从而导致）继续低于这一目标会令美联储的承诺引发更多质疑。

很长时间里，鹰派都在为持续存在的低水平通胀找借口。最近的一次则是将问题归咎于提供不限流量的移动数据的新合约，好像更便宜的通讯就不甚重要似的。美联储应恪守根据数据做决定的承诺，并令利率维持在现有水平。■



The bitcoin bubble

Virtual vertigo

Are bitcoins like tulips, gold or the dollar—or something else entirely?

MARKETS frequently froth and bubble, but the boom in bitcoin, a digital currency, is extraordinary. Although its price is down from an all-time high of \$2,420 on May 24th, it has more than doubled in just two months. Anyone clever or lucky enough to have bought \$1,000 of bitcoins in July 2010, when the price stood at \$0.05, would now have a stash worth \$46m. Other cryptocurrencies have soared, too, giving them a collective market value of about \$80bn.

Ascents this steep are rarely sustainable. More often than not, the word “bitcoin” now comes attached to the word “bubble”. But the question of what has driven up the price is important. Is this just a speculative mania, or is it evidence that bitcoin is taking on a more substantial role as a medium of exchange or a store of value? Put another way, is bitcoin like a tulip, gold or the dollar—or is it something else entirely?

Start with the case that this is nothing more than a virtual tulipmania, a speculative hysteria in which a rising price encourages ever more buyers, no matter what the asset is. Bitcoin’s recent trajectory certainly seems manic. Retail investors have piled in. Many already familiar with bitcoin investing have moved on to bet on alternatives, such as Ethereum, and “initial coin offerings” (ICOs), in which firms issue digital tokens of their own.

It looks like a scammers’ paradise, yet unlike tulips, bitcoins have real uses. They now buy everything from pizzas to computers. So if a tulip isn’t the right analogue, how about gold? Bitcoins certainly seem to bear more than a passing resemblance. Goldbugs mistrust governments and their money-

printing tendencies; so too do bitcoineseurs: no central bank is in charge of bitcoin. But a store of value should not bounce around as much as this one does: bitcoin swung from more than \$1,100 in late 2013 to less than \$200 a year later, before climbing, in fits and starts, to its current dizzying heights.

Rather than being just a form of digital gold, bitcoin aspires to loftier goals: to be a means of exchange like the euro, yen or the dollar. Regulators are starting to take bitcoin seriously. Some of the price surge can be explained by Japan's decision to treat bitcoin more like any other currency. Yet the bitcoin system is operating at its limits and its developers cannot agree on how to increase the number of exchanges the system is able to handle. As a result, a transaction now costs nearly \$4 in fees on average and takes many tedious hours to confirm. For convenience, a dollar bill beats it hands down.

| *Not so dotty*

If bitcoin and the other cryptocurrencies are unlike anything else, what are they? The best comparison may be with the internet and the dotcom boom it created in the late 1990s. Like the internet, cryptocurrencies both embody innovation and give rise to more of it. They are experiments in themselves of how to maintain a public database (the "blockchain") without anybody in particular, a bank, say, being in charge. Georgia, for instance, is using the technology to secure government records. And blockchains are platforms for further experiments. Take Ethereum, for example. It allows all kinds of projects, from video games to online markets, to raise funds by issuing tokens—essentially private money that can be traded and used within these projects. Although such ICOs need to be handled with care, they could also generate intriguing inventions. Fans hope that they will give rise to decentralised upstarts taking aim at today's oligopolistic technology giants, such as Amazon and Facebook.

This may seem like a dangerous way to generate innovation. Investors could lose their shirts; a crash in one asset class could spread to others, creating wobbles in the financial system. But in the case of cryptocurrencies such risks seem limited. It is hard to argue that those buying cryptocurrencies are unaware of the risks. And since they are still a fairly self-contained system, contagion is unlikely.

If there is such a thing as a healthy bubble, this is it. To be sure, regulators should watch out that cryptocurrencies do not become even more of a conduit for criminal activity, such as drug dealing. But they should think twice before coming down hard, particularly on ICOs. Being too spiky would not just prick a bubble, but also prevent a lot of the useful innovation that is likely to come about at the same time. ■



比特币泡沫 虚拟眩晕

比特币是像郁金香，还是黄金或美元？还是它完全是另外一回事？

交易市场上泡沫很常见，但比特币这种数字货币的升势非同寻常。尽管目前其价格比5月24日的2420美元这一史上最高点有所下降，但在短短两个月内已翻了一番还多。当初谁若是够精明或够幸运，在2010年7月以当时0.05美元的价格购入总值1000美元的比特币，现在就已坐拥4600万美元的资产。其他加密货币的价格也已飙升，令该市场整体市值升至约800亿美元。

如此急剧的升势很少能持续。如今，“比特币”往往与“泡沫”一词紧密相连。但推高其价格的因素是什么？这个问题很重要。这只是一场投机狂潮，还是表明比特币已愈发成为一种重要的交换媒介或储值工具？换言之，比特币是像郁金香、黄金、还是美元？或者完全是另一回事？

先来看比特币热是否只是一场“虚拟郁金香狂热”，一次忘乎所以的投机活动——价格上涨会刺激更多人成为买家，不管资产为何。比特币近期的上升轨迹看起来当然很疯狂。散户投资者纷纷涌入。许多熟谙比特币投资的人则开始转投别的加密货币产品，例如以太坊及“首次代币公开预售”（ICO，即各公司发行自己的数字代币）。

这看起来就像个骗子的天堂，但比特币与郁金香不同，它有实际的用途，如今可用来购买披萨以至电脑等各种产品。如果用郁金香来做类比不恰当，那黄金呢？看起来，比特币确实跟黄金有不少相似之处。黄金投资狂热分子不信任政府及其大印钞票的倾向，比特币投资行家也是这样：比特币不受任何央行掌控。但价值存储工具的价格不该如此大幅波动：比特币在2013年底价格超过1100美元，一年后跌至不到200美元，之后又断断续续攀升至当前令人目眩的高度。

比特币不仅仅是一种数字黄金，它还有更远大的目标：成为像欧元、日元

或美元这样的交易媒介。监管机构已开始认真看待比特币。其涨幅一定程度上源于日本愈加把比特币与其他货币同等对待。但比特币系统已达到运行极限，开发者也无法就如何提升系统能处理的交易量达成共识。结果就是，目前平均每宗交易的费用差不多是四美元，且需漫长的等待才能确认。论方便度，美钞完胜比特币。

| 相似，但没那么危险

假如比特币及其他加密货币不同于其他任何事物，那它们是什么？最能与之相提并论的也许是互联网及上世纪90年代的网络繁荣期。和互联网一样，加密货币既体现了创新，也会激发更多创新。它们本身就是在试验如何在没有任何特定机构（比如银行）掌管的情况下维护一个公共数据库（即“区块链”）。举例来说，格鲁吉亚正使用该技术来保护政府档案记录。区块链还是开展进一步实验的平台。以以太坊为例，从电子游戏到线上市场的各类项目都可以在该平台上发行代币来融资，这些代币本质上就是可以交易并在这些项目中使用的私人货币。尽管这类ICO须谨慎对待，但它们也许会激发有趣的新发明。支持者希望这些ICO能造就去中心化的新贵，与亚马逊和Facebook这样的科技寡头抗衡。

如此推动创新似乎是一个险招。投资者可能会血本无归；当一个资产类别崩溃，影响可能会扩散至其他类别，造成金融体系震动。但就加密货币而言，这类风险似乎有限。购买加密货币的人不可能没意识到其中的风险。而且由于加密货币仍属于相当封闭的系统，危机不太可能蔓延。

假如有所谓的“健康泡沫”，这番比特币热潮便是。当然，监管机构应该确保加密货币不会进一步成为毒品交易等犯罪活动的渠道。不过如果它们要收紧管制，尤其是对ICO，还是应三思而后行。太过尖刻不但会戳破泡沫，许多同时出现的有用创新也会一道胎死腹中。■



Airbnb

A different breed of unicorn

Airbnb's cohesive culture and unusual financial discipline mark it out

UNTIL recently “Uber envy” afflicted many top executives at Airbnb, a platform for booking overnight stays in other people’s homes. So admits a big investor in the firm. The two companies often raised money at the same time, and the ride-hailing giant reliably received more cash and closer attention. Uber is America’s most valuable private technology firm, with a valuation of close to \$70bn at last count; Airbnb is still in second place with a value of around \$30bn. But with Uber facing a series of setbacks, including allegations of intellectual-property theft, departures by senior executives and a consumer boycott, jealousy in Airbnb’s hallways has largely evaporated.

It helps that the firm is on a tear. Last year 80m people booked stays on Airbnb, double the number in 2015 (see chart). It now plans to expand into other bits of the market for accommodation, including luxury trips and business travel. New products, such as bespoke city tours, are in the works.

The firm’s ultimate aim is to evolve from being a platform for overnight stays into a comprehensive travel company, capturing an ever-greater share of tourists’ spending. In 2017 it may notch up as much as \$2.8bn in sales, up by around 65% from a year earlier; forecasts suggest it could reach \$8.5bn in revenues by 2020. An IPO may be in the offing, yet pitfalls also lie in wait. Chief among these is regulation, ensuring guests’ safety and, increasingly, the need to fend off rivals such as Priceline, a fearsomely efficient online travel-booking company.

Airbnb’s founders started as complete outsiders to the hospitality business and indeed, to commerce. Brian Chesky, its 35-year-old chief executive, had

no previous business experience or technical expertise. Instead, he and one of his co-founders, Joe Gebbia, had studied design at Rhode Island School of Design before teaming up with a software engineer, Nathan Blecharczyk, to launch what was then called AirBed and Breakfast, with the aim of renting out air mattresses in apartments. They were so untutored in investing that when an early adviser suggested raising money from small investors known as “angels”, Mr Chesky thought people in Silicon Valley believed in celestial beings.

Both Airbnb and Uber—America’s two most valuable “unicorns”, private startups worth over \$1bn—operate platforms without owning the underlying rooms and cars that are being used; both take a cut from every transaction. Airbnb charges both guests (6-12% of total rental fees) and hosts (around 3% of their total earnings from the site). A particular feature of Airbnb’s model is that its rental listings are usually not available on the websites of any of its competitors, because hosts tend to be loyal. So while Uber is locked in a fierce competition with rivals in most markets for customers and drivers, and has chosen to subsidise journeys to avoid losing market share, Airbnb has no need to pay up to keep hosts and users.

An attention to costs that is uncommon in the startup world is also paying off handsomely. In 2015 Airbnb hired as its chief financial officer Laurence Tosi, who had previously done the same job at Blackstone, a private-equity firm. He is regarded as the adult supervision. Airbnb reportedly achieved profitability for the first time in the second half of 2016 and will make money in 2017. It has raised \$3bn and spent only around \$300m of it (Uber is said to have lost \$2.8bn in 2016 alone).

| *Rental health*

Airbnb’s founders were early to recognise the importance of a strong, benign culture. (Uber, meanwhile, is under fire for its hard-charging practices.) Until 2013 the founders interviewed every job applicant, and

today anyone who is hired still has to pass a “core values” interview, where they are judged not on their CV but on how they fit into the firm’s sensibility. This ensures that people have a sense of mission, even if some of the firm’s peppy idealism sounds naive to jaded journalists. Asked whether Airbnb is a technology or a travel company, Vlad Loktev, its director of product, looks cautious. “We’re more of a community company,” he says.

What of the future? Given its financial results, Mr Chesky maintains that “we don’t need to raise any more money ever again.” But the hiring of Mr Tosi and the push for financial discipline suggests the firm does want to go public, perhaps as soon as 2018. If so, Airbnb would come under scrutiny as never before.

Investors note that, although at first the website attracted cost-conscious millennials looking for a more authentic travel experience, growth now depends on broadening its base. Business travellers are one target. Airbnb has made it easier for firms to place roving employees in hosts’ rooms instead of in hotels. It has set up partnerships with companies, such as Hyundai, a carmaker, and Domino’s Pizza, a food chain, to make it easier to find rooms that are suitable for their employees, whose chief needs are wireless internet, a desk and 24-hour check-in. Employees from 250,000 companies now regularly book travel on Airbnb.

The firm also wants to appeal to wealthy globe-trotters. In February Airbnb bought a holiday rental site, Luxury Retreats, for around \$300m. This brings it a portfolio of expensive properties, many of which are rented for thousands of dollars a night. Bringing in more of the mass market will meanwhile require regular additions of new, mid-range inventory. Airbnb must decide how much to favour quantity of listings, which will help it become an automatic place for people to look for accommodation, over quality.

Either way, the rivalry between Airbnb and hotels will surely intensify. An analysis by Morgan Stanley, a bank, suggests that the number of overnight stays in Airbnb accommodation will reach 6% of all hotel nights in America and Europe by 2018, up from 4% in 2016. The chief impact upon hotels so far has been to stop them raising rates. Airbnb brings a supply of available rooms to market whenever there is demand, a blow to hotels that used to be able to charge dizzying prices at peak times.

| *You can't handle the roof*

Lobbying by the hotel industry has contributed to Airbnb's most obvious challenge, which is regulation. Opposition to the firm is fierce in many big cities, especially those with limited affordable housing, where residents blame Airbnb for taking apartments off the market. Several cities that could supply large profits, including Berlin, Barcelona and New York, have imposed rules that make offering short-term rentals difficult. New York, which is Airbnb's third-largest market, has banned short-term rentals in apartment buildings for less than 30 days, unless a host is present. Berlin has passed a de facto ban, by requiring a permit if someone wants to rent more than half of their apartment on a short-term basis and levying hefty fines for violations.

Airbnb has now opted for a new, more conciliatory approach, notes Leigh Gallagher, author of a book, "The Airbnb Story". In Amsterdam and London it has agreed to police its listings to ensure they comply with local laws on the number of days a year each unit can be rented. Yet many investors worry that more restrictive laws will dampen its prospects.

A second, ever-present risk is safety. The platform functions because people trust that user photos and blind reviews will help root out bad actors. It faced a crisis in 2011 when Airbnb guests trashed a host's apartment and she blogged about the experience. Airbnb responded by offering insurance to all hosts of up to \$1m in damages. There remains the

possibility of a dramatic breach in personal security, which could spook hosts and users.

The third threat is growing competition. Airbnb was not the first firm to pursue the concept of alternatives to hotels, but it was the first to become a global success. That has drawn the attention of others. In many markets, including China and Europe, Airbnb faces competition from local firms, as well as from established global players. In 2015 Expedia, an online-travel website, bought HomeAway, an Airbnb rival, for a hefty \$3.9bn.

But Airbnb's most fearsome competitor is Priceline, which owns Booking.com and is considered one of the best-managed internet companies in the world. Priceline has been speedily adding alternative accommodation. Mr Chesky insists that "there is fundamentally not a lot of overlap between what they're offering and what we're offering", because Priceline is working mostly with property-management companies that "look more like hotels". But this will be less true over time. Priceline is too astute to let Airbnb win a category worth owning without a challenge.

The travel industry is a large prize to share. Globally, people spend around \$700bn a year on travel accommodation, according to Euromonitor International, a research firm. With rising incomes and smaller families globally, travel is ever more popular. Many more people than first thought have been willing to forgo hotel luxuries such as gyms and concierges to get the proper feel of a place. That suggests that alternative accommodation will not be a fringe activity for the young, but a mainstream part of the travel business.

In any case, Airbnb's aspirations do not end there. It has created an innovation and design lab, called Samara, with the ambition of creating a new kind of travel offering. Last autumn Airbnb started selling "experiences", which are customised activities that travellers can book,

including special meals, tours and exercise programmes, typically arranged by Airbnb hosts. Your correspondent booked a bicycle tour of San Francisco's Mission neighbourhood. The tour was enjoyable and included a visit to a secret bookstore, Bolerium Books, where works are arranged not by author but by social movement. But for \$100, excluding lunch, the price seems even steeper than San Francisco's hills. There are plenty of other firms offering tours and things to do.

There have also been murmurs that Airbnb will move into flights. Finding online flight options for travellers is a painfully low-margin business. Companies like Priceline and Expedia make the bulk of their revenue from hotels. But that is not the model Airbnb wants to embrace anyway, says Mr Blecharczyk, who declines to share more details on what Airbnb's approach to air travel might look like. "If we're going to do something, we should try to do it differently," he says.

It is possible that Airbnb's best idea will be its first one. It will be up to the firm and one day, perhaps, to its public shareholders to decide whether it is worth pursuing new, ancillary opportunities, when there is still so much to win in the market for travel accommodation. In chasing after a new dream before the first one is realised, Airbnb does bear one resemblance to its Silicon Valley peers. ■



Airbnb

另类独角兽

爱彼迎的文化凝聚力和非同寻常的财务纪律令它卓尔不群

直到不久前，“优步嫉妒症”还困扰着短租民宿平台爱彼迎（Airbnb）的许多高管。该公司的一个大投资者坦然承认自己也是如此。这两家公司经常在同一时间融资，而网约车巨头总是能融到更多资金、得到更密切的关注。优步是美国最有价值的私营科技公司，最新估值近700亿美元，爱彼迎仍然位居第二，估值约300亿美元。不过随着优步经受了一连串的挫折，包括窃取知识产权的指控、高管离职和消费者抵制等，爱彼迎公司内的嫉妒情绪已经基本消散了。

爱彼迎去年业绩风生水起，这也让公司的情绪有所好转。去年，有8000万人通过爱彼迎预定住宿，比2015年的数字多了一倍（见图表）。爱彼迎现在计划向住宿市场的其他领域拓展，包括豪华游和商务行。定制城市游这样的新产品正在筹备中。

爱彼迎的最终目标是从短租平台逐步成为一个综合旅游公司，获取更大的游客消费份额。2017年，爱彼迎或许将创下28亿美元的销售额，比上年增长约65%。还有预测称，到2020年，公司可能实现85亿美元的收入。上市也许为时不远，不过也面临一些困难，其中最主要的是监管和保证用户安全，还有越来越重要的与竞争对手抗衡，比如在线旅行预订公司Priceline就是一个效率极高的对手。

爱彼迎的各位创始人一开始完全是酒店业的外行——实际上他们和整个商业都全无接触。35岁的首席执行官布莱恩·切斯基（Brian Chesky）之前没有任何商业经验或技术专长。相反，他和另一个联合创始人乔·杰比亚（Joe Gebbia）是在罗德岛设计学院（Rhode Island School of Design）学设计出身，后来与软件工程师内森·布莱卡斯亚克（Nathan Blecharczyk）合作成立公司，当时叫作AirBed and Breakfast，目的是出租公寓里的充气床垫。他们几个人在投资方面一窍不通。早期，一个顾问建

议通过被唤作“天使”的个人投资者融资时，切斯基还以为硅谷的人信奉各路天神。

爱彼迎和优步这两个美国最有价值的“独角兽”公司（估值超过10亿美元的私营创业公司）只运营平台，不拥有任何供租用的客房和汽车。两者都从每笔交易中抽成。爱彼迎是对租客和房东双向收费：向租客收取总房租的6%到12%，向房东收取从该平台获得的总收入的约3%。爱彼迎模式的一个特点是房东往往忠诚度高，出租列表中的房屋通常在任何竞争对手的网站上都找不到。因此，虽然优步在大多数市场上都要为争夺乘客和司机而与竞争对手陷入激战，并选择补贴出行以免丢失市场份额，爱彼迎却不用花钱来留住房东和租客。

关注成本在创业公司中不常见，爱彼迎却因此得到了可观的回报。2015年，爱彼迎聘请劳伦斯·托西（Laurence Tosi）担任首席财务官。托西之前在私募股权公司黑石（Blackstone）担任同一职务，人们认为他在爱彼迎扮演了成人监护的角色。据报道，爱彼迎在2016年下半年首次实现盈利，2017年将继续盈利。爱彼迎已融资30亿美元，仅花掉了3亿美元左右（据说优步单在2016年就亏损了28亿美元）。

| 健康租赁

爱彼迎的创始人很早就认识到强大、良性的企业文化的重要性。与此同时，优步正因其强硬的做派而遭到围攻。2013年前，爱彼迎的创始人会亲自面试每位求职者。时至今日，任何被聘用的人仍须通过“核心价值观”面试，这时看的就不是简历，而是他们能否顺应公司的理念。这确保员工负有使命感，尽管公司某些劲头十足的理想主义在饱经世故的记者听来太过天真。在被问到爱彼迎是科技公司还是旅游公司时，产品总监弗拉德·洛克特夫（Vlad Loktev）态度谨慎，说道，“我们更像是一个社区公司。”

未来又会如何呢？鉴于目前的财务状况，切斯基坚持认为“我们再也不需要融资了”。然而聘请托西以及推行财务纪律的举动表明，爱彼迎确实有上市的打算，最早可能会在2018年上市。果真如此的话，爱彼迎会受到前所未有的密切关注。

投资者注意到，虽然该网站最初吸引了想要省钱又寻求更真实的旅行体验的千禧一代，但现在的增长要取决于扩大用户基数。商务旅客便是其中一个目标用户群。爱彼迎已经创造了条件，让企业能更方便地把出差员工安置在短租房而非酒店里。爱彼迎和多家企业建立了合作伙伴关系，包括汽车制造商现代和食品连锁店达美乐披萨（Domino's Pizza），方便它们找到适合员工住宿的房间（主要的需求是无线上网、办公桌，以及24小时登记入住）。目前，来自25万家企业的员工出差都在爱彼迎预定住宿。

爱彼迎还想吸引富裕的环球旅行者。2月，它花费约3亿美元收购了度假屋租赁网站Luxury Retreats。这使它在租屋列表上增加了一系列高档物业，其中有很多每晚租金高达数千美元。而要引入更多大众市场用户，就需要同时定期增加新的中档房源。房源增加可以让爱彼迎成为人们订房时的首选，而爱彼迎必须在量与质之间做出权衡。

不管是更重质还是更重量，爱彼迎和酒店之间的竞争必将更加激烈。摩根士丹利的分析显示，2016年，爱彼迎房源入住天数占欧美酒店房间入住天数的4%，2018年将升至6%。目前为止对酒店的主要影响是遏制了酒店提高房价。只要市场有需求，爱彼迎在任何时候都能提供可预定的房源，对于以往在旺季时收取高昂房价的酒店来说可谓沉重一击。

| 挑战多多

酒店业的游说带来了更多监管压力，成为爱彼迎最显而易见的挑战。公司在许多大城市都遭到了激烈的反对，特别是在价格适中的出租房源很有限的城市，居民埋怨爱彼迎霸占了市场上的房源。几个潜在利润大的城市（包括柏林、巴塞罗那和纽约）已经实施了规定，增加了短期租赁的难度。爱彼迎的第三大市场纽约已经禁止公寓楼30天以内的短期租赁，除非房东也住在那里。柏林已经通过了一项事实上的禁令，如果有人想短期出租其公寓一半以上的面积，必须获得许可证，违者重罚。

《爱彼迎的故事》（The Airbnb Story）一书的作者利·加拉格尔（Leigh Gallagher）注意到，现在爱彼迎选择了一种更能安抚各方的新方法。在阿姆斯特丹和伦敦，爱彼迎已经同意对其预定列表中的房源进行监督，确保

它们符合地方法律对每套房一年之内可出租天数的要求。然而，许多投资者担心越来越多的限制性法律会打击爱彼迎的前景。

第二个风险一直存在——安全。爱彼迎平台得以运转，是因为人们相信用户的照片和匿名评论将有助于去芜存菁。2011年，一些租客破坏了一个房东的公寓，房东为此发了博客，给爱彼迎带来一场危机。爱彼迎遂为所有房东都提供了赔偿上限为100万美元的房屋破坏保险。但在个人安全方面仍然存在严重的风险，这可能会吓走房东和租客。

第三个威胁是日益激烈的竞争。爱彼迎不是第一家主打酒店替代概念的公司，但却是第一个在全球获得成功的此类公司，这引起了其他公司的注意。在包括中国和欧洲在内的许多市场，爱彼迎都面临来自当地企业及老牌全球公司的竞争。2015年，在线旅游网站亿客行（Expedia）收购了爱彼迎的竞争对手HomeAway，收购价高达39亿美元。

旗下拥有缤客（Booking.com）的Priceline是爱彼迎最可怕的竞争对手，被认为是世界上管理水平最高的互联网公司之一。Priceline一直在加快发展替代住宿业务。切斯基坚持认为“他们提供的产品与我们提供的产品在根本上并没有太多重叠”，因为Priceline的主要合作对象是“看起来更像酒店”的物业管理公司。但未来这种情况会变化。以Priceline之精明，它不会坐视爱彼迎轻易拿下下一个值得占有的市场。

旅游业是一块很大的蛋糕。研究公司欧睿国际（Euromonitor International）的数据表明，全球每年的旅游住宿花费约为7000亿美元。随着各国收入增加和家庭规模缩小，旅游变得越发流行。很多人为了更好地体验当地生活，甘愿放弃酒店的健身房和礼宾服务等奢华享受，这是市场一开始没有预想到的。这表明，替代住宿不会是年轻人的边缘行为，而是旅游业的主流组成部分。

不过，爱彼迎的抱负并不止于此。它创建了一个名为萨马拉（Samara）的创新设计实验室，想要创造新型旅游产品。去年秋天，爱彼迎开始销售“体验”，即向旅行者提供定制旅游产品，包括特色餐饮、观光和健身计

划，通常由爱彼迎的房东安排。本文作者预订了旧金山Mission区的单车之旅。旅程很愉快，还去了一个不为人知的书店Bolerium Books，那里的书按社会运动分类摆放，而不是按作者来分类。但是，费用是100美元，还不包括午餐，这价格似乎比旧金山的山丘还高。其他提供定制行程的公司也不在少数。

还有传言说爱彼迎将涉足航空业务。帮旅客在线选择航班的生意利润非常微薄。Priceline和亿客行等公司的大部分收入都来自酒店，但布莱卡斯亚克说这不是爱彼迎想要的模式。他拒绝就爱彼迎航空业务的可能模式透露更多细节，只说“如果我们要去做一件事，就应该尝试不同的做法”。

爱彼迎最好的创意可能是它最初的创意。在旅游住宿市场仍大有可为的时候，追求新的非主营业务是否值得，要看公司的决定——或许有一天就要看公众股东的决定。第一个梦想还未实现之时就开始追求新的梦想，爱彼迎在这一点上倒是和硅谷的其他科技企业很像。■



Curbing jihadists

Terror and the internet

Tech firms could do more to help—within limits

THREE jihadist attacks in Britain in as many months have led to a flood of suggestions about how to fight terrorism, from more police and harsher jail sentences to new legal powers. But one idea has gained momentum in both Europe and America—that internet firms are doing the jihadists' work for them. Technology giants, such as Google and Facebook, are accused of turning a blind eye to violent online propaganda and other platforms of allowing terrorists to communicate with each other out of reach of the intelligence services.

It is only the latest such charge. The technology firms have also been condemned for allowing the spread of fake news and harbouring bullies, bigots and trolls in the pursuit of profit. In the past they were accused of enabling people to evade copyright and of hosting child pornography.

In all these areas, politicians are demanding that the technology giants take more responsibility for what appears on their networks. Within limits, they are right.

| *Shooting the messenger app?*

For as long as there have been data networks, people have exploited them to cause harm. The French mechanical telegraph system was subverted in 1834 in a bond-trading scam that went undetected for two years. Cold-callers run cons by telephone. The internet, with billions of users and unlimited processing power, is the most powerful network of all. It was bound to become the focus of wrongdoers.

That does not mean it should be wrapped in red tape. Openness online is

especially valuable because it allows “permissionless” innovation. Anyone can publish an article, upload a video or distribute a piece of software to a global audience. Freedom from the responsibilities that burden other media companies has served as a boost for a nascent industry.

But the days when the technology firms needed nurturing are long gone. In the past decade they have become the world’s most valuable companies. As their services have reached deeper into every aspect of everyday life, online activity has gained more potential to cause offline harm. For every Spotify there is a WannaCry.

Technology firms complain that this combination of novelty and commercial success makes them a convenient target for politicians, some of whom seem to regard regulating the internet as a shortcut to solving complex social problems such as hate speech. Eager to protect their special status, technology firms have emphasised that online recruitment is only part of the terrorist threat. Besides, they say, they are platforms, not publishers, and that they cannot possibly monitor everything.

Yet the firms can act when they want to. Before Edward Snowden exposed them in a huge leak in 2013, they quietly helped American and British intelligence monitor jihadists. Whenever advertisers withdraw business after their brands ended up alongside pornographic, violent or extremist material, they respond remarkably quickly.

As with car accidents or cyber-attacks, perfect security is unattainable. But an approach based on “defence in depth”, combining technology, policy, education and human oversight, can minimise risk and harm.

Often, commercial self-interest gives an incentive for the technology companies to act. Although fake news is popular and engaging, and provides opportunities to fill advertising slots, it is bad for the technology

giants' reputations. Accordingly, Google and Facebook are doing more to cut off fake-news sites from their advertising networks, build new tools to flag dubious stories and warn readers of them, and establish links with fact-checking organisations.

When self-interest is not enough, governments can prod the firms to tighten up—as German lawmakers have, threatening huge fines. Under a voluntary agreement with European regulators, the big firms have set a target of reviewing (and, when appropriate, removing) within a day at least 50% of content flagged by users as hateful or xenophobic. The latest figures show that Facebook reviewed 58% of flagged items within a day, up from 50% in December. For Twitter, the figure was 39%, up from 24%. (YouTube's score fell from 61% to 43%.)

The strongest measure is new laws. In 2002, for example, Britain made internet service providers (ISPs) liable for child pornography if they did not take it down “expeditiously”. The ISPs used a charity to compile a list of blocked URLs that it updated twice daily. The charity works closely with law-enforcement agencies in Britain and abroad. Similarly, American lawmakers have clamped down on copyright infringement.

| *It's no longer 2005*

As in the offline world, legislators must strike a balance between security and liberty. Especially after attacks, when governments want to be seen to act, they may be tempted to impose blanket bans on speech. Instead, they should set out to be clear and narrow about what is illegal—which will also help platforms deal with posts quickly and consistently. Even then, the threshold between free speech and incitement will be hard to define. The aim should be to translate offline legal norms into the cyber domain.

Before legislators rush in, they also need to think about unintended consequences. If internet firms are threatened with fines, they may simply

remove all flagged content, just in case. Regulation that requires lots of staff to take down offensive posts will most hurt small startups, which can least afford it. Laws mandating cryptographic “back doors” in popular messaging apps would weaken security for innocent users. Bad actors would switch to unregulated alternatives in countries that are unlikely to help Western governments. They would thus become harder for the intelligence services to watch.

In the past, internet firms have tended to “build it first, figure out the rules later”. However, the arguments about terrorism and extremist content are a stark reminder that the lawless, freewheeling era of the early internet is over. Technology firms may find that difficult to accept. But accept it they must, as part of the responsibility that comes with their new-found power and as part of the price of their success. ■



阻止圣战分子

恐怖与互联网

科技公司可以提供更多帮助，但要有限度

英国在三个月内遭受了三次恐怖袭击，大量关于打击恐怖主义的建议随之涌现，包括增加警力、加重刑罚，以及赋予政府新的法律权力。然而有一种看法在欧洲和美国都越来越流行，那就是互联网公司在为伊斯兰圣战主义者帮忙。人们指责谷歌和Facebook这样的科技巨头对网上的暴力宣传视而不见，还有一些平台让恐怖分子得以在情报机构的监控范围之外通信。

这种批评久已有之。人们还谴责科技公司一心逐利，放任假消息传播并包庇恶棍、偏执狂和网络喷子。过去，这些公司还被指控让人们得以逃避版权责任和传播儿童色情。

在上述所有方面，政客们都要求科技巨头对网络上的问题承担更多责任。在一定范围内，他们的要求是合理的。

| 干掉通讯应用？

自从有了数据网络，人们就利用它来危害他人。1834年，法国机械电报系统因一个债券交易骗局而崩塌，这一骗局历经两年都未被发现；陌生人通过电话实施诈骗屡见不鲜。拥有数十亿用户和无限处理能力的互联网是所有网络中最强大的，必然会成为坏人作案的聚集地。

这并不意味着网络应该受到过多监管。网络的开放特别重要，因为这可以产生“无许可”创新。任何人都可以面向全球用户发表文章、上传视频或发布软件。网络不受其他媒体公司所承担的责任的约束，这成为这一新兴产业的推动力。

但科技公司需要呵护的日子早已过去。在过去十年中，它们已成为世界上最有价值的公司。随着它们的服务深入到日常生活的方方面面，线上活动已经拥有更大的潜力在线下造成危害。有Spotify之类的创新，就会有

WannaCry这样的病毒。

科技公司抱怨说，自己是新奇事物，又赚了大钱，很容易就成为政客的攻击目标；有些政客似乎认为监管互联网是个解决仇恨言论等复杂社会问题的捷径。科技公司急于保护自身的特殊地位，强调在线招募恐怖分子只是恐怖威胁的一部分。再者，它们称科技公司是平台而不是出版商，不可能监控一切。

然而只要它们愿意，这些科技公司还是可以采取行动的。2013年爱德华·斯诺登在其大揭秘中暴露它们之前，科技公司一直在悄悄地帮助美国和英国的情报机构监视圣战分子。每当广告主因其品牌与色情、暴力或极端主义内容一同出现而取消投放广告时，科技公司的反应雷厉风行。

和车祸或网络攻击一样，绝对的安全是无法实现的。不过，将技术、政策、教育和人力监督结合起来的“纵深防御”法可以将风险和危害降至最低。

通常，自身的商业利益会激励科技公司采取行动。假新闻虽然受欢迎、有吸引力，且有利于卖广告，但对科技巨头的声誉不利。因此，谷歌和Facebook正在做出更多努力，禁止假新闻网站使用它们的广告服务，创造新工具来标记可疑内容及警示读者，还与事实核查机构合作。

当自身利益驱动不足时，各国政府可以像德国的立法机构那样，督促科技公司加强管理，以巨额罚款相威胁。根据大型科技公司与欧洲监管机构达成的一项自愿协议，这些公司已经设定了目标，在一天之内审查（并在适当时删除）至少50%被用户标记为涉仇恨或仇外情绪的内容。最新数据显示，Facebook在一天之内审查了58%的已标记内容，高于去年12月的50%。推特的审查率是39%，去年12月则是24%。（YouTube的数字则从61%下降到43%）

最强有力的措施就是制定新法律。例如，2002年英国立法规定，互联网服务提供商（ISP）如不“快速”撤除儿童色情内容，将负法律责任。互联网服务供应商请了一家公益机构来编制应阻止的网址黑名单，每天更新两次。

该机构与英国及海外的执法机构有紧密的合作关系。同样，美国立法机构也已在加强打击侵犯版权的行为。

| 今时今日已非2005年

和线下世界一样，立法者必须在安全与自由之间取得平衡。恐怖袭击事件发生后，政府尤其想让公众看到自己有所行动，可能会想要全面禁止言论。然而，政府该做的其实是明确规定哪些言论属于非法，这也将有助于平台快速而一致地处理相关帖子。但即便如此，自由言论和煽动性言论还是很难界定。目标应该是如何将线下的法律规范转化为线上的规则。

立法机构匆忙行动之前，还需要考虑意想不到的后果。如果互联网公司有可能被罚款的可能，它们可能就会把所有标记内容一删了之，以防万一。要求安排大量人力删除攻击性帖子的法规将极大伤害小型创业公司，因为它们最负担不起这种成本。在流行通讯应用中强制安装加密“后门”的法律将削弱无辜用户的安全。有不良企图的人会转而选择那些在不太可能帮助西方政府的国家里使用的不受监管的应用，情报部门追踪起来会更加困难。

过去互联网公司倾向于“先做事，然后再想怎么合规”。但是，关于恐怖主义和极端主义内容的争论明确表明，早期互联网放任自流的自由时代已经结束了。科技公司可能会觉得难以接受，但必须接受——这是伴随它们新发现的权力而需肩负的责任，也是它们获得成功需付出的相应代价。■



Free exchange

Embrace the contradictions

William Baumol, originator of the idea of “cost disease”, dies at 95

ON MAY 4th William Baumol, one of the great economists of the 20th century, died. Mr Baumol, who kept working into his 90s, published more than 500 papers across a dazzling array of topics; his best-known work, describing “cost disease”, was essentially a side-project. He was a scholar whose stray thought on a sleepless night could change how people see the world.

Mr Baumol was born in the South Bronx, attended New York public schools and took an undergraduate degree at the College of the City of New York. Shaped by his family’s left-wing views, in high school he read Karl Marx, which kindled an interest in economics. He did his PhD at the London School of Economics; he defended his dissertation “over whiskies and sodas at the Reform Club”. He spent most of his long career at Princeton University. He had long been on the shortlist for a Nobel prize; sadly, death means he cannot receive one.

His contributions will endure, however. Mr Baumol’s primary intellectual focus was the entrepreneur, whose role was badly neglected by prevailing economic theories. This, he reckoned, was an intolerable omission. The difference between rich countries and poor ones rests on differences in their use of technology, he argued, and it is through enterprising individuals and firms that innovations go from the drawing-board to active use across an economy. Business theories, he lamented, inevitably treated people as automatons, rather than potential revolutionaries.

Mr Baumol did better, casting entrepreneurs as crafty strivers dedicated to raising their personal status, who plot their course in life based on the

incentives they face. Policy determines whether that means climbing the bureaucracy or founding Microsoft.

He helped move economics beyond the narrow ideal of perfect competition by introducing the idea of contestable markets, in which competitive pressure comes from the worry that rivals will swoop in to vie for a market if incumbents are anything other than ruthlessly efficient. Perfectly contestable markets should be just as efficient as perfectly competitive ones, even if only a handful of firms dominate a business. His framework gave economists a way to model what they previously could not: why some industries have lots of firms and others have just a few. Firms should enter the market until all are operating at the most efficient scale (so they cannot cut costs by selling more or fewer units). He was not preaching the Panglossian infallibility of markets. Rather, he helped economists understand why some industries might be more concentrated than others—and when oligopoly is a consequence of corporate chicanery rather than market efficiencies.

Yet Mr Baumol will be remembered best for his cost disease. Its origin was unlikely: a commission to help those promoting the arts understand the financial struggles that cultural organisations faced. A report co-written with William Bowen closed with a simple but striking observation. Workers in the arts compete in the same national labour market as those in factories. As rising productivity in manufacturing lifts the wages of factory workers, arts organisations must pay their staff more to keep them from quitting to make widgets. But rising wages in the arts are not matched, as in manufacturing, by corresponding productivity growth: performing a piece by Schubert took the same time and the same number of musicians in the 20th century as it did in the 19th. Thus rising costs and stagnant productivity create increasing pressure over time to raise ticket prices, or take in more donations, or produce less art. The analysis bore relevance outside the arts, he quickly realised. Technological progress in some

industries implies that in services with relatively low rates of productivity growth—like health care, education and government—swelling costs will outstrip growth in productivity. Costlier public services are a necessary side-effect of long-run growth.

Cost disease is a powerful but frequently misunderstood concept. Sectors in the low-productivity bucket are not necessarily doomed to remain there. In future, new technologies could allow fewer teachers or doctors to serve many more students and patients. Nor must cost disease always entail a crisis of affordability. The wage increases driving it are a side-effect of productivity gains elsewhere, which make the economy richer. Trouble results, Mr Baumol pointed out, when rising spending creates political pressure for cutbacks, leading to needless deterioration in the quality of services. Whereas cost-saving efficiencies are both possible and welcome, budget cuts premised on the notion that the share of spending on, say, education should remain flat hinder rather than help the economy. Indeed, if stagnant services complement an economy's high-flying sectors (plying tech firms with educated workers, for example), then rising employment in stagnant areas raises rather than lowers overall productivity growth.

Cost disease also provides a vision of a world of large-scale automation. As machines become better at doing things, the human role in generating faster productivity growth will converge towards zero. At that point, so long as society expects everyone to work, all spending in the economy will go towards services for which it is crucial that productivity *not* grow, in order to provide jobs for everyone. Society could seemingly be both characterised by technological abundance and paralysed by cost disease.

| *Practising theorist*

Mr Baumol revelled in such contradictions. In the 1990s he tackled trade, and found that in the presence of economies of scale, production could get stuck in the “wrong” place—a country with an underlying comparative

advantage might still fail to dislodge production from incumbent exporters. He relished hard questions, and was happy to find that a hunch of his proved mistaken on closer scrutiny. Probing, pragmatic and humble intellects are all too rare in economics. They are now scarcer still. ■



自由交流

拥抱矛盾

提出“成本疾病”理论的威廉·鲍莫尔去世，享年95岁

5月4日，20世纪杰出的经济学家威廉·鲍莫尔去世。他一直工作到九十几岁，发表了500多篇论文，涉猎的主题范围之广令人惊叹。他阐述“成本疾病”的著作最为知名，却基本上是他研究主业之余的副产品。这位学者在不眠之夜生出的杂念都会改变人们对世界的看法。

鲍莫尔出生于纽约南布朗克斯区，念的是当地的公立学校，本科毕业于纽约市立学院（College of the City of New York）。受持左翼观点的家人影响，他在上高中时阅读了马克思的著作，并由此燃起了对经济学的兴趣。他在伦敦政治经济学院修读博士学位，“在革新俱乐部（Reform Club）里，和众人一起喝着威士忌和苏打水”完成了论文答辩。他漫长职业生涯的大部分时间都在普林斯顿大学里度过。多年来诺贝尔奖的候选名单上一直都有他的名字。可惜如今他已去世，无缘得奖了。

然而他的贡献将会历久常新。鲍莫尔主要的研究重点是企业家。当时盛行的经济学理论严重忽略了企业家的作用，鲍莫尔认为这一疏漏不可容忍。他指出，富国和穷国的区别在于它们对技术的运用。有了开拓进取的个人和公司，新创举才不至停留在制图板上，而是在整个经济中得到积极应用。他哀叹，商业理论不可避免地总是将人视作机器人，而不是有可能带来巨大变革的人。

鲍莫尔在这方面有所建树。他将企业家刻画成精于算计的奋斗者，他们勉力追求自身社会地位的提升，并根据所面对的激励因素规划人生道路。至于这意味着他们会选择在官场里向上爬，还是创建微软，则和政策有关。

他引入了“可竞争市场”的理念，帮助经济学超越了充分竞争这个狭隘的理想状态。在可竞争市场中，如果现有企业不果决地追求效率，竞争对手便会乘虚而入，抢夺市场。这种担忧会催生竞争压力。完全可竞争的市场应

该会和充分竞争的市场一样高效，即使某项业务是由为数不多的几个公司把持。他的理论框架让经济学家得以实现之前无法做到的事情，为这样一种情况建立理论分析模型——为什么有些行业有很多公司，而其他一些行业只有少数几家公司。公司应进入市场，直到所有公司都以最高程度的效率来运营（这样它们便不能靠增加或减少产品的销售来削减成本）。他并不是在鼓吹市场绝对可靠这种盲目乐观的论调，而是帮助经济学家理解为什么有些行业可能要比其他行业更集中，以及寡头垄断何时是企业欺诈行为的产物，而非市场效率的体现。

不过，最令鲍莫尔被人铭记的还是他的成本疾病理论。该理论的缘起颇让人意外：他受托向艺术推广者解释文化组织面临的困难。他与威廉·鲍温（William Bowen）共同撰写了一份报告，在结尾处提出了一个简单但令人惊异的观察结果。艺术工作者和工厂里的劳动者在同一个全国性的劳动力市场内竞争。制造业生产率提升，工厂工人的工资水平也随之上涨，艺术团体必须提高员工的薪资，以防他们辞职跑去工厂做工。但与制造业的情形不同，在艺术行业，工资上涨并未伴随着生产率的相应提升：在20世纪，演奏一部舒伯特的作品所需的时间和音乐家人数与19世纪时并无区别。久而久之，提升的成本和停滞的生产率就会令艺术团体的压力与日俱增，它们或者需要提高票价，或者需要接受更多的捐助，要不然就得减少艺术作品的产出。鲍莫尔很快认识到，这种分析方法也适用于艺术之外的领域。某些行业的技术进步意味着，在生产率增长相对较慢的服务业（例如医疗保健、教育和政府），成本增加的程度会超过生产率提升的水平。公共服务变得更昂贵是长期增长必然带来的副作用。

成本疾病的概念影响深刻，但也屡遭误解。生产率低下的部门并不是注定无法脱离所处的境地。在未来，新的技术可以让更少的教师或医生服务更多的学生或病人。成本疾病也不一定总是会引起负担能力的危机。促成成本疾病的工资水平上涨是其他地方生产率提高而产生的副作用，而其他地方生产率的提高会让整个经济都更富足。鲍莫尔指出，当支出的增加造成了削减支出的政治压力，就会产生问题，令服务质量出现不必要的下降。通过效率来节省成本是可行的，也颇受欢迎，但以某项支出（例如教育）的占比应保持不变这一想法为前提的预算削减只会阻碍而非促进经济发

展。实际上，如果停滞的服务业成为快速发展部门的补充，例如不断向科技公司输送受过良好教育的员工，那么停滞领域内就业的增长其实是会促进而不是降低总体生产率的提升。

通过成本疾病理论，还可以想象一个实现大规模自动化的世界。随着机器的工作表现愈发出色，人类在加快生产率提高方面的作用将趋近于零。到那时，只要社会还想让每个人都有工作，整个经济的支出就都要投入到服务业，从而为所有人提供工作机会，而服务业生产率保持不增长就很关键。社会也许会展现出一幅矛盾的场景，既有丰富的科技成果，也会因成本疾病而丧失活力。

| 执业理论家

这样的矛盾状况让鲍莫尔沉醉不已。上世纪90年代，他在研究贸易难题时发现，在规模经济下，生产也许会停留在“错误”的地方——拥有潜在相对优势的国家也许仍不能令生产从现有的出口国转移出去。他喜欢难解的问题。当发现自己的某个直觉经仔细审视后证实是错的，他感到很高兴。在经济学领域，有探究精神、务实而又谦逊的知识分子实在太少了，如今则更罕有了。■



Free exchange

A political economy

A new anthology of essays reconsiders Thomas Piketty's masterwork

“A MODERN Marx” was how *The Economist* described Thomas Piketty three years ago, when he was well on his way to selling more than 2m copies of “Capital in the Twenty-First Century”. It was meant as a compliment, mostly: as advice to take the analysis seriously, yet to treat the policy recommendations with caution. The book’s striking warning, of the creeping dominance of the very wealthy, looks as relevant as ever: as Donald Trump’s heirs mind his business empire, he works to repeal inheritance tax. But “Capital” changed the agenda of academic economics far less than it seemed it might. A new volume of essays reflecting on Mr Piketty’s book, published in May, prods economists to do better. It is not clear they can.

“After Piketty: The Agenda for Economics and Inequality”, edited by Heather Boushey, Bradford DeLong and Marshall Steinbaum, is a book by economists, for economists. In that it resembles “Capital” itself. Before he was an unlikely cultural icon, Mr Piketty was a respected empirical economist. He was best known as one of a group of scholars, among them Emmanuel Saez and Anthony Atkinson, who used tax data to track long-run inequality. In “Capital” these data became the basis for an ambitious theory of capitalism. Mr Piketty argued that wealth naturally accumulates and concentrates, so that familial riches are ever more critical to determining an individual’s success or failure in life. The extravagant inequality of the Gilded Age could return if no preventive action is taken.

Mr Piketty chose to compress his sweeping narrative into a compact economic model backed up by a few simple equations. The mathematical expression at the heart of his book is little more complicated than an emoji:

$r > g$. It says that the rate of return on capital, r , has historically been greater than g , the growth rate of the economy. Why does this matter? It means, first, that the ratio of an economy's wealth to its output tends to rise, which increases the relative economic power of wealth in society. Second, because the distribution of wealth is usually less equal than the distribution of income, faster growth in wealth than in GDP means a steady increase in inequality. Third, it implies that income from capital will grow as a share of income (and income from labour will fall). So being born rich (or marrying well) becomes a surer route to success than working hard or starting a firm. It is a recipe for social stagnation, and perhaps crisis.

Yet, despite its 700-odd pages, "Capital" gave important details short shrift. "After Piketty" takes these lacunae in turn, pointing out, essay by essay, how Mr Piketty might have devoted more space to the role of human capital and technological change, the structure of the firm and the rise in outsourcing, sexual inequality, geography and so on. Gareth Jones, for example, argues that in "Capital" geographical divisions are treated as "container[s] for data"—that is, the areas within which various statistical agencies do their work—rather than as arenas with changeable boundaries within which the rough-and-tumble tussle between labour and capital plays out.

Most economists have focused on Mr Piketty's model. They question the parameters needed to make it behave as Mr Piketty reckoned it would. "After Piketty" includes an example of the genre, by Devesh Raval. As wealth accumulates, economists reckon the return on capital should fall; society has less use for the hundredth factory or server than the first. As it does, capitalists will seek new, profitable ways to deploy their wealth: by investing in machines that can replace labour, for instance. If firms are relatively good at using their growing piles of capital to replace labour—if, in the language of economics, the elasticity of substitution of capital for labour is greater than one—then wealth can pile up, as Mr Piketty suggests. If, instead, the return falls a lot as markets struggle to put capital into

action, then r will decline towards g , and the ratio of wealth to GDP will eventually stabilise. Mr Raval echoes many other economists in pointing out that most estimates of the elasticity of substitution find it to be less than one.

In economics, this passes for a damning critique. Yet the argument treats the elasticity of substitution as a meaningful parameter in a well-behaved economy. It may not be. In the most incisive essay in “After Piketty”, Suresh Naidu describes a “domesticated Piketty” who communicates in the language of economics and whose argument hinges on things like the elasticity of substitution. Yet in “Capital” there is also a “wild Piketty” who pays attention to social norms, political institutions and the exercise of raw power. He suggests that $r > g$ is not a theory to be disproved but a historical fact to be explained. And he suggests that the wealthy use their influence to shape laws and society in order to guarantee themselves a better return on their wealth.

Do they? The record of the past 40 years is suggestive. Top tax rates have fallen, financial regulation has weakened (at least before the crisis of 2007-08) and companies have found it easier to reduce their obligations to workers. Economists often praise such moves as enhancing efficiency. Yet, somewhat awkwardly, this history is also consistent with a story in which the wealthy seek to protect their returns at the expense of labour. A focus on efficiency is unobjectionable in a world in which political and institutional stability can be taken for granted, much less so in a world in which it cannot.

| *What is to be done?*

Politics is “everywhere and nowhere” in Mr Piketty’s book, as Elisabeth Jacobs notes in her essay. What “After Piketty” reveals is the message lurking within all the undeveloped arguments in “Capital” about politics and ideology. It is that economists set themselves too easy, too useless a

task if they can describe how capitalism works only when politics is
unchanging. ■



自由交流

政治经济学

一本新出版的文集重新思考托马斯·皮凯蒂的代表作

三年前，托马斯·皮凯蒂的《21世纪资本论》销量即将突破两百万册。当时，《经济学人》将他比作“当代马克思”，大体上是想表达一种恭维：建议人们重视他的分析成果，但同时也要谨慎对待那些政策建议。这本书有关巨富阶层正悄然取得支配地位的警告震撼人心，如今看来也毫不过时：特朗普的继承人照管他的商业帝国之时，他正争取废除遗产税。然而，《21世纪资本论》远远未像当初看上去的那般改变了理论经济学的研究方向。5月出版的一本新文集审视了皮凯蒂的著作，敦促经济学家们谋求进步。他们能不能做到就不得而知了。

《皮凯蒂之后：关于经济学及不平等的议题》（After Piketty: The Agenda for Economics and Inequality）由希瑟·布西（Heather Boushey）、布拉德福特·德隆（Bradford DeLong）以及马歇尔·斯坦鲍姆（Marshall Steinbaum）编选。这是一本经济学家写给经济学家看的书，就这点来看，该书与《21世纪资本论》相似。在出人意料地成为文化偶像之前，皮凯蒂是一位受人尊敬的实证经济学家，他最为人所知的一点是他和伊曼纽尔·赛斯（Emmanuel Saez）及安东尼·阿特金森（Anthony Atkinson）一样，都是利用税收数据来追踪长期不平等状况的学者。在《21世纪资本论》一书中，这些数据构成了一个有关资本主义的宏大理论的基础。皮凯蒂认为，财富自然而然就会积累并集中，因此，家族财富在决定一个人一生的成败时日益关键。如果不采取预防措施，“镀金时代”的严重不平等状况也许将卷土重来。

皮凯蒂选择将自己洋洋洒洒的论述压缩成一个紧凑的经济学模型，用几个简单的等式来支撑。作为本书核心内容的数学表达式不比一个表情符号复杂多少： $r > g$ ，表示资本回报的增长速度 r 在历史上一直快于经济增长的速度 g 。这一点为何重要？首先，这意味着一个经济体的财富与其产出的比率往往呈上升趋势，这会提高财富在社会上的相对经济实力。第二，由于

财富分配的公平程度通常都不如收入分配，如果财富增长快过GDP增长，就会令不平等稳步加剧。第三，这个公式意味着资本收益占收入的比重会增加，而劳动收入的比重则会减少。这样一来，和辛勤工作或创办公司比起来，投胎好（或嫁得好、娶得好）就成了更稳妥的成功之路。这会导致社会停滞，说不定还会引发危机。

然而，尽管厚达七百多页，《21世纪资本论》还是忽略了一些重要的细节。《皮凯蒂之后》填补了这些缺漏，用一篇篇文章逐一指出，皮凯蒂本应花费更多笔墨探讨人力资本及技术变革、企业组织结构及外包的兴起、性别不平等和地理等因素的影响。例如，加雷斯·琼斯（Gareth Jones）指出，在《21世纪资本论》中，皮凯蒂将地理区划视作“数据的容器”，即各路统计机构的工作领域，而不是劳动力与资本在其中混战、边界不断变化的竞技场。

大多数经济学家都聚焦于皮凯蒂的模型，质疑模型的参数能否像皮凯蒂认为的那样令模型发挥作用。《皮凯蒂之后》中由戴维什·拉瓦尔（Devesh Raval）撰写的文章便代表着这种质疑的声音。随着财富的积累，经济学家认为资本收益应该会下降：对于社会来说，第一百个工厂或服务器的用处小于第一个。随着资本收益下降，资本家便会去寻觅有利可图的新途径来配置自己的财富，例如投资可取代劳动力的机器。如果企业在利用不断增长的大笔资金取代劳动力这一方面做得还算不错——用经济学的说法，就是资本和劳动力间的替代弹性大于1——那么财富就会像皮凯蒂认为的那样积累起来。如果市场无法令资本实现更佳配置，导致资本收益大幅降低，那么 r 就会下降至 g 的水平，财富占GDP的比率将最终稳定下来。除拉瓦尔外，还有其他很多经济学家指出，大多数对替代弹性的估算得出的结果均小于1。

在经济学中，这样的批评可算切中要害。不过这一论证将替代弹性看作经济运转良好的一个重要参数，但也许它并不是。《皮凯蒂之后》中最尖锐的文章出自苏雷什·耐杜（Suresh Naidu）之手。他刻画了一个“被驯化的皮凯蒂”：这个皮凯蒂用经济学的语言来传达自己的思想，并依赖替代弹性等因素作为自己的论据。不过《21世纪资本论》中还有一个“野性难驯

的皮凯蒂”。这个皮凯蒂关注社会规范、政治制度以及原始权力的运用。他提出， $r > g$ 不是一个有待否决的理论，而是一个需要去解释的历史事实。他还指出，富人会运用自己的权势来影响法律和社会，以此保证自己的财富能获得更好的回报。

富人果真如此吗？过去40年的历程多少有所提示。最高税率下降，金融监管放松（至少在2007到2008年的金融危机发生前是这样），企业发现减少对员工应尽的义务也变得容易了。经济学家通常会称赞这些举措提高了效率。然而，多少有些尴尬的是，这段历史也跟这样的叙事相一致：富人们想方设法保护自己的收益，不惜牺牲劳动力。在一个政治及体制稳定可被视作理所当然的世界里，注重效率无可厚非，而如果不是在这样的世界，对效率的注重就不是无可争议的事了。

| 该怎么做？

正如伊丽莎白·雅克布斯（Elisabeth Jacobs）在其文章中提到的那样，政治在皮凯蒂的书中“无处不在，又难觅踪影”。《21世纪资本论》一书中，所有对政治和意识形态未充分展开的论证都潜藏着一个信息，它在《皮凯蒂之后》中得到揭示，那就是如果经济学家只能在政治保持不变的情况下阐述资本主义如何运作，那他们为自己设置的任务就太简单也太没用处了。■



Cyber-security

The exploits of bug hunters

Trading in software flaws is a booming business

TO HELP shield their products from ransomware like the recent worldwide WannaCry attack, most big software-makers pay “bug bounties” to those who report vulnerabilities in their products that need to be patched. Payouts of up to \$20,000 are common. Google’s bounties reach \$200,000, says Billy Rios, a former member of that firm’s award panel. This may sound like good money for finding a programming oversight, but it is actually “ridiculously low” according to Chaouki Bekrar, boss of Zerodium, a firm in Washington, DC, that is a dealer in “exploits”, as programs which take advantage of vulnerabilities are known.

Last September Zerodium’s payment rates for exploits that hack iPhones tripled, from \$500,000 to \$1.5m. Yuriy Gurkin, the boss of Gleg, an exploit-broker in Moscow, tells a similar story. Mundane exploits for web browsers, which might, a few years ago, have fetched \$5,000 or so, are now, he says, worth “several dozen thousand”. Unsurprisingly, Zerodium and Gleg are not alone in the market. Philippe Langlois, head of P1 Security, a Parisian firm, reckons there are more than 200 exploit brokers in the world.

Such brokers buy exploits from freelance hackers, who make a profitable hobby out of searching for vulnerabilities. They then sell them to those who can use them. Some, Zerodium and Gleg among them, are perfectly respectable, and choosy about whom they deal with (Zerodium says it declines more sales than it makes). Government agencies in America and western Europe, in particular, are eager customers. Others are less scrupulous. For example, e-mails posted to WikiLeaks in 2015 show that Hacking Team, a Milanese broker, sold exploits to Bahrain, Egypt, Morocco, Russia, Saudi Arabia, Sudan and the United Arab Emirates, none of which

has a sparkling record of democracy and freedom.

Exploits are also sold in shadowy online markets, where customers are often out-and-out criminals. At some point, no doubt, WannaCry changed hands this way. Nor is that lack of doubt rhetorical, for monitoring activity in the nether parts of the web can, and in this case did, offer omens of trouble to come.

Just as someone will sell you an exploit, so someone else will sell you a warning. One such is CYR3CON, in Phoenix, Arizona. This firm produces reports of possible threats, based on the results of its software sifting automatically through the online writings, in 15 languages, of hackers involved in the field.

On April 15th, a month before WannaCry began freezing data on Windows-based computers, CYR3CON's software picked up chatter about exploits designed for just that task. Eleven days later, it highlighted exchanges about one such exploit that had been installed but not yet activated on more than 62,000 computers. Many were in medical facilities that had previously paid up "without unnecessary conversations". Forewarned, those who had been using CYR3CON's services could take precautions. Others were not so fortunate. ■



网络安全

查漏商机

软件漏洞信息交易蓬勃发展

最近，“想哭”（WannaCry）勒索软件侵袭全球，为保产品免受类似攻击，大多数大型软件公司都会提供“漏洞赏金”来鼓励人们报告产品中需要修补的漏洞。赏金高达两万美元的情形稀松平常。据谷歌赏金评审小组前成员比利·里奥斯（Billy Rios）说，谷歌的赏金更是高达20万美元。作为发现编程漏洞的报酬，这听起来似乎挺高，但在Zerodium的老板肖德基·贝克拉（Chaouki Bekrar）看来，这实际上“低得可笑”。他的公司位于华盛顿特区，是个交易“漏洞利用程序”的公司。

去年9月，Zerodium对攻击iPhone的漏洞利用程序的出价提高两倍，从50万美元增至150万美元。莫斯科漏洞利用程序中间商Gleg的老板尤里·古尔金（Yuriy Gurkin）透露的情况也差不多。他说网页浏览器的普通漏洞利用程序在几年前大概叫价5000美元，现在值“好几万”。毫不奇怪，Zerodium和Gleg在这个市场上不乏同行。巴黎公司P1安全（P1 Security）的负责人菲利普·兰洛伊丝（Philippe Langlois）估计，全球目前有超过200家漏洞利用程序中间商。

这些中间商从独立黑客（他们以寻找漏洞为爱好并以此获利）手中买入漏洞利用程序，然后卖给能用得上这些程序的人。其中，像Zerodium和Gleg这样公司算是相当正派，它们会谨慎挑选交易对手，比如Zerodium就表示自己谢绝的交易比达成的要多。美国及西欧的政府部门尤其热衷与这些公司交易。不过另一些公司就不那么讲究道德操守。例如，2015年发布在维基解密网站的电子邮件显示，米兰一家名为黑客团队（Hacking Team）的中间商把漏洞利用程序出售给了巴林、埃及、摩洛哥、俄罗斯、沙特阿拉伯、苏丹及阿联酋。这些国家在民主自由方面的记录都不太光彩。

漏洞利用程序也在网上黑市交易，客户往往是彻头彻尾的犯罪分子。无疑，“想哭”病毒在某个时候便是以这种方式转手交易的。说“无疑”并非夸

大，因为对网络黑市的监测能发现麻烦将至的迹象，而这次也确实洞察到了危险。

既然有人售卖漏洞利用程序，就会有人出售病毒预警。亚利桑那州凤凰城（Phoenix）的CYR3CON就是这样一家公司。该公司的软件会自动筛查相关领域黑客的网络文字（涵盖15种语言），然后生成有关潜在威胁的报告。

4月15日，距离“想哭”病毒攻击使用Windows系统的计算机并加密其数据尚有一个月，CYR3CON的软件注意到了一组聊天记录，里面谈到的正是为此次攻击而设计的一些漏洞利用程序。11天后，CYR3CON特别标出了有关其中一个程序的讨论。那个程序已被安装在超过6.2万台计算机上，不过尚未激活。这些计算机中有许多都属于医疗机构，这些机构之前被勒索时都是“二话不说”，立马付钱。一直使用CYR3CON服务的用户收到了预警信息，得以采取预防措施。其他人就没那么幸运了。■



Crowd-funding startups

Placing trades

An attempt to bring liquidity into a new market

EVERYONE would like a piece of the next Google or Facebook. But the big venture-capital (VC) firms do not usually raise money from small investors. And some entrepreneurs complain that it is hard to get noticed by the hotshots in the VC industry. Hence the enthusiasm for crowd-funding, where small investors can buy a stake in startup companies.

Seedrs, a British crowd-funding firm, was set up in 2012, and has backed 500 firms so far, raising a total of £210m (\$271m) from more than 200,000 users. But there are two big problems with crowd-funding. First, it is risky: most startups fail. Second, investments tend to be illiquid—shareholders have to wait for a takeover or a stockmarket flotation to recoup their investment.

Seedrs is trying to solve the illiquidity problem by setting up a secondary market, where buyers and sellers can exchange shares. The new market will start operating this summer, and will allow trading for a week every month, starting on the first Tuesday. The price at which investors can deal will be set by Seedrs itself, based on a valuation mechanism in line with industry guidelines. But there are some restrictions: only current investors in a firm will be allowed to buy shares. And, to the extent that investors make a profit on a sale, Seedrs takes a 7.5% cut of the gains.

Crowd-funding might be even more attractive if investors could at a click assemble a diversified portfolio of small stakes in 20-30 companies rather than just one—just as those who put money into peer-to-peer lending can spread their risk across a range of borrowers. The next challenge will be to build on early efforts to offer the same to investors in shares: ie, mutual

funds for crowd-funded startups. ■



众筹创业

开始交易

一项旨在为新市场带来流动性的尝试

谁都想从下一个谷歌或Facebook那里分得一杯羹。但大型风投公司通常不会向小投资者募集资金。而一些企业家则抱怨很难得到风投界大咖的注意。因此，人们对能让小投资者入股创业公司的众筹热情高涨。

英国众筹公司Seedrs成立于2012年，至今已投资了500家公司，从超过20万用户那里筹集到总共2.1亿英镑（2.71亿美元）。但众筹有两大问题。首先，它有风险：大多数创业企业都会失败。其次，这种投资往往缺乏流动性——股东必须等待企业被收购或上市才能收回投资。

Seedrs正尝试解决流动性问题，方法是建立一个供买卖双方交易股份的二级市场。这个新市场将在今年夏天开始运作，股份交易从每月第一个星期二开始，为期一周。投资者能交易的价格将由Seedrs以符合行业准则的评估机制为基础自行设定。但也有一些限制：只有已持有某家公司股份的投资者可以购买股票。而且，一旦投资者通过出售股票获利，Seedrs会抽取7.5%的收益。

如果只要轻轻一点击，投资者就能建立一个涵盖20至30家公司（而非一家公司）少量股份的多元化投资组合——就像那些投钱到P2P贷款的投资者通过借钱给不同的人分散自身风险那样——那么众筹也许会更有吸引力。所以下一个挑战将是在既有成果的基础上，向股票投资者提供相同的渠道，即投资于众筹创业的共同基金。■



Crypto-currencies

New money

Bitcoin, its imitators and the risk of a crypto-bubble

IT IS hard to predict when bubbles will pop, in particular when they are nested within each other. It helps to keep this image in mind when considering one of the biggest surges in asset values of recent years: the market value of all the world's crypto-currencies has trebled since the beginning of the year, and is now worth more than \$60bn (see chart).

Bitcoin is the best known of these currencies, especially after hackers in May instructed victims to pay ransoms in the anonymous digital cash in order to get their computer files decrypted (see Science and technology). Not that many bitcoins exist: there are about 16.3m of them, with only 1,800 new ones minted every day. But growing demand has pushed bitcoin's price to a record recent high of about \$1,830, up from \$450 a year ago.

Problems abide. Earlier this year some of the biggest exchanges, such as Bitfinex, experienced problems with their correspondent banks and were unable to pay out real-world currencies to account-holders. To get their money out, they had to buy bitcoin and exchange them elsewhere. Yet the market is becoming more mature: institutional investors, from family offices to hedge funds, have become more comfortable with crypto-currencies, says Mike Komaransky of Cumberland Mining, which arranges over-the-counter trades. Other factors driving demand include fluctuations of China's yuan, the French elections and, in a small way, the ransomware attack (when *The Economist* went to press, only about \$80,000 had been sent to the bitcoin accounts held by the hackers).

Counter-intuitively, bitcoin's biggest weakness—the system's limited capacity—has also increased demand for crypto-currencies. Its developers

have argued for years about how to expand the system, which can only handle seven transactions per second, compared with thousands on conventional payment services. Even before worries surfaced that the currency could split in two over the disagreement, bitcoin holders started to diversify into some of the many other crypto-currencies, or “alt.coins”, to emerge in recent years. CoinMarketCap, a website, lists more than 800, from ArcticCoin, an obscure Russian currency, to ZCoin, which boasts added privacy. The latest beneficiary is Ripple, which saw its market value explode from \$2bn early this month to over \$13bn. Ethereum, which issues “ether”, has jumped from \$700m in January to \$8.6bn.

Ethereum’s surge in turn helped inflate another bubble. Feeling richer, holders of ether started investing in what have come to be called initial coin offerings. Startups sell “tokens”, sub-currencies of sorts, which exist on top of Ethereum. A total of 38 such ICOs have already been launched this year, raising more than \$150m, according to Smith+Crowne, a research firm. This has lured even more money into crypto-currencies. Some of the gains have found their way back into bitcoin and alt.coins. Trading between crypto-currencies has grown tenfold to \$2bn on average a day, says Erik Voorhees, the founder of ShapeShift, a crypto-to-crypto exchange.

The question is not if but when the market will turn. Even crypto-aficionados may run for the exits should bitcoin bifurcate or if one of the ICOs, which are completely unregulated, goes badly wrong—if issuers, for example, abscond with the money. Prices will also suffer should regulators start clamping down on such offerings.

On the other hand, although it is now easy to buy crypto-currencies for real cash, selling big amounts can be hard—as the woes of Bitfinex and others show. This makes sudden outflows unlikely. And the price surges have shown how the crypto-currency system is no longer just about bitcoin. Although it is still the biggest kid on the blockchain and functions, in

effect, as a crypto-reserve currency, it now makes up under half the combined market capitalisation of all crypto-currencies. Come a crash, they may not all fall. ■



加密货币

货币新贵

比特币及其效仿者，以及加密货币泡沫的风险

要预测泡沫何时会破裂很难，尤其是当泡沫套叠在一起时。在观察近年来价值升幅最大的资产之一时，不妨谨记这一点。自今年初，全球所有加密货币的市值已增加两倍，目前总额超过600亿美元（见图表）。

这些货币中，比特币最为人熟知，尤其在5月的事件发生后。当时黑客指示受害者用这种匿名数字现金来支付赎金，以破解遭黑客加密的计算机文件。比特币的数量其实不多，大约有1630万个，每天只能生产出1800个新币。但随着需求日增，比特币的价格已被推至近期新高，从一年前的450美元升至如今的约1830美元。

问题仍旧存在。今年早些时候，Bitfinex等一些最大型的比特币交易平台与代理银行之间产生问题，无法向账户持有人支付法币。为了提现，他们不得不买下比特币，然后在其他地方兑换。但该市场正日趋成熟：从家族理财室到对冲基金的各种机构投资者对加密货币都更放心了，场外交易公司坎伯兰矿业（Cumberland Mining）的麦克·科马兰斯基（Mike Komaransky）说道。其他推动需求的因素包括人民币汇率的波动和法国大选，而勒索软件的攻击也有轻微影响（截至本期《经济学人》出版时，黑客持有的比特币账户只收到约八万美元的赎金）。

有违直觉的是，比特币的最大弱点（系统容量有限）却也推高了对加密货币的需求。其开发人员多年来一直在争论该如何扩展这个系统——它每秒只能处理七宗交易，而传统支付服务每秒可处理数千笔交易。即使在该货币可能因这一分歧而分裂为两种货币的担忧浮现之前，比特币持有人就已着手投资近年来大量涌现的其他加密货币或称“比特币替代品”（alt.coins）。网站CoinMarketCap列出的这类加密货币超过800种，其中包括不知名的俄罗斯“北极币”（ArcticCoin）以及宣称能增强隐私保护的“零币”（ZCoin）。最新的受益者是“瑞波币”（Ripple），本月初其市

值还只是20亿美元，目前已猛增至超过130亿美元。发行“以太币”（ether）的以太坊（Ethereum）的货币市值也从1月的七亿美元跃升至86亿美元。

以太坊币值飙升，进而吹大了另一个泡沫。以太币持有者感到自己阔绰了，于是开始投资所谓的“首次代币公开预售”（initial coin offering，简称ICO）。创业公司销售以太坊上的“代币”，即各类次级货币。据调研公司Smith+Crown的数据，今年已有38项此类ICO推出，共融资超过1.5亿美元。这吸引了更多资金进入加密货币市场。部分获益最终回到比特币及其替代币上。加密货币交易所ShapeShift的创始人埃里克·沃里斯（Erik Voorhees）表示，加密货币之间的日均交易额已增长为原来的十倍，达到20亿美元。

问题不在于市场会否转向，而在于何时转向。假如比特币分裂，或者这些完全不受监管的ICO中有哪个出现了重大问题——例如发行人卷款潜逃，那么即便是加密货币的狂热分子也会立即抽身退场。如果监管机构开始打压这类公开预售活动，价格也将受到影响。

另一方面，虽然目前以法币购买加密货币很容易，要大量卖出加密货币却可能是件难事，正如Bitfinex等交易所的困境所显示的那样。因此，资本突然流出不太可能出现。而加密货币价格的飙升表明，其系统已不再仅仅关乎比特币。虽然它仍是区块链及相关功能的老大哥，实际上，在所有加密货币的总市值中，身为加密界储备货币的比特币占比不到一半。市场一旦崩溃，这些货币不一定会全军覆没。 ■



Output gaps

Countries with positive output gaps tend to experience accelerating inflation

The output gap measures how far away an economy is from its full potential, a sweet spot defined as the level of output consistent with stable inflation and full employment. Countries with positive output gaps tend to experience accelerating inflation, indicating economic growth may soon slow. The IMF thinks that many central and eastern European countries may have closed their output gaps this year (although it also warns that estimating these gaps precisely is tricky). In Romania, a 16% rise in the minimum wage is likely to lift domestic demand; inflation should also start to pick up. Policymakers in Bosnia and Ukraine, which still have big negative output gaps, will surely look on in envy. ■



产出缺口

产出缺口为正值的国家往往会经历通胀加速

产出缺口衡量经济体的实际产出与其全部潜力（即实现通胀稳定和充分就业时的产出水平）之间的差距。产出缺口为正值的国家往往会经历通胀加速，表明其经济增长可能即将放缓。国际货币基金组织认为，许多中东欧国家可能会在今年弥合产出缺口，但也警告说，要准确估算这些缺口并不容易。在罗马尼亚，最低工资上涨16%可能会提振国内需求，通胀也应该会开始回升。波斯尼亚和乌克兰仍要面对巨大的产出缺口负值，其政策制定者肯定会对邻国羡慕不已。 ■



Sporting mega-events

Gamesmanship

The business model for the Olympic Games is running out of puff

PIERRE DE COUBERTIN, the French aristocrat who founded the modern Olympics, was seduced by the world's fair. In 1900, 1904 and 1908 his games were embedded within such exhibitions. He soured on the arrangement eventually because the games were overshadowed, “reduced to the role of humiliated vassal”, as he put it. The Olympics still criss-crosses the globe, but with city after city ditching ambitions to put on the world's largest sporting event, the model is under threat.

The latest blow comes courtesy of Budapest, which on March 1st withdrew its bid to host the 2024 summer games after public opposition. Its retreat comes on the heels of Boston, Rome and Hamburg canning their bids within the past two years, whittling a once-crowded pool of candidate cities down to only two: Los Angeles—itself a replacement for the torpedoed Boston bid—and Paris.

The situation ought to feel familiar by now to the International Olympic Committee (IOC), the governing body of the games. After lots of cities bowed out of the competition for the 2022 winter games it was again left with two options: Almaty, Kazakhstan and Beijing, China. The prospect of having no bidders for future events—or of having a bidding contest between autocrats eager to host a vanity project—seems likelier than it once did.

A study in 2016 from the University of Oxford's Saïd Business School found that from 1960-2016 (when data were available), the average cost overrun of hosting the games was 156%, the highest of any megaproject. Tokyo has already seen its costs rise to ¥3trn (\$26bn), four times the original estimate.

The IOC's contract with host cities includes a taxpayer guarantee, which puts them on the hook for overruns.

There is no end of enthusiasm from sponsors or television broadcasters to pay fat sums to affiliate themselves with the Olympic brand. Broadcasters are still making the bet that live sports will continue to fascinate TV audiences. Comcast, the parent company of NBC Universal, an American television company, paid a whopping \$7.75bn for exclusive broadcast rights to the games from 2022-2032. But the IOC pockets an ever-greater share of these revenues: today it gives less than 30% of television revenues to the host city. In 1992, by contrast, it gave Barcelona 69% of the broadcast spoils (see chart).

If no cities wish to host the games, however, this model is unsustainable. The IOC has been here before. Interest in hosting the five-ringed circus waned in the 1970s after a series of games tainted by terrorist attacks, crippling debt and boycotts. Los Angeles was the sole bidder for the 1984 event. Peter Ueberroth, the businessman heading its bid, ripped up the taxpayer guarantee and imposed spartan conditions, such as housing athletes in university dormitories. The games turned a profit for the city, of \$215m.

Could similarly radical reform save the day again? In 2014 the IOC passed Agenda 2020, changes that try to make the games more affordable. They have made little difference. After Budapest withdrew its bid, the IOC said in a statement that politics were to blame, before conceding that further adjustments to the bidding process would need to be made because “the current procedure produces too many losers.”

It could simply tinker with the existing model and give a larger share of its revenues to the host city, or promise to cover a portion of a city's cost overruns. Some suggest a more decentralised hosting model, with different

Olympic events taking place in those cities around the world that have the right sports infrastructure for them. This would spread the costs more widely and decrease the probability of white elephants. But broadcasters would bear the cost of setting up teams around the world.

The really radical answer would be to designate one or a few permanent host cities so that the Olympics sports infrastructure has a life beyond the extinguishing of the Olympic flame. Christine Lagarde, managing director of the International Monetary Fund, has spoken favourably of this idea. The proposal is not new. In 1896 Greece's King George pleaded with de Coubertin to make the country the permanent host. The Frenchman would not have it. "I decided to act as if I were stupid, pretending not to understand," he wrote. Thomas Bach, the IOC's president, may not have the luxury of ignoring reality for much longer. ■



主办大型赛事

竞技手腕

奥运会的商业模式已然力不从心

现代奥运会的创始人、法国贵族皮埃尔·德·顾拜旦（Pierre de Coubertin）被世界博览会吸引，在1900、1904和1908年把奥运会融入世博会中。最终他对这样的安排大失所望，因为奥运会的光芒被掩盖，如其所言，“沦为一个受辱的附属品”。如今，奥运会仍风行全球，但随着越来越多的城市放弃竞逐这项全球最大体育赛事的举办权，其商业模式正受到威胁。

最新的打击来自布达佩斯。因民众反对，该市政府在3月1日撤回举办2024年夏季奥运会的申请。这是过去两年内继波士顿、罗马、汉堡之后又一放弃申办的城市。原本热闹拥挤的竞逐场上如今只剩下两个城市：洛杉矶（替代被撤回提名的波士顿）和巴黎。

对于奥运会的主管机构国际奥委会来说，这种情况应该并不陌生。之前多个城市相继退出申办2022年冬奥会，当时同样只剩下两个选择：哈萨克斯坦的阿拉木图和中国北京。相比以前，未来赛事的主办权大有可能无人问津，或只有那些急切想搞面子工程的独裁政权来争夺。

牛津大学赛德商学院（Saïd Business School）在2016年的一项研究发现，从1960年至2016年（可获数据的年份），举办奥运会平均超支156%，为所有大型项目中最高。现在，东京奥运会的筹办成本已升至三万亿日元（260亿美元），是当初估算额度的四倍。国际奥委会与主办城市的合约包含一份纳税人财政支持的保证书，主办城市因而要为超支兜底。

赞助商或电视广播公司倒是拥有无尽的热情，愿意花大价钱让自己与奥运会品牌挂钩。广播公司仍押注体育赛事现场直播能继续吸引电视观众。美国电视公司NBC环球（NBC Universal）的母公司康卡斯特（Comcast）以77.5亿美元的天价买下了2022年至2032年的奥运会独家转播权。但国际奥

委会从这些收入中捞取的比例越来越高：现在，分到主办城市手中的电视转播收入只有不到30%。相比之下，在1992年，巴塞罗那还能拿到69%的转播权收入（见图表）。

然而，如果没有城市愿意主办奥运会，这样的模式就不可持续了。国际奥委会也不是头一次遇到这样的问题。上世纪70年代，由于一系列赛事受累于恐怖袭击、沉重债务及联合抵制，各国对于举办这一五环竞赛的兴趣大减。洛杉矶是1984年奥运会的唯一申办城市。作为组委会主席的商人彼得·尤伯罗斯（Peter Ueberroth）弃用纳税人财政保底的条款，实行简朴办事的原则，比如用大学宿舍为运动员提供住宿。这届奥运会令洛杉矶赚得2.15亿美元的利润。

类似的激进改革能否再次扭转乾坤？2014年，国际奥委会通过了《2020议程》，提出了试图降低奥运会举办成本的一系列改革。不过到目前收效并不大。布达佩斯宣布退出申办后，国际奥委会在一份声明中把这归咎于政治因素，之后又承认申奥过程需要进一步调整，因为“当前的程序产生了太多的输家”。

国际奥委会可以简单地修补现有模式，并将更大份额的收入分给主办城市，或承诺负担一部分的成本超支。有人建议采用更分散的举办模式，即不同的奥运赛事在全球具有相应体育基础设施的不同城市举行。这样能更广泛地分摊成本，减少产生大而无用的设施。但转播机构将承担派出团队到世界各地转播赛事的成本。

真正激进的方案是指定一个或几个永久性主办城市。如此一来，场馆设施在奥运圣火熄灭后仍可继续保留使用。国际货币基金组织总裁克里斯蒂娜·拉加德（Christine Lagarde）对此想法表示赞同。这一提议并不新鲜。1896年，当时的希腊国王乔治恳求顾拜旦让希腊永久主办奥运会。这位法国人没有答应。他写道，“我决定装疯卖傻，装作没听明白。”如今，国际奥委会主席托马斯·巴赫（Thomas Bach）可能没有这样的资本无视现实，久久地拖延下去。■



Corporate-bond markets

Broken dealers

Corporate-bond markets are astonishingly archaic. Time to bring them into the 21st century

STOCKMARKETS are the public face of finance; indices like the S&P 500 are widely reported proxies for economic health. But they are dwarfed by the corporate-bond markets. In 2016 American equity issuance amounted to just under \$200bn; for corporate bonds the total was \$1.5trn.

The market for corporate debt is not just vast, at \$50trn globally, it has also been growing fast as a result of ultra-cheap borrowing. Issuance in America has risen by half over the past five years. Yet despite its importance as a source of financing for companies, the corporate-bond market is shockingly archaic. Even basic price data are hard to come by. Whereas stocks can be traded at the click of a button, buying and selling corporate bonds often requires a phone call to a trading desk at an investment bank. This method of trading still accounts for over 80% of volume in America. Processes are correspondingly slow: 8% of trades in Europe fail to settle in the allotted two days.

Such inefficiencies partly reflect the particularities of bond markets. An individual firm may have one or two types of shares, but issue dozens of bonds that differ by maturity, date and seniority in its capital structure. Any given bond is thus traded only rarely. In the past, banks made markets by holding an inventory of bonds on their balance-sheet until a buyer came along. Those electronic platforms that do exist have largely stuck to this dealer-based model: under “request for quote” systems that account for almost 95% of electronic trading, dealers are still the only ones with the power to provide a quote and to buy or sell.

But this system is creaking. Tougher capital regulations implemented after the financial crisis sought to discourage banks from holding bonds. Trading desks now hold just 1% of all bonds, down from 2.4% as recently as 2007. Average trade sizes have also fallen. Demand from central banks, in places where corporate-bond purchases were part of quantitative-easing (QE) programmes, may have obscured the extent to which marketmakers have pulled back. As QE unwinds, shortfalls in liquidity may become apparent.

Restoring the banks to their market-making role by relaxing capital rules is no answer. If trouble strikes, it is better for banks to be out of harm's way. Instead, corporate-bond markets need to learn from equities and help buyers and sellers to meet and trade. Regulators can do their bit by requiring prices to be reported for completed transactions, as incoming European rules will from early 2018, and as America has in a more limited fashion since 2002. But the market is also showing the way. A new technology known as "all-to-all" trading allows one institutional investor in a network to trade bonds with any other. There are also systems to help dealers keep track of inquiries across time, turning them from risk-takers into matchmakers.

| *Entering the electronic age*

These innovations will not suit everyone. The automation of equity markets has cut the earnings of brokers; an end to those chummy phone calls will do the same in the bond markets. But investors can only gain from an environment where it is easier and cheaper to buy and sell bonds. Issuers will also benefit from markets that can smooth out turbulence rather than turn it into a full-scale panic and, in normal times, from a lower cost of capital. The corporate-bond market will never be as simple or liquid as the stockmarket. But it can still learn lessons from its higher-profile cousin. ■



公司债市场

过时经纪商

公司债市场极其老旧过时。该让它们进入21世纪了

股票市场是金融的门面。作为经济健康状况的指标，标准普尔500这样的指数被广泛报道。但它们和公司债券市场一比全都相形见绌。2016年美国股票发行额接近2000亿美元，而公司债发行额达1.5万亿美元。

全球公司债市场的规模为50万亿美元，不仅大，而且由于借贷成本极低，增长速度也很快。过去五年来，美国的公司债发行量增长了一半。然而，尽管公司债是企业融资的重要来源，但公司债市场的落后程度令人震惊。即使是基本的价格数据也难以获取。点击按钮就可以交易股票，但买卖公司债券往往需要打电话给投资银行的交易台，这种方式仍占美国公司债交易额的80%以上。交易流程因而也相当缓慢：欧洲有8%的交易都未能在两天限期内结算。

这种低效一定程度上反映出债券市场的特殊性。某家公司的资本结构中可能有一两种股票，却发行了数十种久期和清偿优先级各不相同的债券。因此任何一种债券的交易量都很小。过去，银行通过在自己的资产负债表上持有一批债券来做市，直到买方出现。市场上确实存在一些电子交易平台，但大多采用此种交易商模式：“请求报价”系统几乎占到电子交易的95%，在这种系统内，只有交易商可以提供报价，并买进卖出。

但这个系统已经运转不灵。金融危机后实施的资本法规越来越严，意在阻止银行持有债券。现在交易台的债券持仓量只占总量的1%，低于2007年的2.4%，平均每笔交易量也有所下降。购买公司债是量化宽松政策的一部分，央行对公司债的需求可能掩盖了做市商退出的影响。随着量化宽松政策的退出，流动性短缺可能会变得明显。

通过放松资本规则来恢复银行充当做市商的角色解决不了问题。如果遇到麻烦，银行最好还是能远离危害。相反，公司债券市场需要学习股票市

场，为买卖双方牵线搭桥，协助交易。监管机构可以要求上报已完成交易的价格，新引入的欧洲规则将从2018年初开始有此要求，美国自2002年以来一直有此类要求，但比较有限。不过市场也在指明方向。一种叫做“多对多”的交易新技术允许一个网络内的任意两个机构投资者彼此交易债券。还有一些系统能帮助交易商追踪历史“请求报价”数据，将其从风险承担者转变为牵线搭桥者。

| 进入电子时代

这些创新不会让所有人都开心。股票市场自动化减少了经纪商的收益；在债券市场，终结密切电话沟通的历史也将带来同样的效果。但唯有债券交易变得更容易、成本更低，投资者才能获利。如果市场能够消除动荡，而不是引起全面恐慌，发行人也将受益；而且在正常情况下，较低的资本成本也会让发行人受益。债券市场永远不会像股票市场那样简单，流动性也不会那么高，但仍可从这位更受瞩目的“表亲”身上汲取些经验。 ■



Sheryl Sandberg on grief

To have and to hold

A Silicon Valley heroine explains how to make something out of a sense of nothingness

IN 2013 Sheryl Sandberg became famous, thanks to “Lean In”, her book about how women can control their own fate if they “lean in” to opportunities. But in 2015, the senior Facebook executive was reminded that you can lean in and still fail to control the direction of your life. While on holiday in Mexico, her husband, Dave Goldberg, suffered from a heart arrhythmia, fell off a treadmill and died.

Ms Sandberg shares a great deal of herself and what she has learned since in “Option B”, which she has written with Adam Grant, a professor of psychology and management at the University of Pennsylvania’s Wharton School and author of “Originals”, a business book about “out-of-the-box” thinking. “Option B” takes its name from an anecdote in which Ms Sandberg tells a friend that she does not want to take part in a parent-child activity without Goldberg; with option A not available, she has to choose the second-best option.

At its core “Option B” is a self-help book for those who have been felled by despair. People who have not experienced tragedy often distance themselves from mourners, uncertain of what to say or how to act. But what mourners want is for others to recognise their pain, not hide from it. This book is a guide both for those who have directly suffered loss and for those who are close to people who have. Its optimistic thesis is that adversity can change people for the better. They can “bounce forward” after a tragedy and become more resilient.

Ms Sandberg tracks how her behaviour and perceptions of life changed when she lost her husband. She acknowledges that she was too simplistic

in her earlier book, telling women looking to excel professionally that they should share household chores with their husbands. Many women are single mothers, who raise children alone without a partner. Ms Sandberg realised this when she found herself suddenly on her own, albeit with vastly more resources than most.

The most provocative chapter is about widowhood and dating after losing a spouse. Women are judged harshly for finding another partner. Among the middle-aged, more than half of men are in a romantic relationship a year after losing their spouse, compared with only 7% of women. Ms Sandberg experienced at first hand the guilt and stigma that accompany contemplating moving forward, although she was fortunate to have support from Goldberg's mother and brother.

The author is admirably and chillingly honest in the details she shares about the aftermath of Goldberg's death. She describes the "primal screams" of her children, when she tells them their father is dead, and how her mother slept in her bed for a month, holding her as she cried each night. Recounting these stories takes courage, especially for a businesswoman who always appears highly scripted in her public statements.

"Option B" will be helpful for many mourners. But two things hold it back. Although the book has two authors, Ms Sandberg narrates in the first person and Mr Grant is referred to in the third. It feels unbalanced. Indeed, Mr Grant does not really appear until about a quarter of the way through the book, and the reader may be left wondering whose voice is really telling this story. Corporate self-promotion also sneaks into the book's pages, where it does not belong, with mentions of Facebook's power to connect griever and make the world better. In the end an online social network can never really lift someone's fog of grief; it needs time, strength and a willingness to believe that, against the odds, something good can one day

emerge from the bad. ■



雪莉·桑德伯格讲述丧夫之痛

不失不忘

硅谷女强人讲述如何在丧失中重建

2013年，雪莉·桑德伯格（Sheryl Sandberg）出版了《向前一步》，并因此成名。书中讲述道，女性面对机会时若勇敢地“向前一步”，便能掌控自己的命运。但到了2015年，这位Facebook的高管认识到，你可以不断向前，但仍然无法控制人生的方向。在墨西哥度假的时候，她的丈夫戴夫·戈德伯格（Dave Goldberg）突发心律失常，从跑步机上跌倒并死亡。

在《后备选项》（Option B）一书中，桑德伯格分享了很多自己在丈夫去世后的状况和感悟。这本书由她和宾夕法尼亚大学沃顿商学院心理学和管理学教授亚当·格兰特（Adam Grant）合著，格兰特是关于创新思维的商业书籍《原创力》（Originals）的作者。《后备选项》这个书名源自桑德伯格的一则轶事。她跟朋友说，丈夫不在身边，她并不想参加某个亲子活动。但没有了首选，她只能接受次优选项。

从本质上说，《后备选项》是一本为被绝望击倒的人而写的励志书。没有经历过悲剧的人常常会与哀痛者保持距离，因为不确定该说什么或作何表现。但哀痛者需要的正是他人能明白自己的痛苦，而不是回避它。这本书对那些亲身经历过丧亲之痛的人以及他们的亲朋好友都有指导作用。本书乐观积极，认为逆境会让人变得更好，人们会在悲剧之后“重新振作”，变得更坚韧。

桑德伯格回顾了丈夫去世后自己在行为及对生活的认识上发生的转变。她承认自己在前一本书中想得简单了。在那本书里，她告诉追求事业成功的女性，应该和丈夫分担家务。然而有许多女性是单亲妈妈，她们独自抚养孩子，并没有伴侣协助。桑德伯格在突然间事事都要靠自己时才意识到这一点，而她拥有的资源远多于大多数女性。

最易引起争论的一章是关于失去另一半后的寡居生活和约会的经历。女性

会因寻找新伴侣而遭人指手画脚。一半以上的中年男性在丧偶一年后就有了恋爱对象，而女性只有7%。桑德伯格亲身体会到在考虑迈出新的一步时伴随而来的内疚和耻辱感，尽管她很幸运地得到了婆婆和小叔子的支持。

作者坦呈丈夫逝世后的诸多细节，令人钦佩却也不忍卒读。孩子们从她那里得知父亲的死讯后，发出了“撕心裂肺的哭喊声”；整整一个月里母亲都同她睡在一起，她夜夜哭泣，母亲便抱着她。重述这些过往需要勇气，尤其这是一个在公开场合发言时似乎从来滴水不漏的商界女强人。

《后备选项》对许多陷入哀痛中的人都有帮助。但它有两点不足：本书有两位作者，桑德伯格以第一人称讲述，格兰特以第三人称出现，这导致失衡之感。而且格兰特在约四分之一后的篇章里才真正出现，读者可能会搞不清到底谁才是真正的讲述者。公司宣传也混进了书里——说Facebook能让悲痛的人互相结识，让世界更美好——这不是本书应有的内容。说到底，在线社交网络永远不能真正吹散笼罩在人们心头的阴霾。要真正走出悲痛，人们需要时间和力量，还要愿意去相信：即便命运坎坷重重，某天必能在伤痛中重见阳光。 ■



Cyber-security

Stream slip

A different kind of film review

REMEMBER that racy film you probably should not have enjoyed on Netflix last weekend? Eran Tromer's algorithms can tell what it was. Although videos streamed from services such as Netflix, Amazon and YouTube are encrypted in various ways to ensure privacy, all have one thing in common: they leak information. Dr Tromer, of Tel Aviv university, his colleague Roei Schuster and Vitaly Shmatikov of Cornell have worked out how those leaks can identify the film you are watching—even if they cannot directly observe the stream of bits delivering it, or obtain access to the device on which you are watching it.

Videos streamed over the internet are usually transmitted using a standard called MPEG-DASH. This chops a data stream up into segments that are then encrypted and fetched one at a time by the machine playing the video. The result is an on-off, "bursty" pattern of data arrival. But not all segments are equal. One depicting the mating habits of sloths will contain less information than another showing a car chase. Streaming services use something called variable bit-rate (VBR) compression to take advantage of this. Amorous-sloth segments are compressed to a greater degree than those involving car chases, reducing the overall amount of data that must be transmitted. That means segments of the same duration (in seconds) have different sizes (in bytes). The resulting pattern forms a video fingerprint.

Dr Tromer's method recognises this fingerprint by comparing it with a pre-assembled library of such prints that a snooper has made from videos the viewership of which he might want to follow. The detection algorithm involved is a version of a program called a neural network, a type of

software adept at signal-recognition tasks. Once trained, Dr Tromer's neural network can identify films with up to 99% accuracy, based on a fingerprint between one and five minutes long.

The cleverest part, though, is that, unlike other efforts to exploit leaky video streams, it does not actually need direct access to the stream itself, or even to the device the video is being shown on. By planting a small amount of JavaScript code in a web browser on a personal computer or smartphone that is merely attached to the same Wi-Fi network as the viewer's device, the film being watched can be identified with almost the same accuracy.

Web browsers confine JavaScript—which is ubiquitous in web pages and advertisements, and runs automatically—to a “sandbox” supposed to prevent it from collecting private information. JavaScript code can, however, still communicate with the computer server that sent it—and this is enough for Dr Tromer. It enables his implant to flood the entire Wi-Fi network with random data, creating congestion. The result is that a video stream feeding another device on the network will create bursty delays in the JavaScript's communications with its own server. Measuring these is enough for the spyware to be able to identify the film being watched.

Such information can reveal a lot about a viewer's personality, preferences, politics and so forth. As Dr Tromer notes, by being able to monitor this, “I can show personalised ads based on your viewing habits, adjust your insurance premiums or send in the Spanish Inquisition.” That last suggestion, tongue-in-cheek though it may be, is the most troubling. Censors using his technique could spot and block the viewing of things they disapproved of, no matter how highly encrypted those things were.

At the moment, there is no practical way to derail such attacks. Eliminating VBR would increase network congestion, bringing data-buffers into play to deal with information overflow and underflow. That would translate, for

viewers, into the resurrection of buffering messages, now largely a thing of the past.

In most countries, placing this sort of spyware on a machine without permission would be illegal. But its ability to spy remotely might get around that. Also, blanket permissions associated with installing new software, carelessly agreed to, might see it arrive on clueless users' machines within the letter, if not the spirit of the law. Mind how you go, then. And watch what you watch. ■



网络安全

视频泄密

另类影评

还记得上周末你在Netflix上看的那部激情电影吗？可能你不该看的——埃兰·特拉马（Eran Tromer）的算法能说出你看了哪一部。虽然Netflix、亚马逊和YouTube等服务运用各种不同的方式加密视频流以保护隐私，但它们还是有一个相同点：泄露信息。特拉马在特拉维夫大学任教，他和同事罗伊·舒斯特尔（Roie Schuster）以及康奈尔大学的维塔利·施玛蒂科夫（Vitaly Shmatikov）已经有办法利用这些泄露的信息来识别出你在看什么电影——即使他们并不能直接监测传送电影的比特流，也无法访问你正在看电影的设备。

互联网上的视频流通常使用MPEG-DASH标准来传送。它将数据流分割成一个个数据切片，再把这些切片加密，之后由播放视频的机器每次提取一个切片播放。结果就是数据以断续的“阵发性”模式到达。然而并非所有的数据切片都是一模一样的。一个表现树懒交配习惯的切片比一个展示飞车追逐的切片包含的信息要少。流媒体服务使用一种名叫可变比特率

（VBR）的压缩技术来利用这一点。相比飞车切片，对树懒交配切片的压缩率更高，从而减少了传输后者所需的数据总量。这意味着时长相同（以秒计）的切片大小并不相同（以字节计）。由此产生的切片序列就构成了一个视频的指纹。

特拉马博士能够识别出这一指纹，方法是把它和预先建立的视频指纹库进行比对——监测人员已经预先对一些他们想要跟踪收视情况的影片提取了指纹。所用的检测算法基于名为神经网络（一种擅长处理信号识别任务的软件）的程序而开发。经过训练，特拉马的神经网络能根据一个长度为1至5分钟的视频指纹来识别电影，准确率高达99%。

然而这一算法最聪明的地方在于，不像其他利用泄露的视频流的做法，它实际上并不需要直接访问视频流本身，甚至也不用访问正在播放视频的设

备。在一台个人电脑或智能手机的网络浏览器中加入几行JavaScript代码，只要把这台设备连接到观看者的设备所在的Wi-Fi网络，就可以识别出他观看的电影，准确率几乎也可达到99%。

网络浏览器会把JavaScript（它在网页和广告中无处不在，并且自动运行）置入“沙箱”中，以防它搜集私人信息。不过，JavaScript代码仍能与发送它的计算机服务器通信——而这对特拉马来说已经足够了。这让他植入的代码得以在整个Wi-Fi网络中发送大量随机数据，造成拥塞。结果就是，向网络上另一个设备传输的视频流会让JavaScript与其自身服务器的通信产生阵发性延迟。测量这些足以使间谍软件识别出正在播放的电影。

这些信息可以揭示观众的个性、喜好、政治立场等方面的很多情况。正如特拉马指出的那样，通过这种监测，“我能根据你的观看习惯来播放个性化的广告、调整你的保费，或者提交给西班牙宗教法庭”。最后的那点暗示尽管可能是开玩笑的，却最令人不安。使用这一技术的审查者可能会发现并阻止人们观看他们所禁止的东西，无论这些内容的加密程度有多高。

目前，没有可行的方法能防止这种攻击。摒弃可变比特率将会加重网络拥塞，需要使用数据缓冲区来处理信息流过大或过小的问题。对观众而言，这将表现为缓冲提示再度出现，而它原本已基本成为历史。

在大多数国家，未经允许就将这类间谍软件放到机器中是违法的。但它的远程侦测能力或许能绕过法律限制。此外，人们在安装新软件时会草率地同意那些一揽子许可协议，这可能令间谍软件潜入设备而用户却浑然不觉——这符合法律条文，却违背法律精神。所以你还得小心行事，留心自己观看的东西。■



The revival of cities

Back from the brink

“The Age of Spectacle” is a story of revival

IN 1977 the state of New York hired Milton Glaser, a graphic designer, to help improve its image. Undoubtedly, it needed a lift. Wealth had been escaping New York City for years. Manufacturing had fled to cheaper sites and crime had filled the gaps. Mr Glaser’s simple “I Love New York” logo marked the beginning of an economic and social revival so dramatic that Ed Koch, the mayor, was able to declare: “We’re not catering to the poor any more...there are four other boroughs they can live in. They don’t have to live in Manhattan.”

“The Age of Spectacle” by Tom Dyckhoff, a British architecture critic, is the story of the transformation of cities from the dense manufacturing hubs of the early 20th century to the consumerist meccas they are today. He begins with Jane Jacobs and Ruth Glass, two social scientists who spotted that middle-class youngsters in 1960s London were refusing to move to the suburbs as their parents had done. This was driven both by the “stifling conformism” of life on the outskirts, and, according to Raphael Samuel, a historian, by a love of “values inherent to the dense, historic city, whether its aesthetic form, its layers of history, its ability to somehow encourage neighbourliness or its sheer excitement.” Mr Dyckhoff notes the casual manner in which Ms Glass defines this behaviour as “gentrification”, identifying a movement which he believes became “the most significant force in Western cities in the second half of the 20th century”.

Gentrification might have proved a passing fad, had it not been for favourable government policy and economic trends. The author identifies the role of restoration grants and right-to-buy schemes in cementing the movement. But he is also good at deconstructing the myths that surround

gentrification: “Nothing did the job better of simultaneously rooting you, distinguishing you, emancipating you, investing your money in something safe, but risky enough to stimulate dinner-party conversation—and displaying it for all the world to see—than buying a shabby little warehouse or townhouse downtown, and getting the builders in.” From this point onwards, housing was given a wider purpose than providing shelter; it had to reflect its owners’ identity and make them money.

As cities began to compete more aggressively for investment and employment, they were forced to distinguish themselves. This, according to Mr Dyckhoff, was what lay behind the wave of grandiosity in public architecture, his age of spectacle. But it is also here that his argument loses focus. He marvels at the Guggenheim Museum in Bilbao designed by Frank Gehry, puzzles at Zaha Hadid’s MAXXI gallery in Rome and is alienated by Rem Koolhaas’s CCTV building in Beijing. It is not clear if he believes that the movement to create eye-popping buildings in public spaces is a good thing, or if it depends on the architectural merit of each construction. He is wearied by contemporary bridges that insist on the function of crossing becoming an experience. “No bridge can sit there quietly, keeping itself to itself. It has to be interesting.” Mr Dyckhoff seems to be afflicted by what Mr Koolhaas calls the “Dubai icon paradox”: “When everything looks so wildly different, it ends up looking all the same.”

He has a sharper vision of where architecture is heading. He notes the challenge of working with heavy, permanent materials in a digital age defined by speed and agility. In response, architecture has gone on “a crash diet, losing kilograms, countless tonnes”; interiors have been stripped back in order to cater to every potential occupant; a building’s skin has become more important than ever. In Munich Mr Dyckhoff visits Jacques Herzog and Pierre de Meuron’s football stadium. Clad in partly translucent plastic blisters embedded with strips of light, “the entire façade glow[s] like a low-resolution TV set, bearing the team colours.” Here he sees a building that

transcends its weightiness to communicate to its users, and finally finds a thrill in the experience.

Clarification: Further to our review last week of “Option B” by Sheryl Sandberg (“To have and to hold”), we would like to make clear that her husband, Dave Goldberg, suffered from a heart arrhythmia while on an exercise machine, and died suddenly. ■



城市的复兴 绝处逢生

《奇观时代》讲述了一个关于复兴的故事

1977年，纽约州聘请平面设计师米尔顿·格拉赛（Milton Glaser）帮助改善该州的形象。毫无疑问，纽约州当时确实需要改头换面一番。财富在多年前就已逐步逃离纽约市。制造业也已迁往更便宜的地方，犯罪活动乘虚而入。格拉赛设计了“我爱纽约”（I Love New York）这个简单的图标，标志着经济和社会复兴的开始。这场复兴翻天覆地，纽约时任市长郭德华（Ed Koch）甚至声称：“我们再也不是专为穷人服务的了……他们还有其他四个区可以住，不是非得住在曼哈顿。”

在《奇观时代》（The Age of Spectacle）一书中，伦敦建筑评论家汤姆·迪克霍夫（Tom Dyckhoff）讲述了城市从20世纪初密集的制造业中心转变为现在的消费主义者圣地的故事。他从简·雅各布斯（Jane Jacobs）和露丝·格拉斯（Ruth Glass）开讲，这两位社会学家发现，20世纪60年代伦敦的中产阶级年轻人拒绝像他们的父辈那样搬到郊区。除了因为郊区生活“因循守旧得令人窒息”，这里头还有历史学家拉斐尔·塞缪尔（Raphael Samuel）提到的另一个原因，那就是他们热爱“富有历史意味的密集城市与生俱来的价值，无论是它的美学形态、历史积淀，还是它鼓励睦邻友好的莫名能力和纯粹的刺激”。迪克霍夫指出格拉斯将这一行为定义为“绅士化”时的漫不经心，而他本人则相信这场运动已成为“20世纪后半期西方城市最重要的力量”。

要不是由于有利的政府政策和经济趋势，绅士化可能只是昙花一现。作者指出旧建筑修复拨款和公共住房折价购买计划在强化这一运动中起到的作用。不过他也善于解构关于绅士化的神话：“要想同时让你扎下根来，让你与众不同，让你获得自由，把你的钱投资到安全之处，但也足够冒险而能成为晚宴的谈资，还能让人人都看得到，最好的办法莫过于在市区买个破旧的小仓库或联排屋，让建筑工人来翻新。”自此以后，住房被赋予了更广泛的目的，除了遮风挡雨，还要能体现屋主身份并帮他们赚钱。

城市之间在投资和就业上的竞争日趋激烈，它们不得不让自己显得与众不同。迪克霍夫认为，这引发了建造宏伟公共建筑的风潮，造就了他所谓的奇观时代。但也正是在这里，他的论述失去了重点。他对位于毕尔巴鄂由弗兰克·盖里（Frank Gehry）设计的古根海姆美术馆（Guggenheim Museum）惊叹不已，对扎哈·哈迪德（Zaha Hadid）设计的罗马MAXXI博物馆感到费解，对雷姆·库哈斯（Rem Koolhaas）设计的北京中央电视台大厦感到疏离。无法确定作者是否认为争相在公共空间建造令人瞠目的建筑是件好事，还是说这要取决于每个建筑物本身在建筑上的价值。对于那些非要把交通功能强调为一种经历的现代桥梁，他感到厌倦。“就没有哪座桥能安静低调地待在那儿的。它非得是有趣的。”迪克霍夫似乎深受库哈斯所说的“迪拜标志悖论”的困扰：“当各种各样的事物看起来如此迥异时，到头来它们就会毫无差别。”

对于建筑的发展方向，迪克霍夫的观点更明确些。他指出在强调速度和灵活的数字时代，与沉重而持久的建筑材料打交道是一种挑战。作为回应，建筑已经在“拼命节食，减掉许多斤、无数吨”；建筑内部返璞归真，这样就能迎合每个可能的住户；建筑的皮囊已经变得比以往任何时候都更重要。在慕尼黑，迪克霍夫参观了雅克·赫尔佐格（Jacques Herzog）和皮埃尔·德默龙（Pierre de Meuron）设计的足球场。在嵌着光条的半透明塑料气囊的包裹下，“整个建筑物荧荧发光，就像个低分辨率的电视机，呈现出球队的标志色”。在这里，他看到一座建筑超越了本身的沉重去和使用者交流。他终于在这次经历中感受到了兴奋。





Crowd-sourcing hedge funds

The wisdom of the herd

A new sort of hedge fund bets on the expertise of amateurs

“QUANT” hedge funds have long been seen as the nerdy vanguard of finance. Firms such as Renaissance Technologies, Two Sigma and Man AHL, each of which manages tens of billions of dollars, hire talented mathematicians and physicists to sit in their airy offices and develop trading algorithms. But what if such talent could be harnessed without the hassle of an expensive and time-consuming recruitment process? That is the proposition Quantopian, a hedge fund and online crowd-sourcing platform founded in 2011, is testing. Anyone can learn to build trading algorithms on its platform. The most successful are then picked to manage money. In April the firm announced it had made its first allocations of funds to 15 algorithms it had selected.

Quantopian would appear to have one striking advantage over its competitors: sheer weight of numbers. The difficulty of hiring and a desire for secrecy limit even big quant funds to a full-time research staff in the low hundreds (Man AHL, for instance, has 120). Quantopian boasts 120,000 members on its platform.

These are amateurs, however, not full-time employees. John Fawcett, Quantopian’s CEO, says many sign up to learn how to apply algorithms to trading; they usually already have experience in coding and modelling in domains outside finance. Few will have their algorithms selected, an honour that comes with a licensing fee of 10% of net profits. The rest can at least use their algorithms to trade their own money.

Mr Fawcett plans both to allocate funds to more algorithms, and to increase allocations to those already picked. There is no dearth of capital. Steve

Cohen, a big-name investor who survived an insider-trading scandal at his previous hedge fund, provided some of Quantopian's venture-capital funding and has pledged up to \$250m to promising algorithms on the platform. The firm intends to launch a fund open to other investors this year.

Quantopian-like models have the potential to bring the gig economy to high finance. Most people on its platform hold full-time jobs or are students, earning some income on the side. At least one quant hedge fund has already bet on the trend. WorldQuant's WebSim platform, like Quantopian's, offers access to financial data and a way to test ideas, though it is geared towards more basic research. The best performers on WebSim can become paid part-time research consultants, of whom there are now close to 500, nearly as many as WorldQuant's full-time staff.

It is still early to judge Quantopian's allocations (ranging from \$100,000 to \$3m per algorithm) by their financial return. As a pioneer, it has no obvious comparators. Some algorithms at Quantiacs, a competitor with only around 6,000 members on its platform, have generated up to 40% returns in the past year, but that is with small allocations of capital (Quantiacs has yet to manage outside assets). So the real test for the crowd-sourcers lies ahead: will a deeper talent pool mean better performance, even when serious money is involved? ■



众包对冲基金 群众的智慧

一种新型对冲基金押注于业余人士的能力

“量化”对冲基金长期以来都被视为金融界里的高智商前沿领域。复兴科技（Renaissance Technologies）、双西格玛（Two Sigma）和Man AHL等公司各自管理着数百亿美元的资产，聘请天才数学家和物理家坐在宽敞的办公室里开发交易算法。但假如无需耗资费时的招聘程序便可利用这类人才呢？这正是创立于2011年的对冲基金及网上众包平台Quantopian正在尝试的事。任何人都可以在它的平台上学习创建交易算法。公司而后选出最成功的算法来管理资金。4月，该公司宣布已把首批资金配置给选出的15种算法。

相比竞争对手，Quantopian似乎有一大显著优势：人多势众。招聘的难度，加上公司希望保密，即便是大型量化基金公司也只是一两百个全职研究人员（比如Man AH有120人）。而Quantopian的平台拥有12万会员。

但这些人都是业余人士，并非全职员工。Quantopian的首席执行官约翰·福西特（John Fawcett）表示，许多人注册是为了学习如何将算法应用于金融交易，他们通常在金融业以外的领域已经拥有编程及建模的经验。极少数人的算法会被看中，但如果有幸被选用，便可获得净利润的10%作为授权费。其余的人至少可以用自己的算法来交易自己的资金。

福西特计划配置资金到更多的算法上，同时对已选用的算法追加配置。可投入的资本很充裕。著名投资人史蒂夫·科恩（Steve Cohen）挺过了自己上一只对冲基金的内幕交易丑闻，他为Quantopian提供了一部分风险投资，并承诺对平台上被看好的算法提供最高达2.5亿美元的投资。

Quantopian打算今年推出一只对其他投资者开放的基金。

Quantopian这类模式有可能把零工经济拓展到涉及巨额资金的高端金融领域。其平台用户大多是在职人士或在校学生，只为兼职赚些外快。至少有

一家量化对冲基金公司已经在这一趋势上押注。WorldQuant的WebSim平台跟Quantopian的类似，让人们得以访问金融数据及测试设想，不过该平台针对的是更为基础的研究。在WebSim上表现最佳的人可成为从该公司领取薪水的兼职研究顾问，目前已有近500名，几乎与WorldQuant的全职员工人数相当。

要以财务回报来评价Quantopian的配置（每个算法管理10万美元到300万美元不等的资金），目前还为时尚早。作为行业先锋，Quantopian并无明显可比的对象。对手Quantiacs仅有约6000名用户，但该平台上的一些算法去年产生了高达40%的回报，不过配置的资金数额较小（Quantiacs尚未尝试管理外部资产）。因此，对众包平台而言，真正的考验仍在前方：当涉及巨额资金时，更大的人才库是否意味着更佳的表现？ ■



The maths of life

Mr Big

Non-linear scaling explains everything from the productivity of cities to the safe dosage for LSD

GEOFFREY WEST is the restless sort. He has spent much of his career as a theoretical physicist, working at the Los Alamos National Laboratory in New Mexico. After a while he became fascinated by biology, then cities and companies. He is interested in all sorts of things, from Isambard Kingdom Brunel's ship designs to Ingmar Bergman's films. When he says that he drives his wife nuts, you believe him.

On one level, "Scale" is a book about Mr West's peculiar career path. But on another, it is about the hidden mathematical patterns underlying life, cities and commerce. Many things that appear unrelated are actually linked, he says. The size of an animal is related to the speed of its metabolism and its lifespan. If you know the population of a city and what country it is in, you can predict fairly accurately how many petrol stations it has and how many patents its citizens produce. Mr West even suggests that the mice and the metropolises are linked.

To take an odd example: how much LSD should you give to an elephant, should you feel minded to do such an irresponsible thing? The answer is not the 297 milligrams that was injected into a poor pachyderm called Tusko in 1962, leading shortly to his death. The researchers came up with that amount by extrapolating from research on cats. They had simply scaled up a feline acid dose to account for the greater mass, without accounting for the fact that safe dosages for drugs do not quite double with a doubling in mass, and other factors also play a role. Extrapolate this over the many multiples of mass an elephant has over a cat, and Tusko should have had a few milligrams, not several hundred.

Non-linear scaling relationships such as these fascinate Mr West.

“Underlying the daunting complexity of the natural world lies a surprising simplicity, regularity and unity when viewed through the coarse-grained lens of scale,” he writes. In other words: do not get too distracted by what animals and plants look like, or how they have evolved. Just look at fundamental properties like their size and weight. These tend to obey mathematical laws.

Cities, he suggests, are a little like giant organisms. They often grow in the same exponential way. A map of lorry journeys looks a bit like a network of blood vessels. Cities also scale non-linearly. A city that is twice as populous as another does not have twice as much infrastructure and twice as much productivity. It has a bit less infrastructure than you would expect, and a bit more productivity per head (as well as more crime). Just as an elephant is a more efficient animal than a cat, big cities are more efficient than small ones. That is why people are drawn to them.

Having charted these patterns, Mr West is not quite sure what to make of them. He suggests that urban planners should think of themselves as facilitators of fundamental natural processes. But how, exactly, should they do that? Like many urbanists, Mr West admires Jane Jacobs, who believed that cities such as her beloved New York should be left to evolve naturally rather than being tweaked by meddlesome planners. In fact New York is one of the world’s most rigorously planned cities. Its grid pattern was laid down when the city was just a small settlement on Manhattan’s southern tip.

Mr West is an entertaining, chatty guide to the things that interest him. That is mostly to the good, although the chattiness does mean that “Scale” suffers from a problem of scale. A ruthless editor could have excised at least a quarter of the words and created a tighter, more compelling book. Size is not always everything. ■



生命的数学

大先生

非线性增长可以解释从城市生产率到迷幻药安全剂量的各种现象

杰弗里·韦斯特（Geoffrey West）是那种不安分的人。在他职业生涯的大部分时间里，他是新墨西哥州洛斯阿拉莫斯国家实验室（Los Alamos National Laboratory）的一名理论物理学家。过了一阵子，他开始对生物学、然后是城市和企业着迷。他对各式各样的事感兴趣，从伊桑巴德·金德姆·布鲁内尔（Isambard Kingdom Brunel）设计的船到英格玛·伯格曼的电影。他说自己让太太很抓狂——这应该是真的。

从一个层面看，《规模》是一本记录韦斯特古怪职业生涯的书。但从另一个角度看，它讲述的是生命、城市和商业背后隐藏的数学模式。他指出，许多表面上毫无联系的东西实则相关。一种动物的体型大小会关系到它新陈代谢的速度及寿命的长短。如果你知道一个城市有多少人口、属于哪个国家，你就可以相当准确地推算出它有多少座加油站，以及它的居民创造了多少项专利。韦斯特甚至认为老鼠和大都会之间也存在规律性的关联。

举一个奇怪的例子：你该给大象注射多大剂量的迷幻药——假如你有兴趣做这件不负责任的事？答案不应该是297毫克。1962年，一头可怜的名叫塔斯克（Tusko）的大象在注射了这一剂量的迷幻药后很快就死了。这个剂量是研究人员从对猫的研究上推算来的。他们简单地把给猫的剂量按体重比例增加后给大象用，而没有考虑到药物的安全剂量并非简单地按体重的加倍而加倍，而是还有其他因素。大象的体重虽是猫的许多倍，但若推算时考虑到这一点，塔斯克应当注射的剂量是几毫克而非几百毫克。

这样的非线性增长关系让韦斯特着迷。“透过规模这一粗糙的镜头来观察，自然世界那令人畏惧的复杂表象之下竟是出奇地简单、规律和统一。”他写道。换言之，不要被动植物的长相所迷惑，或者太过关心它们是如何进化的，只要看看大小和重量等基本特征，它们往往遵循数学定律。

他指出，城市有点像巨大的生物。它们通常以相同的指数方式增长。一张卡车路线地图看起来有点像血管网络。城市也遵循非线性扩张。假如一个城市的人口比另一个城市多一倍，其基础设施的数量和生产率并不会相应多一倍。基础设施要比你预期的少一些，人均生产率则是略高些（犯罪率也更高）。正如大象是比猫更高效的动物，大城市也比小城市更高效，而这正是人们被大城市吸引的原因。

描绘出这些模式之后，韦斯特不太确定要如何利用它们。他认为城市规划者应该将自己视为基本自然过程的协调者。但他们究竟该怎么做呢？和许多城市规划研究者一样，韦斯特推崇简·雅各布斯（Jane Jacobs）。雅各布斯认为应当任由城市（比如她热爱的纽约市）自然演变，而非被规划者的干预所扭曲。实际上纽约是全球最严格规划的城市之一。当这座城市还只是曼哈顿岛南端的一小片居住区时，就已经确定了网格状的城市布局。

在谈论自己感兴趣的事物时，韦斯特是一个有趣而健谈的向导。这总体而言是件好事，不过这种健谈也使得《规模》出了规模问题。要是编辑心狠手辣一点，本书的字数至少可以砍掉四分之一，从而变得更紧凑、更扣人心弦。规模并不总是一切。■



Britain's Olympic athletes

What price victory?

Big money and ideas from musicians, soldiers and private-equity gurus are behind major medal hauls

IT SEEMS hardly an auspicious time to release a book on Britain's Olympic success. Numerous scandals—accusations of bullying, sexism and failure to keep proper records of drugs—are engulfing British Cycling, a symbol of national glory. Yet the transformation of Britain's performance in the Olympics remains a remarkable tale. In 1996, Britain's "team of shame" came 36th in the medal table, below Algeria, Ireland and North Korea. At the London games of 2012, Team GB (as the United Kingdom's squad is officially known) won 65 medals, up from 15 in 1996. Britain performed even better in Rio last year, winning 27 golds and 67 medals in all, finishing second, above China, in the overall medal table, defying the trend of host nations' sliding down the tables in the following games.

These hauls have been a triumph for detailed and ambitious planning, as Owen Slot, a sports writer for the *Times*, explains in an engaging book. Huge spikes in cash have helped. Across Olympic and Paralympic sports, UK Sport, Britain's funding body, spent £69m (\$89m) on Sydney 2000 but almost £350m on Rio 2016. Yet cash alone cannot explain all of Team GB's success: for the 2012 games, South Korea and Japan spent over three times more than Britain and had worse returns.

UK Sport adopts the mindset of an investor seeking the best returns wherever they can be found. The model has been unashamedly ruthless, concentrating on disciplines with the best medal prospects while ditching also-rans. Even among the sports that do receive funding, cash is diverted to a tiny coterie of elite athletes: the £21m allocated to swimming before Rio was focused on nine "Golden Children". Before Rio 2016, Liam Tancock,

Britain's best male swimmer of recent times, lost his funding largely because he would turn 31 before the games—past his prime.

Mr Slot's attention to detail turns up some fascinating facts. East German-style national talent-scouting programmes were created, producing Olympic medallists from those who had never previously played the sport—in the process debunking a widespread notion that 10,000 hours are needed to achieve excellence in a skill. Coaches were hooked up to heart-rate-variance monitors, to understand how to manage their stress levels better, and Team GB's managers analysed the optimal way to coach athletes of different sexes. Teams engaged parents about the best techniques for nurturing high-performance athletes. The British Olympic Association made its first reconnaissance mission to Brazil, to find ideal hotels and training facilities, six years before Rio 2016.

UK Sport has borrowed from a wide array of fields in pursuit of an edge. Music schools and military special forces were asked for advice on spotting talent and performing under pressure, and an expert in turning around flagging businesses, borrowed from a private-equity firm, helped improve British shooting's meagre performance. Mr Slot's book is written in conjunction with Simon Timson and Chelsea Warr, two of Team GB's directors of performance, who contribute a brief summary of lessons after each chapter. Their input is double-edged: it ensures that the book provides an unrivalled look inside UK Sport's medal-factory, but may also keep Mr Slot from tackling some subjects with complete independence.

The increased investment in the Olympics and the subsequent bonanza of medals, may have given Britain a reason to hold its head high. But success for the elite has come at a time of falling sports participation in Britain, with the decline greatest among the poor. For all the successes, the question lurking beneath this book is an uncomfortable one. In an era of austerity and impoverished grassroots sport, has the price of these medals

been too great? ■



英国奥运健儿

胜利的代价有多大？

奖牌丰收背后的大笔金钱以及来自于音乐家、军人和私募高手的思想

要出一本书讲述英国在奥林匹克上的成就，现在似乎不是个好时候。许多丑闻——关于霸凌、性别歧视和未能妥善记录药品的指控——正在吞噬着自行车运动这个英国国家荣耀的象征。不过，英国在奥运会上表现的转变依然是一个传奇故事。1996年，英国的“耻辱之队”在奖牌榜上排名第36，排在阿尔及利亚、爱尔兰和朝鲜之后。在2012年伦敦奥运会上，大不列颠队（英国国家队的官方名称）赢得了65枚奖牌，而1996年时只有15枚。英国在去年的里约奥运会上表现更进一步，赢得了27枚金牌和67枚奖牌，在总奖牌榜上超越中国位居第二，打破了东道国在后续奥运会中成绩下滑的惯有趋势。

这些收获是详尽而宏伟的规划的胜利，《泰晤士报》的体育作家欧文·斯洛特（Owen Slot）在一本引人入胜的书中这样解释道。猛增的现金投入收到了效果。在奥运会和残奥会上，英国的筹资机构英国体育（UK Sport）在2000年悉尼奥运会上花费了6900万英镑（合8900万美元），而在2016年里约奥运会上则花费了将近3.5亿英镑。然而，单从资金来看并不能解释英国队的全部成功：在2012年奥运会上，韩国和日本的花销是英国的三倍多，回报却较差。

英国体育投资者的态度，并坚持不懈地寻求最佳回报。这个模式出奇地冷酷，专注于夺牌希望最大的项目，而把陪跑者弃置一旁。即使在获得资助的项目上，资金也集中在寥寥几位精英运动员身上：里约奥运会前，划拨给游泳项目的2100万英镑集中在九位“金童”身上。在2016年里约比赛前，英国近年来最好的男子游泳运动员利亚姆·坦考克（Liam Tancock）失去了资助，主要是因为他在赛前已满31岁——巅峰期过去了。

斯洛特对细节的关注引出了一些迷人的事实。英国设立了东德式的全国人才探寻计划，从以前从未参加过某项运动的人中制造出了奥运奖牌获得者

——在这个过程中破除了需要一万小时才能在某项技能上实现卓越的流行观念。教练挂了上心率波动监测仪，以了解如何更好地管理自己的压力水平，而英国队的经理则分析了训练不同性别的运动员的最佳方式。运动队联系家长，介绍培养杰出运动员的最佳技术。早在2016年里约奥运会举办的6年前，英国奥委会就前往巴西执行了第一次侦察任务，寻找理想的酒店和训练场所。

英国体育从许多领域借鉴经验以获得优势。他们向音乐学校和军事特种部队咨询如何发现人才和抗压，从一家私募股权公司延请擅长为衰败企业扭转局面的专家，帮助改善了英国射击队的糟糕表现。斯洛特的这本书是和英国国家队的两位业绩总监西蒙·蒂姆森（Simon Timson）和切尔西·沃尔（Chelsea Warr）合作完成，这两人贡献了每章末尾简短的经验小结。他们的参与是一把双刃剑：确保了这本书无与伦比地展现了英国体育奖牌工厂的内幕，但同时可能也使得斯洛特无法完全独立地处理某些话题。

对奥运会投资的增加以及随之而来的奖牌潮可能让英国有了昂首挺胸的理由。然而，精英的成功恰逢英国体育参与率下降的时代，而穷人的参与率下降最大。尽管讲述了种种成功，这本书背后却隐藏着一个让人不安的问题：在财政紧缩而草根体育贫瘠的年代，这些奖牌的价格是否过高？ ■



Buttonwood

Jumping the shark

The exchange-traded fund industry is getting too specialised

THERE comes a time when every financial innovation is taken a bit too far—when, in television terms, it “jumps the shark” and sacrifices plausibility in search of popularity. That may have happened in the exchange-traded fund (ETF) industry. The latest ETF to be launched is a fund that invests in the shares of ETF providers.

The notion has a certain logic. The ETF industry has been growing fast, thanks to its ability to offer investors a diversified portfolio at low cost. The assets under management in these funds passed \$3trn last year, up from \$715bn in 2008. Some investors might well want to take advantage of that rapid expansion.

But by no stretch of the imagination would this be a well-diversified portfolio; it would be a focused bet on the financial sector. And many of the companies in the portfolio, such as BlackRock, a huge fund manager, and NASDAQ, a stock exchange, are involved in a lot more than just ETFs. Even if the ETF industry keeps growing, the bet could still go wrong.

The new fund (with the catchy title of the ETF Industry Exposure and Financial Services ETF) is just the latest example of the industry’s drive to specialisation. The earliest ETFs bought diversified portfolios that track indices such as the S&P 500. But there are now some 1,338 specialist funds worldwide, with \$434bn in assets, according to ETFGI, a research firm.

Some of these specialist funds are based on industries, such as energy or media. They appeal to investors who believe an industry will outperform, but who do not want to pin their hopes on an individual company. But

others are pretty obscure: an ETF that invests in founder-run companies, with just \$3.1m in assets, for example; or another which buys shares in companies based near Nashville, Tennessee, with \$8.5m. A recent fund was launched to back companies involved in the cannabis industry.

Heady stuff. But the more specialised the fund, the fewer companies it has to invest in. So these funds will probably be more volatile and less liquid—not the ideal home for the savings of small investors.

The financial industry has been down this road before. In the early 2000s Britain suffered a crisis in the investment-trust sector. Like ETFs, investment trusts are managed portfolios that are traded on the stockmarket; they have been around since the 19th century. But a craze developed for so-called split-capital trusts, which had different classes of shares; some received all the income from the fund, others all the capital growth. These shares had some tax advantages and were snapped up by small investors. However, some split-capital trusts only invested in the shares of other trusts. When problems emerged in some funds, they rippled right through the asset class, eventually requiring nearly £200m (\$258m) to be paid out in compensation.

A similar pattern emerged, on a much bigger scale, with mortgage-backed securities (MBS) in America. The idea of issuing a bond, backed by mortgage payments, dates back to the 19th century, but the residential MBS market took off in the 1980s. The market jumped the shark only in the early 2000s, with the rapid growth of vehicles known as collateralised debt obligations (CDOs) that grouped mortgage-backed bonds together, giving different investors different rights over the assets and cash flows of the portfolio. Doubts over the creditworthiness of these securities in 2007 triggered the financial crisis.

The ETF sector has not yet reached the extremes attained by split-capital

trusts or CDOs. By and large, funds do not invest directly in other ETFs; although there are a few “leveraged” ETFs, where losses and gains are magnified, they represent only 1% of the industry’s assets.

Still, there are signs that rapid flows into some ETFs can lead to price distortions. A rush of money into gold funds in recent years has caused the VanEck Junior Gold Miners ETF to be the largest investor in two-thirds of the 54 companies it owns, according to Factset, a data provider. The fund’s assets grew by more than half, to reach \$5.4bn, between January 1st and April 17th. The rush was accelerated by another fund which made a leveraged bet on the performance of the VanEck ETF.

The danger is of a feedback effect: as the fund pours money into the smaller companies in its portfolio, their prices rise, attracting more money into the ETF. But should investors change their mind and want to withdraw their money, there could be a sharp fall in these mining shares. VanEck is allowing the fund to invest in larger companies in an attempt to solve the problem. But the more the ETF industry specialises, the more often such difficulties are going to arise. ■



梧桐

开始下坡

交易所交易基金行业变得过于专业化

对每个金融创新来说，都总有那么一天会玩过头。用电视术语来说，就是“剧情开始走下坡”后，用来涨人气的招数反倒牺牲了合理性。交易所交易基金（ETF）行业可能也已出现了这种情况——即将发行的最新一只ETF投资的是ETF基金公司的股份。

这种现象有它的逻辑。ETF行业能够以低成本为投资者提供多元化的投资组合，因而发展迅速。去年，这些基金的资产管理规模超过3万亿美元，而2008年时还只有7150亿美元。有些投资者很可能会想要搭上这趟快速行进的顺风车。

但是，ETF无论如何都不会是一个足够多样化的投资组合，而是对金融领域的一种集中的赌注。而且其投资组合中诸如大型基金公司贝莱德和纳斯达克股票交易所等许多公司都远非只经营ETF。即使ETF行业持续增长，这种赌注仍可能出现问題。

那只即将发行的新基金（名字很好记，叫做ETF行业配置和金融服务ETF）只是该行业变得专门化的最新例证。最早的ETF购买多种投资组合，跟踪诸如标准普尔500等指数。但据研究公司ETFGI估计，目前全球约有1338只专门基金，资产总计4340亿美元。

有些专门基金专攻能源或媒体等行业，吸引了那些认为某个行业将跑赢大市但不想押宝在一家公司的投资者。然而其他一些基金的目标相当模糊，比如有一只ETF投资的是由公司创始人管理的公司，资产仅为310万美元；另外一只ETF专门投资美国田纳西州纳什维尔市（Nashville）附近公司的股票，总资产850万美元；最近发行的一只基金则投资大麻行业内的公司。

真是让人晕头转向啊。但是，基金越专门化，可投资的公司就越少，因此波动性可能更大，流动性也可能更差，不是小投资者储蓄的理想去处。

金融业曾走过这样的道路。21世纪的头几年，英国的投资信托领域遭遇危机。和ETF一样，投资信托是可在股票市场上交易的托管投资组合，自19世纪以来一直存在。但是，在21世纪初，市场开始追捧有不同级别份额的所谓分割资本信托，有些人得到了基金的全部收入性收益，其他人则拿到了所有的资本增值收益。这些基金份额有一些税收优惠，小投资者纷纷抢购。然而，一些分割资本信托只投资于其他信托的股份。当一些基金出现问题时，就会通过这一资产类别发生连锁反应，最终需要近2亿英镑（2.58亿美元）来进行补偿。

类似的模式也曾出现在美国，但规模更大，主角是抵押贷款支持证券（MBS）。发行抵押贷款支付债券的理念可以追溯到19世纪，而住宅MBS市场崛起于上世纪80年代。刚进入21世纪，这一市场就开始跳水，当时称为担保债务凭证（CDO）的投资工具快速增长，CDO将抵押贷款债券分组，令不同的投资者对投资组合中的资产和现金流享有不同的权利。2007年，市场对这些证券的资信产生质疑，引发了金融危机。

ETF领域尚未达到分割资本信托或CDO曾达到的极限。总的来说，ETF基金不直接投资于其他ETF，尽管确实有几个“杠杆化”的ETF，令其损失和收益都被放大，但它们只占行业资产的1%。

然而，有迹象表明，资金快速流入某些ETF可能导致价格扭曲。VanEck中小金矿指数基金（The VanEck Junior Gold Miners ETF，简称VanEck ETF）投资54家中小型黄金上市公司的股票。数据提供商FactSet表示，近年来，大量资金涌入黄金基金，导致VanEck ETF在其投资的三分之二的公司里都成了最大的投资者。1月1日至4月17日，该基金的资产增长了一半以上，达到54亿美元。另外一只看好VanEck ETF表现的基金对它进行了杠杆投资，加速了资金的涌入。

这存在反馈效应的危险：由于基金将大量资金投入小型公司，致其股价上

涨，就会吸引更多的资金进入该ETF。但是，如果投资者改变主意，想要收回资金，这些矿业股可能会大幅下挫。VanEck现在允许该基金投资更大型的公司，试图借此解决问题。但是，ETF行业的专门化程度越高，这类困难就会越频繁地出现。 ■



Cloning voices

You took the words right out of my mouth

It is now possible to imitate people's speech patterns easily and precisely. That could bring trouble

UTTER 160 or so French or English phrases into a phone app developed by CandyVoice, a new Parisian company, and the app's software will reassemble tiny slices of those sounds to enunciate, in a plausible simulacrum of your own dulcet tones, whatever typed words it is subsequently fed. In effect, the app has cloned your voice. The result still sounds a little synthetic but CandyVoice's boss, Jean-Luc Crébouw, reckons advances in the firm's algorithms will render it increasingly natural. Similar software for English and four widely spoken Indian languages, developed under the name of Festvox, by Carnegie Mellon University's Language Technologies Institute, is also available. And Baidu, a Chinese internet giant, says it has software that needs only 50 sentences to simulate a person's voice.

Until recently, voice cloning—or voice banking, as it was then known—was a bespoke industry which served those at risk of losing the power of speech to cancer or surgery. Creating a synthetic copy of a voice was a lengthy and pricey process. It meant recording many phrases, each spoken many times, with different emotional emphases and in different contexts (statement, question, command and so forth), in order to cover all possible pronunciations. Acapela Group, a Belgian voice-banking company, charges €3,000 (\$3,200) for a process that requires eight hours of recording. Other firms charge more and require a speaker to spend days in a sound studio.

Not any more. Software exists that can store slivers of recorded speech a mere five milliseconds long, each annotated with a precise pitch. These can be shuffled together to make new words, and tweaked individually so that

they fit harmoniously into their new sonic homes. This is much cheaper than conventional voice banking, and permits novel uses to be developed. With little effort, a wife can lend her voice to her blind husband's screen-reading software. A boss can give his to workplace robots. A Facebook user can listen to a post apparently read aloud by its author. Parents often away on business can personalise their children's wirelessly connected talking toys. And so on. At least, that is the vision of Gershon Silbert, boss of VivoText, a voice-cloning firm in Tel Aviv.

| *Words to the wise*

Next year VivoText plans to release an app that lets users select the emphasis, speed and level of happiness or sadness with which individual words and phrases are produced. Mr Silbert refers to the emotive quality of the human voice as "the ultimate instrument". Yet this power also troubles him. VivoText licenses its software to Hasbro, an American toymaker keen to sell increasingly interactive playthings. Hasbro is aware, Mr Silbert notes, that without safeguards a prankster might, for example, type curses on his mother's smartphone in order to see a younger sibling burst into tears on hearing them spoken by a toy using mum's voice.

More troubling, any voice—including that of a stranger—can be cloned if decent recordings are available on YouTube or elsewhere. Researchers at the University of Alabama, Birmingham, led by Nitesh Saxena, were able to use Festvox to clone voices based on only five minutes of speech retrieved online. When tested against voice-biometrics software like that used by many banks to block unauthorised access to accounts, more than 80% of the fake voices tricked the computer. Alan Black, one of Festvox's developers, reckons systems that rely on voice-ID software are now "deeply, fundamentally insecure".

And, lest people get smug about the inferiority of machines, humans have proved only a little harder to fool than software is. Dr Saxena and his

colleagues asked volunteers if a voice sample belonged to a person whose real speech they had just listened to for about 90 seconds. The volunteers recognised cloned speech as such only half the time (ie, no better than chance). The upshot, according to George Papcun, an expert witness paid to detect faked recordings produced as evidence in court, is the emergence of a technology with “enormous potential value for disinformation”. Dr Papcun, who previously worked as a speech-synthesis scientist at Los Alamos National Laboratory, a weapons establishment in New Mexico, ponders on things like the ability to clone an enemy leader’s voice in wartime.

As might be expected, countermeasures to sniff out such deception are being developed. Nuance Communications, a maker of voice-activated software, is working on algorithms that detect tiny skips in frequency at the points where slices of speech are stuck together. Adobe, best known as the maker of Photoshop, an image-editing software suite, says that it may encode digital watermarks into speech fabricated by a voice-cloning feature called VoCo it is developing. Such wizardry may help computers flag up suspicious speech. Even so, it is easy to imagine the mayhem that might be created in a world which makes it easy to put authentic-sounding words into the mouths of adversaries—be they colleagues or heads of state. ■



语音克隆

你道出我心声

现在机器可以轻松又准确地模仿人类讲话，问题或许也随之而来

巴黎一家新公司CandyVoice开发了一款手机应用，只要对着它说出约160个法语或英语短语，程序就能将这些发音的片段重组，念出之后打字输入的任何字句，听起来和你自己的声音颇为神似。这个应用其实是克隆了你的语音。拼合出的语音听起来还是有点合成的味道，但CandyVoice的老板让·吕克·克莱伯（Jean-Luc Crébouv）认为，公司算法的改进会令声音变得越来越自然。此外还有一款类似的软件Festvox，由卡内基梅隆大学的语言技术研究所针对英语及四种广泛使用的印度语言开发。而中国互联网巨头百度则表示，其开发的软件仅凭50句话就可以模拟一个人的声音。

直到不久前，语音克隆，即过去所说的“语音银行”，还只是个定制业务，为那些有可能因癌症或手术丧失语言能力的人服务。过去，模仿并合成语音耗时漫长，花费不菲。过程中要录制许多短句，每一句都要以不同的情感侧重及根据不同的语境（陈述、疑问、命令等）重复多次，为的是涵盖所有可能的发音。比利时语音银行公司阿卡贝拉集团（Acapela Group）对需耗时八小时的录制过程收取3000欧元（3200美元）的费用。其他公司收费更高，还需要顾客在录音室里花上好几天的时间。

今非昔比。现有的软件可以存储仅五毫秒长的语音录音片段，并逐一精确标注音调。这些片段可以调换顺序组成新词，并可单独微调，让新词听起来自然顺耳。这比传统语音银行便宜得多，而且还可以开发新的用途。妻子不用太费劲，就可以把自己的声音植入盲人丈夫的屏幕阅读软件里。雇主可以把自己的声音用到工厂机器人身上。Facebook用户可以收听仿佛是由帖子作者亲自朗读的内容。经常出差的家长可以个性化配置孩子的无线联网说话玩具。诸如此类。至少，这是特拉维夫语音克隆公司VivoText的老板格森·希尔伯特（Gershon Silbert）的期望。

| 向智者进言

VivoText计划明年发布一款应用，可让用户选择每一个单词和短语的重音、语速、快乐或悲伤的程度。希尔伯特把人声中这种情感特性形容为“终极工具”，但这种力量也让他感到困扰。VivoText将其软件授权给美国玩具制造商孩之宝（Hasbro），这家公司一心想出售互动性更强的玩具。希尔伯特指出，孩之宝也意识到，若没有防范措施，可能会出现一些问题，比如淘气的孩子可能在妈妈的智能手机上输入骂人的话，就为了看弟弟妹妹被玩具用妈妈的声音责骂后嚎啕大哭。

更令人担忧的是，只要在YouTube或其他地方能找到质量不错的语音片段，任何声音都可以克隆，包括陌生人的声音。在尼特什·塞克森纳（Nitesh Saxena）的带领下，阿拉巴马大学伯明翰分校的研究人员凭借短短五分钟的网络讲话片段就用Festvox克隆出了语音。许多银行使用语音识别软件来阻止非法入侵账户，当用这类软件来测试时，超过80%的合成语音成功骗过了计算机。Festvox的开发人员之一艾伦·布莱克（Alan Black）认为，如今依赖语音识别软件的系统“从根本上来说，极为不安全”。

机器的表现是很差，但人也没什么好自鸣得意的。实验证明，相比软件，要骗过人类也难不了多少。塞克森纳博士及其同事先让志愿者听一段90秒的人声录音，然后播放另一个语音样本，让他们判断是否出自说话者本人之口。志愿者仅在半数情况下辨别出了克隆语音，准确率跟纯靠猜是一样的。受聘为法庭鉴定伪造录音证据的专家证人乔治·帕普森（George Papcun）称，这会产生一种“在制造假情报方面有巨大潜在价值”的科技。曾任洛斯阿拉莫斯国家实验室（Los Alamos National Laboratory）语音合成科学家的帕普森琢磨着它会有怎样的用途，例如能否在战时克隆敌方领导人的语音。这一位于新墨西哥州的实验室是军方的武器研发机构。

正如所料，已有机构在开发识别这类骗术的对策。语音控制软件开发商Nuance通讯公司（Nuance Communications）正在研究算法，检测语音片段之间连接点上微小的频率跳跃。以出品图像编辑软件Photoshop闻名的Adobe公司表示，它正在开发的名为VoCo的语音克隆软件也许可在合成

的语音中添加数字水印。这类精妙技术或许有助计算机辨别可疑语音。即便如此，既然人们轻易就能让对手（无论是同事还是国家元首）“亲口”说出逼真的言语，不难想象未来会出现怎样的混乱局面。■



Artificial intelligence

Shall we play a game?

Why AI researchers are so keen on video games

LAST year Artur Filipowicz, a computer scientist at Princeton University, had a stop-sign problem. Dr Filipowicz is teaching cars how to see and interpret the world, with a view to them being able to drive themselves around unaided. One quality they will need is an ability to recognise stop signs. To that end, he was trying to train an appropriate algorithm. Such training meant showing this algorithm (or, rather, the computer running it) lots of pictures of lots of stop signs in lots of different circumstances: old signs and new signs; clean signs and dirty signs; signs partly obscured by lorries or buildings; signs in sunny places, in rainy places and in foggy ones; signs in the day, at dusk and at night.

Obtaining all these images from photo libraries would have been hard. Going out into the world and shooting them in person would have been tedious. Instead, Dr Filipowicz turned to “Grand Theft Auto V”, the most recent release of a well-known series of video games. “Grand Theft Auto V” is controversial because of its realistic portrayal of crime and violence—but from Dr Filipowicz’s point of view it was ideal, because it also features realistic stop signs. By tinkering with the game’s software, he persuaded it to spit out thousands of pictures of these signs, in all sorts of situations, for his algorithm to digest.

Dr Filipowicz’s stop signs are one instance of the fondness that students of artificial intelligence (AI, of which machine vision is an example) have for video games. There are several reasons for this popularity. Some people, such as Dr Filipowicz, use games as training grounds for the real world. Others, observing that different games require different cognitive skills, think games can help them understand how the problem of intelligence

may be broken down into smaller, more manageable chunks. Others still, building on these two observations, think games can help them develop a proper theory of artificial (and perhaps even natural) intelligence.

| *Learner driver*

For all of this to happen, though, the games themselves have first to be tweaked so that they can be played directly by another computer program, rather than by a human being watching the action on a screen. “Grand Theft Auto V”, for instance, can be turned from a source of pictures of road signs into a driving simulator for autonomous vehicles by bolting onto it a piece of software called “Deep Drive”. This lets the driving and navigation programs of such vehicles take control—a cheaper and safer way of testing driving software than letting it loose on roads.

Games companies are beginning to understand this. In June 2015, for instance, Microsoft started Project Malmo, an AI-development platform based on a popular “world-building” game called “Minecraft” that it had recently purchased. In November 2016 Activision Blizzard, owners of “Starcraft II”, a science-fiction strategy game in which players build and command human and alien armies, announced something similar in collaboration with DeepMind, an AI firm owned by Alphabet, Google’s holding company.

The following month, with the permission of the owners involved, a privately financed research group in San Francisco, called OpenAI, released “Universe”. This is a piece of software, free for all to use, which features hundreds of games presented in ways that mean they can be played directly by appropriate programs. The offerings in “Universe” range from bestselling, big-budget titles such as “Portal 2” (a physics-based puzzle game) to cheap-and-cheerful web games like “Bubble Hit Pony Parade” and “James the Space Zebra”.

One of Microsoft's hopes in starting Project Malmö was to teach AI software to collaborate with people. To this end, Katja Hofman, the project's head, is trying to use "Minecraft" to create an advanced personal assistant. Her goal is software that can anticipate what its human operator wants, and help him achieve it. "Minecraft", which is simpler than the real world but still complicated enough to be interesting, makes the perfect testing-ground. Dr Hofman and her colleagues are, for instance, using it to try to teach a computer to work out that it must co-operate with a human player in order to catch a virtual pig. Since the machine is incapable of understanding written instructions, it must learn co-operation purely by watching the actions of its human confrères in the game.

Acting as training wheels for the real world is not, however, the only thing video games can do for AI. The fact that different games require different talents helps researchers chop up the problem of intelligence. In 2015 DeepMind released a paper describing how its researchers had trained an artificial neural network—a program based loosely on the structure of a biological brain—to play dozens of different games released in the 1970s and 1980s by Atari, a pioneering video-games company.

Some games proved harder than others for the network to master.

"Breakout", which is a bit like a single-player version of tennis, was easy. The objective is to smash floating blocks by hitting them with a bouncing ball. A player can do one of two things: move the "racket" left or move it right. Failure is punished instantly (missing the ball costs a life). Similarly, success is instantly rewarded (each smashed block adds to the score). This combination of simplicity and immediate feedback suited DeepMind's neural network, which learnt to play "Breakout" so well that it reached scores more than ten times those a professional human games-tester can manage.

Other games were less straightforward. In "Montezuma's Revenge" the goal

is to retrieve treasure buried deep inside a danger-filled pyramid. To do this players must first achieve lots of sub-goals, such as finding keys to open doors. Feedback is less immediate than in “Breakout”—for instance, a key that turns up in one area might open a door in another, far away. And the ultimate reward, reaching the treasure, is the consequence of thousands of previous actions. This meant that the network found it hard to connect cause and effect. In contrast to its virtuoso performance at “Breakout”, it was able to make almost no headway at all with “Montezuma’s Revenge”.

Since then, DeepMind’s researchers have tweaked their algorithms to make the system more curious about things, by giving it bigger rewards for exploration and experimentation. This makes it more likely to stumble across good strategies which have payouts that are not immediately apparent. That approach is not limit to mastering skills in a virtual world—it can be applied to the real one, as well. DeepMind’s algorithms have, for instance, been put to use in Google’s data centres, where they have developed ways to cut energy use by 40%. Indeed, it is possible to view tasks like that as games in themselves. To cut energy use in a data centre, a network can tweak things like coolant-pump settings and load distributions while keeping an eye on energy use. The lower it can get the “score”, the better it is doing.

| *Embodiments of truth*

At the moment, repurposing a games-playing program to run a data centre’s energy budget really is like teaching it a new game from scratch. That is because DeepMind’s original neural network could learn to play only one game at a time. In order to understand “Breakout”, for example, it would have to forget everything it knew about “Space Invaders”. Such amnesia is in the nature of artificial neural networks—and is something that distinguishes them from real brains. They learn by system-wide adjustments of the strengths of the connections between the virtual

neurons of which they are composed. Change the task to be learned, and the old web of connections will gradually be overwritten. Now, however, as they describe in a paper published in March, DeepMind's programmers have worked out how to overcome this and let a network master many games at once, in the way that a real brain can. That is a step towards transfer learning—the ability to put to use in one context patterns of behaviour learned in another—which is a hot topic in AI research.

Like displaying curiosity and delaying rewards, transferring learning from one task to another is something humans do effortlessly but machines struggle to manage. Here again, games are playing an important role in research. For example, Julian Togelius of New York University has organised a challenge called the General Video Game AI Competition. Entrants must create a single program that can play, with reasonable competence, ten different video games that neither it nor its programmers have come across. This requires the software to master many skills—planning, exploration, decision-making and so on—and apply them to problems it has not previously encountered.

Even when transfer learning is mastered, though, constructing useful artificial intelligence will remain a piecemeal activity. What researchers would really like is an underlying theory of how to do so systematically. One candidate to be such a theory, called embodied cognition, argues that, instead of trying to design intelligence into a program from the beginning, it needs to be learned entirely from experience.

Dr Hofman, in particular, backs this approach. She reckons video games are perfect platforms on which to explore the idea. Previous attempts to study embodied cognition, carried out in the 1980s, involved fitting robots with sensors and letting them learn, by running around and bumping into things, how the real world works. Researchers back then did have some success with this approach, but they ran into problems scaling their

experiments up. As David Silver, who works at DeepMind, observes: “Robots have gears and wheels and motors, and all sorts of fiddly things like that. You end up spending a lot of time doing maintenance work.”

| *Play up, play up and play the game*

Video games can streamline this process. A virtual robot in a virtual world is weightless. It has no moving parts, so needs no maintenance. Adjusting it to change its specifications does not require breaking out the spanners and taking it to bits. A few strokes on a keyboard will suffice.

Its environment can be altered easily, too. Rerouting a maze no longer means welding sheets of metal together or gluing plastic walls. And a computer can run thousands of such simulations at a time, allowing legions of virtual robots to try tasks again and again, learning with each attempt. That kind of large-scale testing, which permits the learning process itself to be monitored and understood, is simply not practical using real machines.

The important thing, according to Demis Hassabis, DeepMind’s founder, is to make sure the virtual robot cannot cheat. It must navigate using only the information its virtual sensors can gather. There can be no peeking behind the scenes of the simulation. If such a robot wants to learn its way around the danger-filled pyramid in “Montezuma’s Revenge”, or the fictional city of Los Santos in “Grand Theft Auto”, it must work out where it is and what is happening from what it can “see”, not by asking the computer which is running the game to give it co-ordinates. This is the approach DeepMind takes when it teaches programs to play video games.

Studying embodied cognition in this way is a logical conclusion of the games-playing approach to AI. It seems an appropriate one. Watch the young of any intelligent creature, from dogs to humans, and you will see them building up something that looks suspiciously like embodied

cognition by playing. Evolution did not have the assistance of computers when it arrived at this process. But the fundamental point of such activity, in both the artificial and the natural worlds, is to prepare players for the biggest game of all—reality. ■



人工智能

玩个游戏吧

为什么AI研究人员如此热衷电子游戏

去年，普林斯顿大学的计算机科学家阿图尔·菲利波维奇（Artur Filipowicz）遇到了一个有关停车标志的问题。菲利波维奇教汽车识别和解读这个世界，希望它们能够无需辅助、自动驾驶。这些汽车必需的一个能力是识别停车标志。为此，菲利波维奇要努力训练出一个合适的算法，也就是给算法（或者说是运行它的电脑）展示各种不同情况下各类停车标志的大量图片。这些标志有的新的有的旧的，有的清晰的有的脏兮兮的，有的局部被卡车或建筑物遮蔽，还有的是在不同天气状况（阳光明媚、阴天下雨、雾气环绕）和不同时间段（白天、黄昏和夜间）拍摄的。

从照片库中找出所有这些图很麻烦，亲自到真实世界中拍照也是个乏味枯燥的活。菲利波维奇仅仅借助了一款电子游戏。著名系列游戏最新版《侠盗猎车手5》（Grand Theft Auto V）因为对犯罪和暴力的真实展现而引发争议，但对菲利波维奇来说却是理想之选，因为游戏中展现了真实的停车标志。对游戏软件一番鼓捣之后，菲利波维奇成功让软件提供了数千张各种情况下的停车标志图片，给他的算法慢慢消化。

除了菲利波维奇的停车标志以外，还有很多人工智能（简称AI，机器视觉就是AI的一种）的研究人员喜欢电子游戏的例子。电子游戏受追捧有几个原因：有些人，比如菲利波维奇，将游戏作为现实世界的训练场；其他人则注意到不同的游戏需要不同的认知技能，认为游戏可以帮助他们了解如何把智能问题分解成更易处理的小模块；还有人基于以上两种原因，认为游戏可以帮助他们发展出一套合适的人工（甚至自然）智能理论。

| 初学驾驶

不过，要让游戏发挥上述这些作用，首先要对游戏本身做调整，以便另一个计算机程序可以直接玩这个游戏，而不是由人看着屏幕来操纵。比方说，通过和软件“Deep Drive”结合，《侠盗猎车手5》就可以从停车标志的

一个资料来源转换为无人驾驶汽车的驾驶模拟器，让这些车辆的驾驶和导航程序来控制汽车。这种测试驾驶软件的方法比让无人驾驶汽车直接上路更便宜、安全。

游戏公司也开始认识到这个趋势。举例来说，2015年6月，微软启动了AI开发平台Project Malmö，这个平台就是基于微软最近收购的《我的世界》（Minecraft）这款热门的“建设世界”游戏。2016年11月，动视暴雪（Activision Blizzard）宣布与谷歌的控股公司Alphabet拥有的AI公司DeepMind达成类似的合作。动视暴雪旗下的《星际争霸II》（Starcraft II）是一款让玩家建设并指挥人类和外星人军队的科幻策略游戏。

之后的一个月里，经相关所有者的许可，旧金山一个由私人资助的研究小组OpenAI发布了对所有人免费的软件“Universe”，这个平台上提供的数百款游戏可以由适当的AI程序直接操作，其中既有物理益智游戏《传送门2》这样畅销的大成本制作，也有《小海马泡泡龙》和《太空斑马》这类低成本的趣味网游。

微软启动Project Malmö的目标之一是教AI软件与人合作。为此，项目负责人卡佳·霍夫曼（Katja Hofman）试图利用《我的世界》来打造出一个先进的个人助理。她希望能开发出一种软件，可以预测并协助实现人类操作者的意图。《我的世界》要比现实世界简单，但它的复杂度已足够有趣，因而成为了一个完美的测试场。例如，霍夫曼及其同事尝试用它来教电脑理解它必须与人类玩家合作，共同捕捉一头虚拟的猪。由于机器无法理解书面指示，所以只能完全通过观察游戏中人类同伴的行为来学习合作。

不过，电子游戏可以为AI做的事不止是提供现实世界的训练场。玩不同的游戏需要不同的能力，这有助于研究人员分解智能问题。2015年，DeepMind发表了一篇文章，描述了研究人员训练一个神经网络玩游戏的过程。这个神经网络粗略模仿人脑结构，玩的是电子游戏先驱雅达利公司（Atari）在20世纪七八十年代发行的数十款游戏。

对于神经网络来说，有些游戏比其他游戏更难掌握。有点像单人版网

球的“打砖块”很容易，这个游戏是用一个不断反弹的球来击打并消除砖块。玩家可以选择将“球拍”向左或向右移动。失败会立即受罚（丢一次球少一条命）。同理，成功会立即得到奖励（消除砖块会加分）。简单的操作加上即时的反馈很适合DeepMind的神经网络，它很快就学会了玩“打砖块”，得分比专业游戏测试人员高十倍以上。

有些游戏就没那么简单了。在“Montezuma’s Revenge”中，要在危险重重的金字塔内探寻深埋的宝藏，玩家必须首先完成许多小任务，例如找到开门的钥匙。游戏中结果的反馈没有“打砖块”那么直接。例如，在一个地方找到了钥匙后，可能要到另一个很远的地方去用钥匙开门。游戏的最终奖励是寻获宝藏，这是之前数千次行为的结果，这让人工神经网络很难建立因果关系。与玩“打砖块”时大师级的表现相反，神经网络在玩“Montezuma Revenge”时几乎一筹莫展。

此后，DeepMind的研究人员调整了算法，为探索和尝试设置了更大的回报，让系统变得更加好奇，从而有可能偶然发现一些没有明显即时回报的好策略。这种方法并不限于掌握虚拟世界的技能，也可以应用于真实世界。例如，DeepMind的算法已用于谷歌的数据中心，找出了将能耗减低40%的方法。实际上，可以将这类任务看成游戏。为了减少数据中心的能耗，神经网络可以调整冷却液泵的设置和负荷分布，同时观察能源消耗。它能把能耗“得分”压得越低，则战绩越好。

| 身体感知真相

目前，调整玩游戏的软件，让它来管理数据中心的能源预算，着实就像从头开始教它玩一个新游戏，因为DeepMind最初的神经网络一次只能玩一个游戏。例如，为了理解“打砖块”游戏，软件必须忘记其所知的《太空侵略者》（Space Invaders）的所有技巧。这种遗忘是由人工神经网络的本质决定的，这也是它与真正的大脑的不同之处。人工神经网络通过对组成网络的虚拟神经元之间的连接强度进行系统性调整来学习。改变学习任务后，旧的连接网络将逐渐被改写。然而，如DeepMind在3月份发表的一篇文章所述，现在他们的程序员已经找到了解决之道，让网络能够同时掌握多款游戏，就像真正的大脑一样，这就向迁移学习（transfer learning）迈

进了一步。迁移学习是指把从一个情景中学到的行为模式应用到另一个情景中的能力，在AI研究中是一个热门话题。

与显示好奇心和延迟获得奖励一样，从学习一个任务转移到另一个任务对人类来说毫不费力，而机器却难以胜任。游戏在相关研究中再次起到了重要的作用。举例来说，纽约大学的朱利安·图吉利斯（Julian Togelius）组织了一个叫做通用电子游戏AI大赛（General Video Game AI Competition）的挑战。参赛者必须编写一个软件，能玩十个软件自身及其程序员都从未玩过的游戏，还要成绩不错。这需要软件掌握多项技能，包括规划、探索、决策等等，还要应用这些能力解决从未遇到过的问题。

不过，即使掌握了转移学习，构建有用的人工智能仍停留在零打碎敲的阶段。研究人员真正希望看到的是可以指导系统性构建AI的基础理论。有望成为这种基础理论的候选之一是具身认知（embodied cognition），这种理论认为，智能不是一开始就在软件中设计好的，而是完全从经验中学来的。

霍夫曼尤其支持这种看法，她认为电子游戏是探索这种理论的完美平台。在20世纪80年代进行的早期具身认知研究中，人们把传感器装到机器人上，让它们磕磕碰碰地四处探索来认识现实世界。当时的研究人员用这种方法确实取得了一些成功，但是他们在扩大实验规模时遇到了问题。DeepMind的大卫·席尔瓦（David Silver）指出：“机器人有齿轮、轮子和电机，以及各种各样的精密零件，最后时间都花在了维护上。”

| 来啊，来啊，一起玩游戏

电子游戏可以简化这个过程。虚拟世界中的虚拟机器人没有重量，没有移动部件，无需维护。改变规格进行调整用不着拿出扳手把它拆成零件，在键盘上敲几下就足够了。

游戏的环境也可以轻松改变。重新设置迷宫路线不再需要焊接金属板或粘合塑料墙壁，一台计算机可以一次运行数千个这样的模拟，让大量的虚拟机器人一次又一次地尝试任务，每次都学到新内容。研究人员还可以监控

和了解学习过程。这种大规模测试用真正的机器根本做不到。

DeepMind的创始人丹米斯·哈撒比斯（Demis Hassabis）认为，重点在于确保虚拟机器人无法作弊，只能使用虚拟传感器收集到的信息来完成任务，而不能有任何窥视虚拟游戏背后数据的行为。如果这样一个机器人想要在《Montezuma's Revenge》中危险重重的金字塔内或者《侠盗猎车手》中虚构的洛斯桑托斯市中完成任务，它必须靠自己“看”来搞清楚自己身处何处，发生了何事，而不是让运行游戏的电脑告诉它坐标。

DeepMind就是用这种方法来教程序玩游戏的。

既然可以通过玩游戏来训练AI，那么用游戏来研究具身认知也就顺理成章。这看起来也是个合适的方式。只要观察一下任何智能生物的幼体，不论狗还是人类，都会看到他们是通过玩来建立认知的，和具身认知很相似。生物进化走到这一步并没有计算机的辅助。但在人工和自然世界中，玩的根本目的都是让玩家为一个最大的游戏做好准备，那就是现实。■



New materials

The lotus position

A self-repairing surface that stays clean and dry

THE repulsive powers of lotus leaves are the stuff of legend. Water sprayed onto them forms instantly into silvery beads (see picture) and rolls right off again—carrying any dirt on the leaf's surface with it.

The physics behind this impressive and beautiful phenomenon is well understood. Lotus leaves repel water because they are covered with minuscule waxy nodules that stop water molecules bonding with a leaf's surface tissues, meaning those molecules bond with each other instead. That arrangement has been replicated in several man-made materials. Unfortunately, these are easily damaged by abrasion—and, not being alive, cannot regrow and repair themselves. They are thus hard to commercialise, which is a pity, because the self-cleaning, self-drying surfaces they create could be of great value. A technique just described in *Langmuir* by Jürgen Rühle of the University of Freiburg, in Germany, may, however, fix this problem by giving lotus-like materials the ability to regenerate when damaged.

Dr Rühle's approach is to mimic a second living organism—this time an animal, the lizard. As lizards grow, their scales do not grow with them. Instead, old scales are shed and replaced from below by new ones. Dr Rühle theorised that it might likewise be possible to create a stack of lotus-like layers that would flake off when damaged, revealing a pristine surface beneath.

Lotus-like man-made materials belong to a class known as nanograsses—so called because, under an electron microscope, they resemble lawns. Dr Rühle's nanograsses have water-repellent “blades” attached to thin sheets of

silicon. The task he set himself was to create a stack of these that could tell when the one at the top was compromised so badly that it needed to be replaced, and then replace it automatically.

He conceived of doing this by gluing the layers of the stack together with a water-soluble material. He reasoned that, as the top layer got worn, and water began leaking through it, this glue would start to dissolve. A small amount of damage would do no harm. But enough would weaken the glue to the point where the uppermost nanograss lawn flaked off, and the next one down took over.

Testing this idea out using an appropriate glue (a special water-soluble polymer), he found that it worked. When he scratched the top of such a stack with a scalpel and exposed it to water, it did, indeed, come loose and fall off as the water seeped into the underlying glue. Such an arrangement will not, of course, last for ever. Eventually, it will run out of layers. But if the idea can be applied to industrial practice, then long-lived, self-cleaning surfaces may at last become routine.

Correction: In “Skating on thin ice” (April 27th) we referred to Oystein Bo as Norway’s defence minister. In fact, he is state secretary in the Ministry of Defence. ■



新材料

莲花效应

一种能保持清洁和干燥的自修复表面

荷叶的疏水性人人皆知。喷洒到叶面上的水会立刻形成晶莹的水珠（见图片）然后迅速滚落，同时带走叶面上所有的污垢。

这令人惊叹而美妙的现象背后有怎样的物理原理，人们已了解得很清楚。荷叶拒水，是因为它们表面覆盖着微小的蜡质结节，会阻止水分子与叶面组织结合，因而水分子只能彼此结合。已有几种人造材料复制了这种结构。遗憾的是，这些材料都很容易因磨蚀而损坏，而且由于它们不是活体组织，无法再生或自我修复。因此，这些材料都难以商业化。这很可惜，因为它们形成的自洁、自干燥表面可能极具价值。不过德国弗莱堡大学（University of Freiburg）的尤尔根·胡荷（Jürgen Rühle）最近刚刚在期刊《朗缪尔》（Langmuir）中介绍了一种技术，可以让仿荷叶材料具备受损后再生的能力，可能会解决这个问题。

胡荷的方法是模仿另一种活体组织。这次是一种动物——蜥蜴。蜥蜴逐渐长大，它们的鳞片并不随之长大。相反，旧鳞片会脱落，被下面长出的新鳞片取代。胡荷由此推测，也许同样可以设计出层层堆叠的仿荷叶膜层，上层在受损后脱落，露出下层的全新表面。

人造的仿荷叶材料属于一类名为“纳米草”（nanograss）的材料，这样叫是因为它们在电子显微镜下看起来很像草坪。胡荷的纳米草有着拒水的“草叶”，附着在硅薄片上。他给自己设定的任务是创造出一叠这样的结构，它能自行判断上层受损的程度已经到了需要替换的地步，而后自动更换。

他设想用一种水溶性材料把各个膜层粘合起来。他解释说，当顶层磨损后，水就会开始渗透下去，这种水溶性粘胶就会逐渐溶解。轻微的损坏不会有太大问题。但严重的损坏会削弱水溶性粘胶的粘合作用，直到最上层的纳米草剥落，露出下一层。

使用合适的粘胶（一种特殊的水溶性聚合物）测验之后，他发现这个想法可行。他用一把手术刀将这种堆叠结构的表层刮破后，让它与水接触。水渗入下方的胶层，表层果真松动并脱落。当然，这种结构并非永续性的，膜层总有一天会掉光。不过，假如这个创意能够应用于工业实践，使用寿命长且有自洁功能的表面也许终会变得司空见惯。





Business advice

Corporate insurgency

Management lessons from an American general

STANLEY MCCHRYSTAL'S voice is hoarse as he addresses a packed arena in Helsinki. His audience, mostly businessmen in dark suits, is rapt. The American former general tells thrilling battlefield stories of leading the Joint Special Operations Command in Iraq, which captured Saddam Hussein and killed Abu Musab al-Zarqawi, al-Qaeda's local chief. He explains how his outfit adapted against an unexpectedly difficult enemy. A change in management style let his group go from conducting a handful of raids each month to hundreds, achieving better results against insurgents.

Neither America's occupation of Iraq nor Mr McChrystal's military career ended well. He went on to lead Western forces in Afghanistan, but stood down in 2010 after falling out with his political bosses. He reinvented himself as a management consultant. His McChrystal Group employs 65 people. It draws on its founder's experience hunting insurgents to advise businesses, including on Wall Street, on corporate culture.

What insight does an old soldier offer? Mr McChrystal is an apostle of devolved responsibility, or letting junior employees know and do more. One convert is his host in Helsinki: Reaktor, a 17-year-old firm of 400 staff, mostly coders, with a side-interest in launching satellites. An employee, Mikko Olkkonen, explains that "we have no hierarchy, no bosses, no targets, no quarters." It heeds Mr McChrystal's approach: firms can adapt in complex competitive environments, he argues, only if information is shared and teams of capable staff—not just the boss—can take decisions. It also helps greatly with recruiting to say that junior staff will have clout early in their careers.

A variety of big firms are listening. Mr McChrystal sits on the board of JetBlue Airways and of an American subsidiary of Siemens, a German engineering company. His firm advises Barrick Gold, a Canadian miner; Under Armour, a sportswear brand; a large bank; and several hospitals. Any assignment begins with “discovery” by an intelligence analyst who previously assessed the organisational structure of al-Qaeda. She works out who takes decisions inside companies. The reality usually differs from formal organisation charts.

“The management ideas I believe in are not revolutionary, but I came at it from a different experience,” says the ex-general. He says firms should break apart “silos” and get employees talking. Mr McChrystal’s advice on devolved power has its limits—no army, after all, has done away with hierarchies entirely, and even decentralised al-Qaeda was weakened by removing its leaders. It is hard to know how much his big corporate clients use the approach in pursuing sales and markets. But hearing an ex-general disparage hierarchies so forcefully thrills employees. Even as a Reaktor staffer explained in Helsinki that Finns rarely idolise heroes, the crowd sent Mr McChrystal off with an excited ovation. ■



商业建议

企业叛乱

一位美国将军的管理课

赫尔辛基的一个场馆里座无虚席。台上的斯坦利·麦克里斯特尔（Stanley McChrystal）声音嘶哑。听众全神贯注——他们多是身着深色西装的商界人士。麦克里斯特尔是退役美军上将，曾在伊拉克领导联合特种作战司令部。他忆述了当时的种种惊险战事：活捉萨达姆·侯赛因，击毙基地组织的当地头目阿布·穆萨布·扎卡维（Abu Musab al-Zarqawi）。他讲解自己领导的部队如何做出调整，以应对异常棘手的敌人。管理风格上的一大转变令部队从每月突袭几次发展为几百次，提升了打击当地叛军的战绩。

美国占领伊拉克以失意收场，麦克里斯特尔的军旅生涯也一样。他后来在阿富汗领导西方部队作战，但在2010年因与其政界上司闹翻而下台。之后他摇身一变，成了一名管理顾问。他的麦克里斯特尔集团（McChrystal Group）雇有65人，运用其创始人当年追捕叛军的经验，为包括华尔街在内的各类公司提供企业文化方面的建议。

一名老兵会提供什么灼见？麦克里斯特尔信奉下放责任，让初级员工了解并承担更多任务。赫尔辛基这场演讲的主办方Reaktor便是皈依该理念的企业之一。这家成立17年的公司有400名员工，大部分为程序员，公司还有卫星发射的副业。员工米克科·奥尔科宁（Mikko Olkkonen）解释说，“我们没有等级之分，没上司，没任务目标，没固定办公室。”该公司认同麦克里斯特尔的方法：只有当信息得以共享、让有能力的员工队伍也可以作决策（而不只限于领导），公司才能适应复杂的竞争环境。宣称初级员工在任职之初便可大展拳脚，这对招聘也很有帮助。

来自不同行业的一批大公司都在洗耳恭听。麦克里斯特尔目前是捷蓝航空公司（JetBlue Airways）和德国工程公司西门子美国子公司的董事会成员。其公司为加拿大矿业公司巴里克黄金（Barrick Gold）、运动服装品牌安德玛（Under Armour）及一家大型银行和几家医院提供咨询服务。

所有任务都先由一名曾评估过“基地”组织架构的情报分析师“刺探”一番。她会研究出这些公司都是由谁来拍板。现实往往与正式组织架构图显示的不同。

“我信奉的管理思想并非革命性的，但那是我从有别于他人的经历中总结而来的。”这位退役将军说道。他表示，公司应打破“竖井”式的组织方式，给予员工发言权。麦克里斯特尔有关下放权力的建议有其局限性，毕竟没有哪支军队完全取消了等级制度，就连去中心化的基地组织在首领被除掉后也受到削弱。麦克里斯特尔的大企业客户在多大程度上运用这一方式来拓展销售及市场？情况不得而知。不过听着一位退役将军如此强烈地抨击等级制度，员工们热血沸腾。在赫尔辛基，正当Reaktor公司的一名员工说芬兰人很少崇拜英雄时，人们向麦克里斯特尔报以热烈的掌声，欢送他退场。■



OPEC policy

Know thy enemy

OPEC is fighting not just shale producers but the futures market—and losing

BORROWING three words from Mario Draghi, the central banker who helped save the euro zone, Khalid al-Falih, Saudi Arabia's energy minister, and his Russian counterpart, Alexander Novak, on May 15th promised to do "whatever it takes" to curb the glut in the global oil markets. Ahead of a May 25th meeting of OPEC, the oil producers' cartel, they promised to extend cuts agreed last year by nine months, to March 2018, pushing oil prices up sharply, to around \$50 a barrel. But to make the rally last, a more apt three-word phrase might be: "know thy enemy".

In two and a half years of flip-flopping over how to deal with tumbling oil prices, OPEC has been consistent in one respect. It has underestimated the ability of shale-oil producers in America—its nemesis in the sheikhs-versus-shale battle—to use more efficient financial techniques to weather the storm of lower prices. A lifeline for American producers has been their ability to use capital markets to raise money, and to use futures and options markets to hedge against perilously low prices by selling future production at prices set by these markets. Only recently has the cartel woken up to the effectiveness of this strategy. It is not clear that it has found the solution.

The most obvious challenge shale producers have posed to OPEC this decade is the use of hydraulic fracturing, or fracking, to drill oil quickly and cheaply in places previously thought uneconomic. Once OPEC woke up to this in 2014, it started to flood the world with oil to drive high-cost competitors out of business (damaging its members' own fortunes to boot).

But it overlooked a more subtle change. Fracking is a more predictable business than the old wildcatter model of pouring money into holes in the

ground, hoping a gusher will generate a huge pay-off. As John Saucer of Mobius Risk Group, an advisory firm, says, shale has made oil production more like a manufacturing business than a high-rolling commodity one.

That has made it easier to secure financing to raise production, enabling producers to spend well in excess of their cashflows. Mr Saucer says the backers of the most efficient shale firms include private-equity and pension-fund investors who demand juicy but reliable returns. They are more likely to hedge production to protect those returns than to gamble on the “home run” of the oil price doubling to \$100 a barrel. “Their hedging is very systematic and transparent,” he says. “They don’t mess around with commodity speculation.”

Data from America’s Commodity Futures Trading Commission, a regulatory body, bear out the shift. They show that energy and other non-financial firms trade the equivalent of more than 1bn barrels-worth of futures contracts in West Texas Intermediate (WTI), more than double the level of five years ago and representing almost a quarter of the market compared with 16% in 2012. Many of these are hedges, though Mr Saucer says the data only reflect part of the total, excluding bilateral deals with big banks and energy merchants.

OPEC and non-OPEC producers unwittingly exacerbated the hedging activity by inflating output late last year even as they decided to cut production from January 1st. The conflicting policies helped depress the spot price relative to the price of WTI futures, preserving an upwardly sloping futures curve known as “contango”. This made it more attractive for shale producers to sell forward their future production, enabling them to raise output.

That higher shale output will persist is borne out by a surge in the number of drilling rigs, which shows no signs of ebbing. The Energy Information

Administration, an American government agency, reckons that by next year the United States will be producing 10m barrels of oil a day, above its recent high in April 2015. That would put it on a par with Russia and Saudi Arabia. Shale producers will have gained market share at their expense.

In response, the frustrated interventionists appear now to have set out to put the futures curve into “backwardation”, in which short-term prices are higher than long-term ones. The aim is to discourage the stockpiling of crude, as well as the habit of hedging. But success is not guaranteed.

The International Energy Agency, a forecasting body, said in mid-May that, even if the OPEC/non-OPEC cuts are formally extended on May 25th, more work would need to be done in the second half of this year to cut inventories of crude to their five-year average, which is the stated goal of Messrs al-Falih and Novak. It also noted that Libya and Nigeria, two OPEC members not subject to the cuts because of difficult domestic circumstances, have sharply raised production recently, perhaps undercutting the efforts of their peers.

Moreover, global demand this year has been weaker than expected. In a recent report, Roland Berger, a consultancy, argued that rich-country oil demand has peaked, and that, as developing countries such as China and India industrialise, they will use oil more efficiently than did their developed-world counterparts (see chart). All this raises doubts about how far the oil price can climb.

Eventually, shale producers will have their comeuppance. Labour and equipment shortages will push up drilling costs. Higher interest rates will dampen investor enthusiasm. “Irrational exuberance” may lead them to produce so much that prices collapse. But for now, Saudi Arabia seems to be leading OPEC into a war it cannot win. As Pierre Lacaze, of LCMCommodities, a research firm, memorably puts it, it has taken “a knife

to a gunfight". Worse, it has wounded mostly itself. ■



欧佩克政策 知己知彼

欧佩克不仅在对抗页岩油生产商，还在对战期货市场，并且战且败

5月15日，沙特阿拉伯能源部长哈立德·法利赫（Khalid al-Falih）和俄罗斯能源部长亚历山大·诺瓦克（Alexander Novak）借用曾助力拯救欧元区的欧洲央行行长马里奥·德拉吉（Mario Draghi）的四个字，承诺将为遏制全球石油市场供大于求而“在所不惜”。在石油生产国联盟欧佩克5月25日的会议召开前夕，两位部长承诺将去年达成的减产协议延长九个月至2018年3月。消息一出，油价应声大幅上涨至每桶50美元左右。但是要保持住这种回升的势头，遵循“知己知彼”这四个字可能更合适些。

在过去两年半的时间里，欧佩克在应对油价下滑方面摇摆不定，但在一个方面却始终如一。在石油对页岩油的斗争中，它一直都低估了美国页岩油生产商这个对手利用更有效的金融手段来抵御低价风暴的能力。这些页岩油生产商利用资本市场融资，并以期货期权市场上设定的价格出售未来的产出，从而对冲危险的低价，这种能力一直是他们渡过低价难关的救生索。欧佩克直到近期才意识到这种策略的有效性，但目前尚不清楚它是否找到了对策。

页岩油生产商利用水力压裂法，在以前被认为开采成本过高的地方快速、低成本地开采页岩油，这成为欧佩克十年来面临的最显著的挑战。欧佩克在2014年意识到这一点后，立即开始向国际市场大量供应石油，希望挤走高成本竞争对手，但同时也牺牲了其成员的收入。

但欧佩克忽略了一个更微妙的变化。比起盲目开采油井的传统模式（大笔投钱、多处钻井，希望有一口井能大量产油，带来巨大回报），压裂法采油的可预测性更高。正如咨询公司莫比乌斯风险集团（Mobius Risk Group）的约翰·索瑟（John Saucer）所说，页岩油开采让产油变得更像制造业，而不是豪赌般的大宗商品行业。

这让页岩油生产商更容易获得融资来提高产量，让它们能利用远远超出其现金流的资金。索瑟说，生产效率最高的页岩油生产商的出资者包括私募和养老基金投资者，它们需要丰厚但稳定的回报。这些资金更有可能对页岩油生产做套期保值来确保回报，而不是去赌石油价格能打出个“本垒打”、上涨一倍到每桶100美元。“它们的套期保值非常系统而且透明，”索瑟说，“不会胡乱去搞大宗商品投机。”

监管机构美国商品期货交易委员会（America's Commodity Futures Trading Commission）的数据证实了这一转变。数据表明，能源和其他非金融公司在WTI原油交易的期货合约的交易价值相当于超过10亿桶原油，是五年前的两倍以上，占市场近四分之一，而2012年还只占16%。其中很多是套期保值，但索瑟说，这些数据还只是反映了一部分交易，并未包括与大型银行和能源商的双边交易。

欧佩克和非欧佩克生产商决定从1月1日起减产，但去年年末却因增加供应而无意中加剧了套期保值。欧佩克政策前后矛盾，帮助打压了现货相对于WTI期货的价格，维持了一个向上的期货价格曲线，即“期货升水”。这让页岩油生产商觉得以期货销售未来产出变得更有利可图，因而不断提高产量。

较高的页岩油产量将持续下去，钻井平台数量激增且没有放缓的迹象证实了这一点。美国政府机构能源信息署（Energy Information Administration）估计，明年美国日产油量将达到1000万桶，超出2015年4月的近期最高水平。这将让美国的产量与俄罗斯和沙特阿拉伯旗鼓相当，页岩油生产商将会侵蚀俄罗斯和沙特的市场份额。

作为回应，沮丧的干预主义者似乎已开始着手要让期货曲线变成“期货贴水”（backwardation），即让现货价格高于远期价格。此举目的在于遏制原油库存增加以及套期保值的做法，但并不一定会成功。

预测机构国际能源署（International Energy Agency）在5月中旬表示，即使欧佩克及非欧佩克的减产协议在5月25日正式延长，今年下半年还需付

出更多努力，将原油库存降至其五年平均水平，这也是法利赫和诺瓦克提出的目标。由于国内困境，利比亚和尼日利亚这两个欧佩克成员国并未遵守减产协议。国际能源署指出，近期两国大幅度提高了产量，可能会削弱其他产油国的努力。

此外，今年的全球需求比预期疲弱。在近日的一份报告中，咨询公司罗兰贝格（Roland Berger）指出，富国的石油需求已达到顶峰，而中国和印度等发展中国家在工业化进程中会比发达国家当年更高效地利用石油（见图表）。所有这些都让人愈加怀疑油价还有多大的攀升空间。

最终，页岩油生产商也将尝到恶果。劳动力和设备的短缺将增加钻井成本；更高的利率会抑制投资者的热情。“非理性繁荣”可能会让页岩油生产商开采出过多的页岩油，从而导致价格崩溃。但就目前而言，沙特阿拉伯似乎正在带领欧佩克投身于一场不可能胜出的战争。研究公司LCMCommodities的皮埃尔·拉卡泽（Pierre Lacaze）说过的一句话令人难忘——欧佩克是“拿着一把刀子去对抗枪林弹雨”。更糟糕的是，它伤到的主要还是它自己。■



The marine world

Deep trouble

Humans are wrecking the ocean. Technology shows the scale of the problem—and offers some solutions

EARTH is poorly named. The ocean covers almost three-quarters of the planet. It is divided into five basins: the Pacific, the Atlantic, the Indian, the Arctic and the Southern oceans. Were all the planet's water placed over the United States, it would form a column of liquid 132km tall. The ocean provides 3bn people with almost a fifth of their protein (making fish a bigger source of the stuff than beef). Fishing and aquaculture assure the livelihoods of one in ten of the world's people. Climate and weather systems depend on the temperature patterns of the ocean and its interactions with the atmosphere. If anything ought to be too big to fail, it is the ocean.

Humans have long assumed that the ocean's size allowed them to put anything they wanted into it and to take anything they wanted out. Changing temperatures and chemistry, overfishing and pollution have stressed its ecosystems for decades. The ocean stores more than nine-tenths of the heat trapped on Earth by greenhouse-gas emissions. Coral reefs are suffering as a result; scientists expect almost all corals to be gone by 2050.

By the middle of the century the ocean could contain more plastic than fish by weight. Ground down into tiny pieces, it is eaten by fish and then by people, with uncertain effects on human health. Appetite for fish grows nevertheless: almost 90% of stocks are fished either at or beyond their sustainable limits (see pages 22-24). The ocean nurtures humanity. Humanity treats it with contempt.

| *Depths plumbed*

Such self-destructive behaviour demands explanation. Three reasons for it stand out. One is geography. The bulk of the ocean is beyond the horizon and below the waterline. The damage being done to its health is visible in a few liminal places—the Great Barrier Reef, say, or the oyster farms of Washington state. But for the most part, the sea is out of sight and out of mind. It is telling that there is only a single fleeting reference to the ocean in the Paris agreement on climate change.

A second problem is governance. The ocean is subject to a patchwork of laws and agreements. Enforcement is hard and incentives are often misaligned. Waters outside national jurisdictions—the high seas—are a global commons. Without defined property rights or a community invested in their upkeep, the interests of individual actors in exploiting such areas win out over the collective interest in husbanding them. Fish are particularly tricky because they move. Why observe quotas if you think your neighbour can haul in catches with impunity?

Third, the ocean is a victim of other, bigger processes. The emission of greenhouse gases into the atmosphere is changing the marine environment along with the rest of the planet. The ocean has warmed by 0.7°C since the 19th century, damaging corals and encouraging organisms to migrate towards the poles in search of cooler waters. Greater concentrations of carbon dioxide in the water are making it more acidic. That tends to harm creatures such as crabs and oysters, whose calcium carbonate shells suffer as marine chemistry alters.

Some of these problems are easier to deal with than others. “Ocean blindness” can be cured by access to information. And indeed, improvements in computing power, satellite imaging and drones are bringing the ocean into better view than ever before. Work is under way to map the sea floor in detail using sonar technology. On the surface, aquatic

drones can get to remote, stormy places at a far smaller cost than manned vessels. From above, ocean-colour radiometry is improving understanding of how phytoplankton, simple organisms that support marine food chains, move and thrive. Tiny satellites, weighing 1-10kg, are enhancing scrutiny of fishing vessels.

Transparency can also mitigate the second difficulty, of ocean governance. More scientific data ought to improve the oversight of nascent industries. As sea-floor soundings proliferate, the supervision of deep-sea mining, which is overseen by the International Seabed Authority in areas beyond national jurisdiction, should get better. More data and analysis also make it easier to police existing agreements. Satellite monitoring can provide clues to illegal fishing activity: craft that switch off their tracking devices when they approach a marine protected area excite suspicion, for example. Such data make it easier to enforce codes like the Port State Measures Agreement, which requires foreign vessels to submit to inspections at any port of call and requires port states to share information on any suspected wrongdoing they find.

Clearer information may also help align incentives and allow private capital to reward good behaviour. Insurance firms, for instance, have an incentive to ask for more data on fishing vessels; if ships switch off their tracking systems, the chances of collisions rise, and so do premiums. Greater traceability gives consumers who are concerned about fish a way to press seafood firms into behaving responsibly.

| *Sunk costs*

Thanks to technology, the ocean's expanse and remoteness are becoming less formidable—and less of an excuse for inaction. A UN meeting on the ocean in June in New York is a sign that policymakers are paying more attention to the state of the marine realm. But superior information does not solve the fundamental problem of allocating and enforcing property

rights and responsibilities for the high seas. And the effectiveness of incentives to take care of the ocean varies. Commercial pay-offs from giving fish stocks time to recover, for example, are large and well-documented; but the rewards that accrue from removing plastic from the high seas are unclear.

Above all, better measurement of global warming's effect on the ocean does not make a solution any easier. The Paris agreement is the single best hope for protecting the ocean and its resources. But America is not strongly committed to the deal; it may even pull out. And the limits agreed on in Paris will not prevent sea levels from rising and corals from bleaching. Indeed, unless they are drastically strengthened, both problems risk getting much worse. Mankind is increasingly able to see the damage it is doing to the ocean. Whether it can stop it is another question. ■



海洋世界

海洋的深重危机

人类正在破坏海洋。技术揭示了其为祸之大，并提供了一些解决方案

“地球”这个名字起得不好，这个星球表面四分之三都是海洋，分为五个海洋盆地：太平洋、大西洋、印度洋、北冰洋和南冰洋。如果将地球上所有的水都集中到美国国土之上，将形成一道132千米高的巨型水柱。海洋为30亿人口提供了近五分之一的蛋白质，使得鱼类成为比牛肉更大的蛋白质来源。渔业和水产养殖是世界十分之一人口的生计所依。气候和天气系统取决于海洋的温度模式及其与大气的相互作用。如果说有什么事情万般紧要，容不得一点差池，那就数海洋了。

人类长久以来都以为，既然海洋浩瀚无边，人类可以任意倾倒废物、予取予求。数十年来，海洋温度和化学环境的变化，以及过度捕捞和污染都让海洋生态系统不堪重荷。被温室气体困在地球上的热量有九成以上都储存在大海里，珊瑚礁因此遭殃。科学家预计，到2050年，珊瑚礁将消失殆尽。

到本世纪中叶，海洋中塑料垃圾的总重量可能将超过鱼类。磨成细小碎片的塑料被鱼吃掉，人再吃鱼，这对人体健康的影响仍未可知。然而人类对鱼类的需求仍在增长：近90%的鱼类的捕捞量已达到或超出可持续的限度。海洋滋养人类，人类却回以傲慢不恭。

| 深度探测

这种自我毁坏的行为令人困惑。有三个原因比较突出。一是地理。海洋的大部分地方都无边无际、深不可测，而海洋健康遭受的损害只在少数几个地方看得到，比如大堡礁或华盛顿州的牡蛎养殖场。但在大多数情况下，人们对海洋的问题都是眼不见心不烦。《巴黎气候协议》仅潦草地提及海洋一次，这很说明问题。

第二个问题是治理。海洋保护方面的法律和协议不成体系，执行难度大，

而激励措施又往往不一致。国家管辖范围以外的水域（即公海）为全球共有，没有明确的所属权，也没有哪个团体投资来维护它们，单个国家肆意开发这些海域的利益就会凌驾于有节制地利用海洋资源的共同利益之上。鱼会游来游去，因而是个特别棘手的问题。如果你觉得邻国能大肆捕鱼而无需承担任何后果，自己为什么还要死守捕鱼配额规定呢？

第三个原因是，海洋本身是其他更大变化的受害者。排放到大气层中的温室气体让海洋环境与地球其他部分都在发生改变。19世纪以来，海水温度已经上升了 0.7°C ，破坏了珊瑚礁，导致生物朝极地更冷的水域迁徙。海水中二氧化碳的浓度越来越高，以致酸性越来越强，常会伤害诸如螃蟹和牡蛎等生物，它们由碳酸钙构成的外壳会因海洋化学环境的变化而受损。

以上这些问题中，有些解决起来会容易一些。“海洋破坏无知症”（Ocean blindness）可以通过获得信息来治愈。事实上，计算能力、卫星成像和无人机技术的改进正在让人们以前所未有的程度了解海洋。声纳技术正在详细测绘海底地貌；在海面上，水上无人机可以到达暴风雨肆虐的遥远海域，成本比载人船只低得多；在海面上空，海洋水色辐射测量技术正在帮助人们了解支撑起海洋食物链的简单生物体浮游植物是如何移动和大量生长的；重量在1到10公斤的微型卫星则正在加强对渔船的监督。

增加透明度也可以减轻海洋治理这第二个难题。不断累积的科学数据应该会改善对新兴行业的监督。随着海底探测的范围迅速扩大，国际海底管理局（International Seabed Authority）在各国领海以外海域对深海采矿的监督应该会有所改善。更多的数据和分析也让现有协议的执行情况更容易受到监督。卫星监控可以提供非法捕鱼活动的线索，例如，船只在接近海洋保护区时关闭船上跟踪装置就会引起怀疑。这样的数据使执行像《港口国措施协定》（Port State Measures Agreement）这类法规变得更为容易。该协定要求外国船只接受停靠港的检查，并要求港口国分享所发现的任何可疑不法行为的信息。

信息更加公开透明也可能有助于协调激励措施，让私人资本去奖励良好行为。例如，保险公司会更有动力要求渔船提供更多数据，如果船只关闭跟

踪系统，撞船的机率就会上升，保费也会随之上升。提高可追溯性能让关心鱼类的消费者得以对海产品公司施压，让它们行事更负责任。

| 沉没成本

技术的发展让海洋不再显得那么广阔无垠、遥不可及，也让人类越来越没有不作为的借口。6月将在纽约举行的一个联合国海洋会议显示，决策者正日益关注海洋状况。但信息再发达也不能解决公海的责权分配和执行这个根本问题。保护海洋的激励措施效果也是参差不齐。例如，给鱼群时间休养生息能产生巨大的商业回报，这一点证据充分，但是从公海清除塑料垃圾所产生的回报尚不明确。

最重要的是，更准确地衡量全球变暖对海洋的影响并不会让解决方案变得更容易。《巴黎气候协议》是保护海洋及海洋资源的最大希望，但美国对此协议意兴阑珊，甚至还有可能退出。而且该协议确定的目标也无法阻止海平面继续上升和珊瑚白化。事实上，除非大幅提高这些目标，这两个问题都可能变得更为严峻。人类已能够越来越清楚地认识到自己对海洋造成的破坏，但能否扭转局面则是另一个问题。■



Clearing-houses and Brexit

Clearing out

New European proposals might force euro clearing out of London

BREXIT has thrust a mundane, if crucial, bit of financial-market plumbing into the spotlight: the clearing of financial instruments. Clearing-houses sit in the middle of a securities or derivatives transaction, and ensure that deals are honoured even if one counterparty goes bust. In November a study commissioned by the London Stock Exchange (LSE) warned that if euro clearing was forced out of the City, 83,000 British jobs could be lost, and a further 232,000 affected. On May 4th the European Commission said it was looking into new rules for euro-denominated clearing. One option is relocation from London, an idea greeted in the City with a mixture of incredulity, disdain and fear.

In the wake of the financial crisis, the G20 group of big economies made it mandatory to settle most simple derivatives trades through clearing-houses. By 2016, 62% of the notional \$544trn global over-the-counter derivatives market was settled in this way. Globally, London handles 37% of foreign-exchange derivatives and 39% of interest-rate derivatives, including three-quarters of those in euros (see chart). So unsurprisingly, it also dominates clearing. LCH, a clearing-house that is part of the LSE, clears over 50% of all interest-rate swaps across all currencies. Around 75% of those in euros are cleared in London.

But centralising clearing concentrates risk: the failure of a clearing-house would be disastrous. So clearing-houses require collateral from the counterparties using them, and must submit to close supervision. The European Central Bank has long worried that it has no direct control over euro-denominated clearing outside the euro area, yet any problems would embroil banks and payment systems within it. In 2015 it lost a court case

against Britain over its attempt to force clearing to move. Many jurisdictions, the EU included, limit their financial institutions' access to foreign clearing-houses. The European Securities and Markets Authority (ESMA) lets European firms use clearing-houses only in countries it has deemed "equivalent", ie, America and a dozen others.

Brexit necessitates a new arrangement. The City has mostly been focused on obtaining "equivalence". But the commission argues the systemic importance of British clearing-houses for the euro area may well require new, stricter oversight. So it is assessing two other options. "Enhanced supervision"—favoured by ESMA—would mean adopting the American model, in which clearing-houses that deal directly with American clients, such as the LCH, are also supervised by the American regulator. But the other option—forced relocation—has gained the support of many senior EU policymakers. Barney Reynolds of Shearman & Sterling, a law firm, insists it would not amount to much: the most the EU could do is to compel European banks to use EU-based clearing-houses. Since firms based in the EU outside Britain account for only 7% of cleared euro-denominated interest-rate derivatives at LCH, the impact could be modest for London. LCH itself claims the result would be a larger euro-denominated market outside the EU and a smaller, less-liquid euro-area market.

Since America tolerates 97% of dollar interest-rate swaps being cleared in London, it seems perverse for the EU to shift euro clearing. But Simon Puleston Jones of FIA, an industry body, points out that America is comfortable because its regime allows its regulators much greater oversight. If Brexit turns acrimonious and precludes a moderate change such as enhanced supervision, Europeans may seek blunter instruments. It is not just Brexiteers who want to take back control. ■



结算所与英国脱欧

大清算

欧盟新提案可能迫使欧元结算撤离伦敦

英国启动脱欧进程，将金融系统中一个乏味但关键的环节推至聚光灯下：金融工具清算。结算所在证券或衍生品交易中居于中间位置，确保即使一方破产，交易也能达成。去年11月，伦敦证券交易所（LSE）委托开展的一项研究警告称，假如欧元结算被迫撤离伦敦金融城，英国将损失8.3万个就业岗位，另外还有23.2万个岗位将受影响。5月4日，欧盟委员会表示正在研究有关欧元计价清算的新规则，方案之一是撤离伦敦。伦敦金融城对这一方案的反应混杂着怀疑、不屑和恐惧。

2008年金融危机后，大型经济体组成的二十国集团要求大部分简单衍生品交易必须通过结算所清算。到2016年，全球场外衍生品市场544万亿美元的名义价值中，62%是以此方法结算的。伦敦经手处理全球37%的外汇衍生品和39%的利率衍生品交易，包括四分之三以欧元计价的利率衍生品交易（见图表）。所以伦敦还雄霸了结算业务也就不奇怪了。隶属伦敦证券交易所的伦敦清算所（LCH）清算超过50%的所有币种的利率掉期交易。其中以欧元计价的交易约有75%在伦敦清算。

但清算集中化会导致风险聚集：结算所一旦出问题，后果不堪设想。所以结算所要求使用其清算业务的交易各方提供抵押品，而且必须接受严密监管。欧洲央行长期以来一直担心自己无法直接控制欧元区以外的欧元计价清算，然而一旦出现问题，欧元区内的银行和支付系统都将受到牵连。欧洲央行曾尝试迫使欧元清算从英国转移出去，并与其对簿公堂，但在2015年败诉。包括欧盟在内，许多司法管辖区限制区内金融机构采用外国结算所。欧洲证券和市场管理局（ESMA）只允许欧洲公司采用其认为“等同”的国家（即美国等十多个国家）的结算所。

英国脱欧后，改换方式已无可避免。伦敦一直专注于争取“等同”地位。但欧盟委员会认为，英国结算所以对欧元区具有系统重要性，很可能需要采用

更严格的新监管方法，所以它正在权衡另外两个方案。“加强监管”是欧洲证券和市场管理局倾向的做法，即采用美国模式。在美国模式下，与美国客户直接交易的结算所，如伦敦清算所，还要受美国监管机构的监管。另一个“强制迁移”方案则获得了欧盟许多高级官员的支持。谢尔曼思特灵律师事务所（Shearman & Sterling）的巴尼·雷诺兹（Barney Reynolds）坚持认为这种做法作用不大，欧盟最多也只能迫使欧盟的银行改用欧盟境内的清算所。总部在欧盟境内而又不英国的公司仅占伦敦清算所欧元计价利率衍生品交易的7%，所以这对伦敦的影响可能不大。伦敦清算所则宣称，这么做的结果是欧盟外欧元结算市场将扩大，欧元区市场会变小且流动性降低。

美国允许多达97%的美元利率掉期合约在伦敦结算，这样看起来欧盟要求转移欧元结算地似乎有点偏执古怪。但行业组织美国期货业协会（FIA）的西蒙·普鲁斯顿·琼斯（Simon Puleston Jones）指出，美国之所以处之泰然，是因为美国的制度让其监管机构拥有的监督权比欧盟的大得多。假如英国脱欧谈至剑拔弩张，“加强监管”这类温和的变革手段被排除，欧盟官员也许会采用更强硬的手段。想取回控制权的并不只有脱欧派。■



Street food

Rules of the road

America's food-truck revolution stalls in some cities, accelerates in others

IT WAS in 2008 that an out-of-work chef named Roy Choi began selling \$2 Korean barbecue tacos from a roaming kitchen on wheels, tweeting to customers as he drove the streets of Los Angeles. Mr Choi's gourmet food truck has since inspired a reality-TV programme and a hit Hollywood film, and helped jumpstart a \$1.2bn industry.

Within the food industry, the food-truck business, built on unique dishes, low prices and clever use of social media, is the fastest-growing segment. Restaurants fret about an army of trucks stealing customers but such concerns are unwarranted. According to the Bureau of Labour Statistics, counties that have experienced higher growth in mobile-food services have also had quicker growth in their restaurant and catering businesses.

Although many cities have treated food trucks as a fad, a nuisance, or a threat to existing businesses, others have actively promoted them. Portland, Oregon, known for its vibrant culinary scene, has had small food carts on its streets for decades. After a study in 2008 by researchers at Portland State University concluded that the carts benefited residents, the city began encouraging the use of vacant land for food-truck clusters or "pods". Today, Food Carts Portland, a website, reckons the city has over 500 carts and trucks.

Yet government figures suggest the revolution has stalled in several of the country's biggest cities (see chart). The sector is subject to a patchwork of state and local regulations. In few places are these stricter than in Chicago. Influenced by a powerful restaurant industry, the city prohibits food trucks from setting up shop within 200 feet of a bricks-and-mortar eatery or from

parking in any one location for more than two hours. Vendors are required to carry GPS devices that record their whereabouts every five minutes, on pain of heavy fines. Such restrictions have stifled the industry's growth. Despite being home to more than 7,000 restaurants and 144 craft breweries, Chicago has just 70 licensed food trucks.

The Windy City may be the least food-truck-friendly place in America but New York and Boston are little better. In Boston vendors must compete for space on public roads at specified places and times through an annual lottery. In New York a vendor must obtain a two-year government permit, which requires sitting through a 15-year waiting list or shelling out as much as \$25,000 to rent one on the black market. Adam Sobel, owner of Cinnamon Snail, a popular vegan food truck, shut down his operations in 2015 because of rising costs. "You kind of have to be crazy to have a food truck in New York," he says.

Fortunately, truck operators can drive to more welcoming cities, such as Minneapolis and Philadelphia. Once there, and no matter how cosy they get with policymakers, truck owners still want to cultivate their underdog image. "It used to be the restaurants and their chefs that had all the power," says Han Hwang, the chef and owner of Portland's Kim Jong Grillin'. "Now it's the people. That's the revolution that's happening right now." ■



街头快餐

马路统治者

美国的快餐车革命在一些城市停滞，在另一些城市加速

2008年，一位名叫罗伊·崔（Roy Choi）的失业厨师开始在一辆流动快餐车上出售韩式烧烤风味玉米卷，两美元一个。他一边在洛杉矶的街道上行驶，一边向顾客发推特。在这之后，崔的美食快餐车为一档电视真人秀节目和一部好莱坞热门电影提供了灵感，并开启了一个价值12亿美元的产业。

在食品行业，风味独特、价格低廉并能巧妙运用社交媒体的快餐车业务是增长最快的部分。餐馆担心大批快餐车会分流顾客，然而这种担忧并没有根据。据美国劳工统计局的数据，在流动食品服务业增长较快的县里，餐饮业增长也更快。

尽管许多城市将快餐车视为一时的风潮、一种滋扰，或是对现有商家的一种威胁，但在其他城市它们却得到了积极的推动。俄勒冈州的波特兰以充满活力的烹饪界著称，小型快餐拖车在这个城市的街道上已存在了几十年。2008年，波特兰州立大学的研究人员在一项研究中得出结论：这些拖车使居民受益。此后，该市开始鼓励提供空地，供集中在一起经营、形成一个“群落”的快餐车使用。据网站“快餐车波特兰”（Food Carts Portland）估计，该市如今已有超过500辆拖车和卡车。

然而，政府数据表明，这场革命在美国几个最大的城市已经停滞（见图表）。该行业受州和地方法规的共同管辖。芝加哥的管理尤为严格。受强大的饭店行业的影响，该市禁止快餐车在实体餐馆200英尺（约60米）的范围内摆摊，或在任何一个位置停车超过两个小时。快餐车车主必须安装GPS，每5分钟就记录一次他们的行踪，违者重罚。这些规定遏制了该行业的发展。尽管芝加哥拥有超过7000家餐厅和144家精酿啤酒作坊，但只有70辆快餐车获得营业许可。

风城芝加哥可能是美国对快餐车最不友好的地方，但纽约和波士顿也好不了多少。在波士顿，快餐车主每年必须通过抽签来争抢指定地点和时间的公共道路摊位。在纽约，商家必须获得为期两年的政府许可证，而这需要在等待名单里等候15年，或者花费高达25,000美元从黑市租一张许可。2015年，受欢迎的素食快餐车“肉桂卷”的车主亚当·索贝尔（Adam Sobel）因成本上升而停业。他说：“一个人肯定是疯了才会在纽约经营一辆快餐车。”

好在快餐车商家可以把车开到更欢迎他们的城市，比如明尼阿波利斯和费城。而到了那里，无论他们与政策制定者相处多么融洽，快餐车主仍然想树立自己弱者的形象。“过去是餐厅和厨师拥有所有的权力，”波特兰Kim Jong Grillin'餐车的老板兼主厨黄汉（Han Hwang，音译）表示，“现在有权的是人民。这就是当前正在发生的革命。”■



Synthetic biology

Breaking free from cells

A new approach could deliver the benefits of nature without the hassle of life

LIVING creatures are jolly useful. Farmers rear animals and then harvest their flesh, eggs and milk for humans to eat. Drug companies genetically engineer animal cells and grow them in vats, so they can churn out drugs to treat disease. There is a catch, however. It is hard work to corral cells and higher organisms to do humans' bidding.

There may be a better way. Cell-free biology, an idea first proposed about a century ago, is at last having its coming-out party. The technique involves extracting the protein-making machinery from living cells. Cell walls, useless molecules and the organism's own DNA are all thrown away. By adding doses of new DNA to the resultant gloop, proteins can then be made to order. In May, in California, a 1,000-litre vat of cellular machinery belonging to a company called Sutro Biopharma will start churning out components of a cancer drug, which will go through tests with the Food and Drug Administration, America's medical regulator, next year. It will be the first commercial product made in this way. Other firms are working on similar techniques to produce everything from plastics to pesticides. Cell-free biology could also help those trying to produce artificial meat without relying on animals.

It is still early days, and the commercial viability of these techniques has yet to be proved. Synthetic biology smacks to many of "playing God": regulators will have a big say in how quickly the technology is adopted. But divorcing biological production from living things makes sense, for three reasons.

The first is efficiency. Living organisms are shaped by evolution to survive

and reproduce. That wastes energy. Consider insulin, which used to be harvested from pig carcasses, and these days is made in vats of genetically modified yeast or bacteria. Those bacteria (and their porcine predecessors) use valuable nutrients to build a host of other proteins besides insulin which are vital for their own survival but worthless to humans. With cell-free biology, more of those nutrients could be turned into the end-product that is being produced.

Living creatures are also irritatingly fragile. Genetically engineered bacteria can be used, for instance, to make a fuel called isobutenol. But it is a solvent, and kills the bacteria before they can make very much. A cell-free system is more robust. Or consider Genzyme, the maker of Cerezyme and Fabrazyme, drugs for treating rare genetic disorders, which are produced in vats of hamster-ovary cells. In 2009 production was stopped for more than a month after these delicate cells caught a viral disease. That shutdown cost hundreds of millions of dollars. But because cell-free production systems are not alive, they cannot fall ill.

The second benefit of cell-free biology is that it has the potential to avoid some of the social and environmental drawbacks associated with relying on living organisms. Growing corn (maize) as a feedstock to make ethanol occupies land that could otherwise be used for growing food, for example. Livestock farming takes up about a quarter of the planet's ice-free land and contributes to climate change. Generating fuel or food in vats could be an attractive alternative.

| *A cultural shift*

The third reason is ethical. Animals have a capacity for suffering that the cellular machinery from which they are built does not. Modern technology has replaced many natural products with synthetic alternatives. But humans still rely on animals for food, fabrics and a few medicines. Snake farms, crude and expensive, produce antivenom. Factory farming of pigs,

chickens and cows has many opponents. Animals' skins and coats, used to make leather and fur, are often the most valuable part of their farmed carcasses. You do not have to be a vegetarian or an animal-rights activist to welcome the possibility of making such products in more humane ways.

There are many pitfalls on the road from the laboratory to mass production. But cell-free biology should be cheered on. Humans will always need the bounty that nature provides, whether in the form of nutrients, drugs or chemicals. But they may not always need living things to produce them. ■



合成生物学

摆脱细胞的束缚

有一种新方法可以不依赖活体生物就能享受大自然的馈赠

活体生物用处多多。农民饲养动物，然后获取它们的肉、蛋、奶供人食用。制药公司对动物细胞进行基因改造，然后放在容器里培育，生产出药物，用以治疗疾病。但这里有个问题：把细胞和高等生物“圈养”起来使它们听命于人类，并非易事。

也许还有更好的方法。大约一个世纪前，无细胞生物学的想法首次提出，如今终于要隆重登场。这项技术从活细胞中提取蛋白质合成机制，细胞壁、无用的分子和生物体自身的DNA都弃之不用。然后在剩下的粘稠液体中加入一定量的新DNA，就可以定制蛋白质了。5月，加州Sutro Biopharma公司一个1000升容量的细胞机器容器将开始生产抗癌药物的成分，明年将接受美国药品监管机构食品和药物管理局的测试。这将是这种方式制造出来的第一个商业化产品，其他公司正在利用类似的技术，生产从塑料到杀虫剂等各种产品。无细胞生物学还可以帮助那些尝试生产人造肉的企业，让它们不用饲养动物就可以生产出肉来。

这些技术还在起步阶段，其商业可行性尚未得到证实。很多人会觉得合成生物学有种“扮演上帝”的色彩，监管机构对这一技术的普及速度将有很大的话语权。但将生物生产与活体生物分离是明智的，原因有三。

首先是效率。生物体历经进化以生存繁衍，这个过程浪费能量。以胰岛素为例，以前需要从猪的尸体中提取它，现在可以在转基因酵母或细菌容器中生产。这些转基因细菌（以及猪身上尚未经转基因的细菌）使用宝贵的营养物质来制造胰岛素以外的许多其他蛋白质，这些蛋白质对它们自己的生存至关重要，但对人类毫无价值。通过无细胞生物学，更多的营养成分可以转化成所要生产的最终产品。

活体生物的脆弱也很恼人。例如，经基因改造的细菌可用于生成一种名为

异丁醇的燃料，但异丁醇是一种溶剂，生产过程中会杀死制备它的细菌，从而减少产量。无细胞体系的生产效率要更高。或者再看看健赞公司（Genzyme）的例子。它生产的治疗罕见遗传疾病的药物思尔赞（Cerezyme）和Fabrazyme是在放有仓鼠卵巢细胞的容器中制造的。2009年，那些脆弱的细胞感染了一种病毒性疾病，致使健赞停产一个多月，损失数亿美元。而无细胞生产过程不涉及活细胞，所以不会染病。

无细胞生物学的第二个好处是，它有可能避免因依赖活体生物而导致的某些社会和环境缺陷。比如，种植玉米作为原料生产乙醇占用了大量可用来种植粮食的土地。畜牧业占用了地球约四分之一的无冰地面，加剧了气候变化。在容器中生产燃料或食物的替代方案可能很有吸引力。

| 文化转变

第三个原因是道德方面的。动物能感受痛苦，而从动物身上提取的细胞机制没有痛感。现代技术已经用合成品替代了许多天然产品，但人类仍然依赖动物来获取或生产食物、织物和一些药物。养蛇场生产抗蛇毒素，方法原始且成本高昂；工厂化饲养猪、鸡、牛有很多反对者；用于制作皮革和皮草的动物皮毛通常是养殖户屠宰牲畜后最有价值的部分。就算不是素食者或动物权益保护者，也会欢迎以更人道的方式制作此类产品的可能性。

从实验室到大量生产的道路上困难重重，但是无细胞生物学的发展应该受到鼓励。人类永远都会需要大自然的馈赠，无论是营养、药物或化学物质，但要获取这些馈赠，不一定总是要靠活体生物。 ■



The pharma industry

Hard to swallow

Cancer drugs are getting better and dearer

THE debate in rich countries about the high price of drugs is a furious and frustrating one. The controversy is already having an impact on spending on drugs, suggest new figures from the QuintilesIMS Institute, a research firm. The rate of growth in spending on prescription medicines in America fell to 4.8% in 2016, less than half the average rate of the previous two years (after adjusting for discounts and rebates). Michael Levesque of Moody's, a rating agency, reckons that pressure over pricing is contributing to a deceleration in earnings growth at pharma firms. Public scrutiny constrains their flexibility over what they can charge and allows payers to get tougher.

In one area, however, earnings are expected to keep rising: cancer. Oncology is the industry's bright spot, says Mr Levesque. The grim fact is that two-fifths of people can now expect to get cancer in their lifetime because of rising longevity. This is one of the reasons why the number of new cancer drugs has expanded by more than 60% over the past decade. The late-phase pipeline of new medicines contains more than 600 cancer treatments. New cancer drugs are being approved more quickly.

More are arriving all the time. On May 1st, America's Food and Drug Administration approved durvalumab (trademarked Imfinzi), a drug from AstraZeneca, a British firm, which treats cancer of the bladder. Imfinzi, which has a wholesale price of \$180,000 for treatment lasting a year, joins a growing crowd of medicines known as "checkpoint inhibitors", designed to work on a key molecular target that helps the body's own immune system to fight cancer. Merck of America has pembrolizumab (Keytruda); Bristol-Myers Squibb has nivolumab (Opdivo); and Switzerland's Roche has

atezolizumab (Tecentriq).

These checkpoint inhibitors are expected to account for much of the growth in spending on cancer medicines. Merck, in particular, has done well with Keytruda. A sense of the value of the new drugs came when Opdivo failed a key clinical trial in August last year. The market value of Bristol-Myers Squibb fell by 16%, and its shares have been in the doldrums since.

Handsome prices for cancer drugs are far less pleasing for governments, insurers and patients. Even five years ago, most newly-approved treatments had gross annual prices of more than \$100,000. But the pressure on budgets has worsened with the new generation of more expensive immuno-oncology drugs, and could become more severe still if they are found to work best in combination with each other.

Making a mistake over which cancer drugs to use can be extremely costly for a payer, as illustrated by a disastrous recent attempt by Britain's government to increase access to new cancer drugs by creating a special fund in 2010. By the time it closed in 2016, £1.27bn (\$1.83bn) had been spent, mostly on drugs that were later shown to be ineffective for the conditions they were tried on.

Some think a better approach would be to try drugs out on patients and for payers to pay a price based on how well they work, an approach known as "value-based pricing". That would mean collecting a great deal of data from patients, which would be far from straightforward.

Some companies, such as Genentech, a biotech company owned by Roche, are trying to do just this, as are some payers including American health insurers. But however reassuring it is to know that money is going on drugs that are proven to work, it does not solve the broader problem of

affordability. ■



制药业

难以下咽

抗癌药物变得更有效也更昂贵

富裕国家对高药价的争论趋于白热化且令人沮丧。研究公司昆泰医药信息研究所（QuintilesIMS Institute）的新数据表明，这番争议已对药物开支造成影响。2016年，美国处方药开支的增长率下降至4.8%，不到前两年平均水平的一半（已计入折扣及返利）。评级机构穆迪的迈克尔·莱维斯克（Michael Levesque）认为，定价压力导致制药公司盈利增长减速。公众监督限制了它们的定价空间，也使得支付方态度更为强硬。

然而，有一个领域的收入仍有望继续上涨：抗癌。莱维斯克表示，肿瘤药物是医药行业的亮点。如今，由于寿命延长，一个严酷的现实便是五分之一的人会在生命某个阶段罹患癌症。这是过去十年抗癌新药数量增加超过60%的原因之一。在进入研发后期的新药中，有600多种是抗癌药物。抗癌新药的审批也在加快。

更多新药陆续上市。5月1日，美国食品和药物管理局批准了英国公司阿斯利康（AstraZeneca）研发的膀胱癌药物durvalumab（商品名为Imfinzi），一年期疗程的批发价为18万美元。它作用于关键分子靶，激发人体自身免疫系统对抗癌症，是日益壮大的免疫检查点抑制剂（checkpoint inhibitors）大军中的一员。其他这类药物有美国默克公司（Merck）的pembrolizumab（商品名为Keytruda）、百时美施贵宝（Bristol-Myers Squibb）的nivolumab（商品名为Opdivo），以及瑞士罗氏（Roche）的atezolizumab（商品名为Tecentriq）等。

这些检查点抑制剂将成为抗癌药物支出增长的主力。默克公司的Keytruda表现尤其出色。去年8月，Opdivo的关键临床试验失败，百时美施贵宝的市值下降了16%，其股价自此一蹶不振。新药价值举足轻重，由此可见一斑。

但对政府、保险公司和病人而言，药价高可不是什么开心的事。即便在五年前，大部分新批准药物一年的药费也要超过十万美元。但随着新一代更昂贵的免疫肿瘤药物面世，预算压力进一步加剧。如果发现这些药品相互配合使用效果最佳，形势还可能更加严峻。

选错抗癌药物可能让买单者付出极为高昂的代价。最近的例子是，英国政府在2010年创立了一个专项基金来增加抗癌新药的使用，结果惨淡收场。到2016年项目结束时，英国政府共花费了12.7亿英镑（18.3亿美元），但后来的情况表明，大部分钱都没有带来疗效。

有人认为，更好的做法是采用所谓的“价值定价”，即患者试用新药，然后由支付方根据疗效来支付费用。但这意味着要从患者那里收集大量数据，远非简单易行。

罗氏旗下的生物技术公司基因泰克（Genentech）等企业就在做这方面的尝试，包括美国医疗保险公司在内的一些支付方也在做同样的努力。知道钱是花在有效的药物上，这一点着实令人宽慰，但在更大层面上，吃不起药的问题仍然没有解决。 ■



Schumpeter

From great to good

A confidential memorandum to the senior faculty of Harvard Business School

YOU will all be aware that a book has just been published about our institution, Harvard Business School (HBS). Entitled “The Golden Passport”, by Duff McDonald, it makes a number of unflattering claims about the school’s ethics and its purpose. While often unbalanced, it is likely to galvanise hostility to HBS both inside Harvard University, of which we are a part, and among the public. This memorandum, circulated only to the most senior faculty members, assesses HBS’s strategic position.

Our school has been among the country’s most influential institutions since its foundation in 1908. Our forebears helped build America’s economy in the early 20th century and helped win the second world war. HBS educates less than 1% of American MBA students but case studies written by our faculty are used at business schools around the world. Our alumni fill the corridors of elite firms such as McKinsey. Many bosses of big American companies studied here. Even in Silicon Valley, where we are relatively weak, about a tenth of “unicorns”—private startups worth over \$1bn—have one of our tribe as a founder.

We have a business model that monetises the Harvard brand through four revenue streams. About \$127m, or 17%, of sales come from MBA tuition fees. Our case-study method, in which students learn from real business situations, is popular. But it is only one reason why they are willing to pay headline fees of \$71,635 a year. Like parents of pupils at Britain’s elite private schools, they are buying social standing as well as access to an alumni network that will dramatically raise their odds of getting high-paying jobs.

A further 23% of sales comes from our executive-education operation, which sells short courses to mid-career executives. They get a modest amount of mental stimulation and the right to call themselves Harvard alumni. We get \$176m a year in return. Our publishing arm sells case studies to other universities and publishes books and a magazine; that brings in 29% of our revenues. The remaining 31% comes chiefly from wealthy businessmen in the form of donations. Some of them may well be under the impression that they gain influence over what we teach.

We have had a fantastic run of it, with sales growing at a compound annual rate of 8% in the past decade, above the university's rate of 5% and outperforming the median firm in the S&P 500 index. Our balance-sheet is strong, with \$3.2bn of endowment funds (run by the university's management company) and \$1.6bn of other assets, including our campus. You have all benefited handsomely; we pay out a higher share of our income in compensation than Goldman Sachs does. It may look like poor cost control, with expenses rising at a 7% annual rate, but it also means we live up to our legal status as a non-profit organisation. After deducting capital expenditure, the school makes a modest loss.

However, we face three strategic problems. First, conflicts of interest—let's be honest here—that have become glaring. We grant companies a veto over case studies written about them. We permit our faculty to be paid, for example, through consulting gigs, by firms they teach about. We do case studies on some of our big donors. It is likely that this compromises our objectivity.

Second, we face ever more competition to our claim to intellectual leadership. Important business thinkers such as Michael Porter and Clayton Christensen are still on staff, but a new generation of superstars has not yet caught fire. The authors of the most influential recent business book, "The Second Machine Age", work across the Charles river at the Massachusetts

Institute of Technology. As the tech industry expands, its chief alma mater, Stanford University, is growing ever more powerful.

Last, we may perpetuate inequality, a relevant subject at the moment. We have worked to make our intake of students more diverse. But even after the financial aid that we give to some, we have ramped up our effective MBA fees by 31% over the past five years. Relative to the median salary our graduates earn in their first year at work, our fees are twice as costly as they were in 1986. It doesn't take much to see our network as a form of cronyism.

Left unaddressed these weaknesses could compromise our business model. If HBS is more about cash and contacts than ideas, bright people may eventually go elsewhere. Other schools may stop buying our case studies if they doubt their objectivity. We are part of Harvard University, but our already uneasy relationship with it could deteriorate. We benefit from an implicit subsidy because we can use the Harvard brand while operating at arm's length. In return they benefit from our alumni, who often donate to the university as well as to HBS. But the university has, at least notionally, the power to overhaul our management.

| *The Boston Business School Inc*

Our school, led by Nitin Nohria, dean since 2010, has made important reforms. We have tightened disclosure rules on conflicts of interest. Students must spend time in emerging markets. We have tried to signal that our interests go beyond shareholder value by publishing essays criticising it. Yet deeper changes are needed if we are to maintain our competitive position. One course is to reduce the influence of big money and fully eliminate conflicts. Our dependence on big donors' generosity would have to fall and, by implication, we would have to be less extravagant.

If you have a good thing going, though, why stop? An alternative is to follow the advice of Alfred Chandler, a theorist at HBS between 1970-89, who taught that structure must reflect strategy. HBS would cut loose from Harvard and acknowledge its tacit commercial status. If we trimmed costs to their level five years ago and were valued on the S&P 500's price-earnings multiple, HBS would be worth \$5bn. The university would get a huge special dividend with which to pay for more scholarships for underprivileged applicants. We would be subject to the forces of accountability and transparency that we have always argued maximise performance. We look forward to your feedback. ■



熊彼特

从卓越到优秀

致哈佛商学院资深教授们的一份机密备忘录

你们应该都知道，最近有一本关于我们哈佛商学院（HBS）的书刚刚出版，书名为《黄金护照》（The Golden Passport），作者是达夫·麦克唐纳（Duff McDonald）。书中毫不客气地列举了一长串学院在道德伦理及办学宗旨方面的问题。虽然多处内容都有失偏颇，但这本书仍有可能令HBS在我们所属的哈佛大学内部以及社会上受到敌视。这份备忘录将评估HBS的战略地位，仅供学院最资深的教授传阅。

自1908年创立以来，HBS一直位列美国最具影响力的院校。我们的前辈校友在20世纪初期为打造美国经济出谋划策，还帮助国家在二战中取得胜利。HBS培养的MBA学生还不到美国MBA学生总人数的1%，但由学院教授编写的案例研究却为全世界的商学院广泛使用。麦肯锡等精英公司的走廊上挂满了学院校友的肖像。许多大型美国公司的老板都曾在这里学习。即使是在我们势力相对较弱的硅谷，大约十分之一的“独角兽”公司（即估值超过十亿美元的私营创业公司）都有一位创始人毕业于我们学院。

我们的商业模式从四个方面将哈佛品牌转化成真金白银。大约1.27亿美元或者说17%的销售额来自MBA课程的学费。我们的案例研究让学生从真实的商业情境中获得知识，这种教学法广受欢迎。但学生们之所以愿意支付每年高达71,635美元的学费，这只是原因之一。就和英国精英私立学校的学生家长一样，他们购买的不仅是社会地位，还有打入校友关系网的机会。这样的关系网将大大提升他们找到高薪工作的机会。

还有23%的销售额来自我们的高管教育项目，即针对处于职业中期的高管推出的短期课程。他们在才智上得到的点拨很有限，却也有资格自诩哈佛校友。我们因此获得了每年1.76亿美元的回报。我们的出版机构向其他大学出售案例研究，并出版图书以及一本杂志，这些为我们带来了29%的收入。剩下的31%主要来自富商们的捐赠。他们当中的一些人很有可能以为

自己可以因此影响我们的授课内容。

我们的商业模式运作得极其有效，过去十年来，销售额以8%的复合年增长率增长，高于哈佛大学的5%，也超过标普500公司的中位水平。我们的资产负债表很强健，拥有32亿美元的捐赠基金（由哈佛大学的资产管理公司负责打理），以及包括校园在内的价值16亿美元的其他资产。你们各位也都获益颇丰：我们支付的薪酬占收益的比重比高盛还要高。我们的开支以每年7%的速率上涨，看上去成本控制不太理想，不过这倒也表明我们符合作为非营利组织的法律身份。扣除资本支出后，商学院稍有损失。

然而，我们面临着三个战略性问题。首先，坦白地说，利益冲突已变得非常明显。对于编写案例研究时所涉及的公司，我们赋予其对案例发表与否的否决权。我们允许教授从自己教学案例中提到的公司那里收取报酬，例如，你们可以在这些公司里做兼职顾问。我们会对学院最大的捐助者开展案例研究。这很可能会令我们的客观性打折扣。

第二，我们在知识领域的领先地位受到越来越多的挑战。迈克尔·波特（Michael Porter）和克莱顿·克里斯坦森（Clayton Christensen）等重要的商业思想家仍在学院任教，但新一代的学术明星尚未得到广泛瞩目。近期最有影响力的商业类图书《第二次机器革命》（The Second Machine Age）的作者就职于查尔斯河对岸的麻省理工学院。随着科技行业的扩张，该行业绝大多数从业者的母校斯坦福大学也正展现出越来越大的影响力。

最后，说到不平等这个时下的重要话题，我们恐怕会令不平等的状况持续下去。学院努力令学生的组成更加多样化，但即便向某些学生提供了经济上的援助，过去五年来我们实际的MBA学费仍上涨了31%。相对于毕业生在工作头一年的薪酬中位数这个参照值而言，如今我们的学费已是1986年的两倍。我们的校友关系网也很容易就被视为某种裙带主义。

如果对这些不足之处置之不理，我们的商业模式或许就会受损。如果HBS给人的印象更多是金钱和人脉，而不是思想，那么那些聪明的人到最后也

许就会另寻去处。如果其他学校质疑我们案例研究的客观性，也许就不会继续购买它们。商学院是哈佛大学的组成部分，不过两者间本就不甚融洽的关系也许还会恶化。我们享受到了隐形的好处，因为学院在使用哈佛这个招牌的同时还能与其保持一定的距离。反过来，校方也从我们的校友那里获益，因为这些校友通常既会向HBS也会向哈佛大学捐赠。不过至少在理论上，哈佛大学有权全面改组我们的管理层。

| 波士顿商学院股份有限公司

自2010年尼汀·诺里亚（Nitin Nohria）担任院长以来，我们学院已做出了重大改革。针对利益冲突这一问题，我们加强了信息披露原则。学生必须去往新兴市场待上一段时间。我们还发表文章批评股东价值，以此试着向外界表明我们关注的不仅股东价值。然而，如果要保持学院的竞争地位，我们还需要更深刻的改变。其中一个做法是削弱巨额金钱对学院的影响力，并全面消除利益冲突。我们必须摆脱对慷慨的重要捐赠者的依赖，这也就是说我们不应再那么铺张了。

如果一件事进展得不错，为什么还要另辟蹊径？不过仍值得考虑理论家阿尔弗雷德·钱德勒（Alfred Chandler）的建议。他曾于1970年至1989年间在HBS执教，他的教诲是组织架构必须反映策略。HBS应该脱离哈佛大学，并公开它是一个商业机构这一大家都心照不宣的事实。如果我们将支出削减至和五年前一样的水平，并以标普500指数市盈率估算上市，HBS估值可以达到50亿美元。哈佛大学将会从交易中得到一大笔特别股息，可用于为属于弱势群体的申请人提供奖学金。我们一贯主张问责和透明会激发最优表现，我们如果上市也会受益于这两股力量的推动。期待你们的反馈。 ■



Health-care spending

Spending on health care per person in China is projected to rise by more than 700% by 2040

Global spending on health care per person will more than double by 2040, according to a study in the *Lancet*, a medical journal. This increase will be driven principally by rising expenditure in upper-middle-income countries. Spending per person in China is projected to rise by more than 700% by 2040. At the bottom end of the scale, Somalia will spend only \$42 per person in 2040. Cuba has a world-class health-care system; in 2014 96% of spending was accounted for by the government. In Singapore the government accounted for less than half of total spending. The state also bears little of the burden in Bangladesh, where personal out-of-pocket payments account for two-thirds of expenditure. ■



医疗支出

到2040年，中国的人均医疗支出将增加超过七倍

医学杂志《柳叶刀》的一项研究显示，到2040年，全球人均医疗保健支出将增加一倍以上，主要是由于中高收入国家的支出上升。预计到2040年，中国的人均医疗支出将增加七倍多。在医疗支出最低的国家中，索马里到2040年的人均花费将只有42美元。古巴拥有世界一流的医疗保健系统，2014年，该国96%的医疗支出都是由政府承担，而新加坡政府承担的支出不到总数的一半。孟加拉国政府担负医疗费用的比例也很低，个人自付部分占总支出的三分之二。 ■



Buttonwood

Cape Fear

Investors are simultaneously bullish and skittish about valuations

TEN years ago this month investors were pretty confident. True, there were signs that problems in the American housing market would mean trouble for mortgage lenders. But most people agreed with Ben Bernanke, the Federal Reserve chairman, that “the impact on the broader economy...seems likely to be contained.” The IMF had just reported that “overall risks to the outlook seem less threatening than six months ago.”

That was reflected in market valuations. In May 2007 the cyclically-adjusted price-earnings ratio (CAPE), a measure that averages profits over ten years, was 27.6 for American equities (see chart). That ratio turned out to be the peak for the cycle. As the problems at Bear Stearns, Lehman Brothers and others emerged, and as the world was gripped by recession, share prices plunged. By March 2009 the CAPE had fallen by more than half.

Central banks then kicked into action, slashing interest rates and buying assets via quantitative easing (QE). The stockmarkets recovered rapidly and the S&P 500 is now more than 50% higher than it was ten years ago. And the American stockmarket’s CAPE, at 29.2, is also higher than it was back then.

Investors might worry about equity valuations but what are their alternatives? A decade ago, the ten-year Treasury-bond yield was around 4.8%; now it is 2.3%. The Fed may have started to raise rates but the return on cash is still pitiful in nominal terms and negative in real (ie, after inflation) terms.

But at least the return on cash and bonds (held to maturity) is fixed in

nominal terms. Investors have already suffered two big bear markets in equities this millennium. On each occasion, their losses in percentage terms were in the double digits. What might trigger another collapse?

There is no law that says the CAPE has to return to its long-run average of 16.7; indeed, the ratio's mean over the past 30 years has been 24.5. Even in the depths of the 2008-09 crisis, the ratio only fell below the long-run average for ten months.

When investors accept a high CAPE for shares, they are confident about the ability of companies to maintain, and increase, their profits. One reason why the American market has powered ahead since the election of Donald Trump is that investors expect cuts to the tax rate on corporate profits, allowing more of those profits to be passed on to shareholders.

As Jeremy Grantham of GMO, a fund-management group, points out, there does seem to have been a step change in the level of American profits, as a proportion of both sales and GDP, since 1996. The corollary has been a lower share of GDP for labour, one factor behind voter discontent.

Mr Grantham suggests two forces behind the higher profits: enhanced monopoly power for American companies; and low real interest rates, which have allowed firms to operate with more debt. Both suggest there is something wrong about the way capitalism is currently working. If profit margins are high, then more capital ought to be ploughed into businesses until investment-led competition drives margins back down; that has not happened. And low real interest rates reflect, in part, the extraordinary measures taken by central banks to revive developed economies after the financial crisis.

The conventional threats to the equity market are twofold: a sharp rise in interest rates, which would hit indebted individuals and companies; or a

decline into recession, which would dent profits. Neither looks imminent at the moment, which helps explain why Wall Street keeps hitting record highs.

But there are other ways that profit margins could be hit. Protectionist policies could disrupt the free flow of goods, services and people across borders. A credit crisis could emerge elsewhere in the world—in China, for example, where debt has been growing rapidly. Flashpoints in the Middle East or on the Korean peninsula could spark war.

Investors are not as complacent as they seemed a decade ago. In a poll conducted by Bank of America Merrill Lynch, a net 32% of global fund managers think shares are overvalued. Despite that, however, a net 40% have higher-than-normal holdings in shares.

In other words, investors are managing to be simultaneously bullish and skittish. By a large majority, fund managers expect global growth and corporate profits to be strong over the next 12 months; but they also know such expectations are already fully reflected in share prices. All will be well provided there are no shocks. But history suggests shocks have a nasty habit of occurring. ■



梧桐

恐怖角

投资者看涨股市，同时又对估值提心吊胆

十年前的这个月，投资者信心满满。诚然，那时已有迹象表明，美国房地产市场的问题会给抵押贷款机构带来麻烦，但大多数人都赞同美联储主席本·伯南克（Ben Bernanke）的观点：“更广泛的经济所受到的影响……似乎有可能得到控制。”此前国际货币基金组织刚刚宣布“总体看来，整体经济前景面临的风险小于六个月前”。

市场估值反映了这些观点。2007年5月，美国股市的周期性调整市盈率（以过去十年的平均盈利计算，以下简称CAPE）为27.6倍（见图表），后来发现这个数字是这一周期的峰值。随着贝尔斯登（Bear Stearns）、雷曼兄弟（Lehman Brothers）等机构的问题浮出水面，加上全世界陷入衰退，股价暴跌。到2009年3月，CAPE已经下跌超过一半。

各国央行随后开始采取行动，大幅降低利率，通过量化宽松政策购买资产。股票市场迅速复苏，如今标准普尔500指数比十年前高出50%以上，而美国股市29.2倍的CAPE也高于十年前的水平。

投资者可能对股票估值过高有所担心，但他们有什么别的选择呢？十年前，十年期国债的收益率约为4.8%，现在仅为2.3%。美联储总算已经开始加息了，但现金回报率在名义上仍然少得可怜，而实际回报率（即考虑通货膨胀后）则是负数。

但至少现金和债券（持有至到期）的名义回报率是确定的。股票投资者在新千年已经遭受了两次熊市，每一次的损失按百分比计都是两位数。触发下一次股市崩盘的会是什么呢？

并没有规定说CAPE必须恢复到16.7倍的长期平均水平。事实上，过去30年里CAPE平均值为24.5倍。即使在2008至2009年的深度危机期间，CAPE也

只有十个月低于长期平均水平而已。

当投资者接受股市的高CAPE时，他们对公司维持和增加利润的能力抱有信心。特朗普获胜以来，美国股市仍保持上涨，原因之一就是投资者预计政府会对公司利润减税，使得更多利润可用于支付股东红利。

基金管理公司GMO的杰里米·格兰瑟姆（Jeremy Grantham）指出，1996年以来，美国利润占销售额和GDP的比重看来确实都大幅提升，结果必然是劳动力收入占GDP比重较低，这也是选民不满的因素之一。

格兰瑟姆认为有两股力量推动利润升高：美国公司的垄断力增强，以及实际利率低，让企业能够承担更多的债务。两者都表明资本主义当前的运作方式有问题。如果利润率高，就应该有更多的资本投入到企业中去，直到投资主导的竞争推动利润率回落。但事实并非如此。在某种程度上，实际利率低反映了各国央行在金融危机爆发后为重振发达经济体所采取的特别措施。

股票市场一般受到两方面的威胁：利率大幅上涨，这会对负债的个体和企业造成冲击；或经济衰退，这将削弱利润。目前看来，这两个威胁都不紧迫，这在一定程度上解释了华尔街持续创下历史新高的原因。

但利润水平可能会因其他因素遭受冲击。保护主义政策可能会扰乱货物、服务和人员的自由跨境流动。其他地方也有可能出现信贷危机，比如债务增长迅速的中国；中东或朝鲜半岛局势一触即发，可能引发战争。

如今投资者不像十年前那样盲目乐观。美银美林的一项调查显示，全球32%的基金经理认为股价被高估。但尽管如此，仍有40%的基金公司的股票持仓量高于正常水平。

换言之，投资者一边看涨，一边又心里没底。绝大多数基金公司预期未来12个月全球经济和公司利润都将保持强劲增长，但它们也知道这些预期已经充分体现在股价中。只要不发生意外，一切都会很好。但历史表明，意外事件有个恶习——总是不请自来。■



Schumpeter

The anti-mogul

Time Warner's boss calls the top of the television business

THERE is a hawk in Central Park that sometimes dismembers its prey on the balcony outside Jeff Bewkes's office. Guts are splattered around in the kind of Darwinian spectacle that any self-respecting media baron should appreciate as he plots plans for future world domination. Mr Bewkes, however, only manages a laconic shrug when he mentions the feathered predator.

The boss of Time Warner is an anti-mogul in more ways than one. In an industry long-dominated by imperious tycoons intent on amassing power—think of Rupert Murdoch, or Viacom's Sumner Redstone in his heyday—Mr Bewkes has shrunk a content empire, not expanded it. He is about to sell it to AT&T for \$109bn in the fifth-biggest takeover of all time. If the deal goes through shareholders will have made a 341% return during his tenure (including spin-offs and dividends), making Time Warner one of the best-performing big firms in America during that time.

Beneath his laid-back surfer persona, Mr Bewkes has been ruthless but in the rational pursuit of his owners' interests, not his own vanity. His tenure can be split into three parts—culling, defending and preparing to exit on a high.

Back in 2000 Time Warner had become a corporate catastrophe after being bought by AOL, a web firm pumped up by the dotcom bubble. Upon taking charge in 2008 Mr Bewkes dusted off the lessons from the MBA he had picked up at Stanford University and his time spent at HBO, the group's subscription video-on-demand service, where he was known for giving creative types space to invent hits such as "The Sopranos" and "Sex and the

City”. He restructured the firm to focus it on its competitive advantage—visual content. In 2009 he spun off AOL. That year he also offloaded the cable distribution business, which hooked up too few homes to be able to compete. It was later bought by Charter, a rival. In 2014 he got rid of Time Inc, a magazine group.

The core business that is left is one of the two greatest agglomerations of video content in the world, together with Disney’s library. HBO has 134m subscribers—in America they buy the service via pipes that are supplied by cable, telecommunications and satellite firms. Turner, another subsidiary, sells bundles of sports and TV shows to the pipe firms—its channels include CNN. Warner Brothers is Hollywood’s second-biggest studio.

But the business model is deeply flawed. Conventional media firms are a cross between artists and merchants, who buy or create content and resell it with a large markup. Time Warner’s sales are 2.3 times the size of its content budget. It has no direct relationship with viewers, so cannot collect the customer data that are becoming central to most businesses. The bulk of its sales are from traditional sources: advertising and fees from pipe companies and cinema chains.

Internet-based services, such as Netflix and Amazon Prime, are exploiting this shortcoming, bypassing the middlemen and selling content directly to customers. Netflix costs about \$10 a month, compared with up to \$100 for a cable-TV package. It collects copious data on its viewers in order to serve them better. A war is raging to make the best TV: over 400 original shows are made a year, about double the number half a decade ago. Meanwhile, people are spending more and more time on social media and YouTube. Americans aged 18-24 spend around half as much time watching live TV as they did in 2010.

You might think that a firm such as Time Warner would have had its

innards ripped out by now. But its share of the free cashflow that the content industry (defined broadly to include pipe firms, media groups and internet-platform firms such as Google and Amazon) generates has risen from 3% to 4% in the past five years. Mr Bewkes's defence has had several elements. He has spent heavily on content, ploughing \$12.5bn a year into shows such as "True Detective". He has cranked up the prices he charges the pipe firms—fees paid by them rose by 12% last year—while improving the bundles of shows sold and making more films available on demand. Time Warner has been willing to sell content to the internet firms. And it has copied Netflix with a new internet service called HBO Now. It only has 2m users but is growing fast.

Yet Mr Bewkes must know that, like the best shows, the TV business cannot carry on for ever—at least, not while maintaining its plump margins. The new entrants have deep pockets. And when Time Warner and other media firms raise the fees they charge the pipe firms, the latter pass this on to consumers. At some point the tolerance of American TV-watchers for being gouged by their cable firms must end.

| *Time Warning*

AT&T has offered a stonking price, half of it in cash, far more than the lowball bid that Fox, Mr Murdoch's firm, offered in 2014 and which Mr Bewkes sensibly rejected. It can give Time Warner a direct relationship with viewers. A mobile user watching a Warner film could be tracked and the data used to sell smart advertising. Antitrust regulators may insist that these data are made available to other content companies, lowering their value. Even so, the two firms argue that being under common ownership will still make sense because they can launch new services faster. Before the election Donald Trump, who regards CNN as "fake news", slammed the deal as bad for consumers. But the signals from the government are more favourable of late. Wall Street's arbitrageurs reckon the odds of it being

approved this year are over 75%.

For Mr Bewkes that will be a poignant moment. A creative powerhouse will pass into the hands of a regulated monolith that lays copper in the ground and has a quarter of a million staff, none of whom gets paid to discuss plot twists and dolly shots. Yet the truth is that traditional media moguls who cling on to their empires have yet to show that their business models can survive the internet. Inside Mr Bewkes's office, as well as outside on its balcony, there is no room for syrupy sentimentality. ■



熊彼特

非典型传媒大亨

时代华纳的老板认为电视行业已经见顶

中央公园有一只鹰，有时会在杰夫·比克斯（Jeff Bewkes）办公室外的阳台上肢解自己的猎物，撕碎的内脏飞溅到各处。任何一个自我感觉良好、谋划主宰世界的媒体大亨应该都会乐见这个充满达尔文主义色彩的场面，但比克斯在提到这只披着羽毛的掠食者时，只是勉强耸了耸肩。

这位时代华纳的老板在很多方面都不同于一般的传媒大亨。在一个长期以来都由盛气凌人又一心聚敛权力的巨头们主导的产业里（想想鲁伯特·默多克，或处于人生巅峰期的维亚康姆[Viacom]的创始人萨摩·雷石东[Sumner Redstone]），比克斯并没有扩张自己所统领的内容帝国，而是令它“瘦身”。他即将把时代华纳以1090亿美元的价格出售给AT&T，这也是史上第五大并购交易。如果这笔交易获得通过，股东们在比克斯任期内的回报率将达341%（包括拆分获益与股息），这使时代华纳成为这期间美国表现最好的大公司之一。

在他闲适的表象下，比克斯在为股东谋求利益（而不是为满足自身的虚荣）时虽理性却也毫不留情。他任期内的的工作可分为三个部分：去劣留优、捍卫公司业务，以及为在高点时将公司卖出而做准备。

2000年，被互联网泡沫推高的美国在线（AOL）收购了时代华纳，后者自此遭受大灾难。2008年比克斯接管时代华纳，他搬出了在斯坦福大学的MBA课程中学到的东西，以及在HBO的工作经验。HBO隶属时代华纳旗下，提供付费频道及视频点播服务。在那里，比斯克因向有创意的人提供施展的空间，让他们得以创造出《黑道家族》和《欲望都市》这样的大热作品而知名。他重组了时代华纳，使其专注于视觉内容这一竞争优势。2009年，他剥离了AOL，同年又将因家庭用户太少而无力参与竞争的有线电视部门转手——该业务后被竞争对手Charter收购。2014年比克斯又将杂志出版集团时代公司（Time Inc）分拆出去。

剩下的核心业务和迪士尼的资源库一道，成为世界上资源最丰富的视频库。HBO的订户达1.34亿——在美国，他们通过有线电视、电信及卫星公司提供的渠道来购买服务。另一家子公司特纳（Turner）向渠道公司出售一系列体育及电视节目，CNN是其频道之一。华纳兄弟则是好莱坞第二大电影公司。

但这种商业模式存在严重缺陷。传统的媒体公司既是艺术家，又是商人，它们购买或制作内容，然后抬高价格转卖出去。时代华纳的销售额是其内容制作预算的2.3倍。它并未与电视观众建立起直接的联系，故不能收集到消费者的数据，而这种数据正成为大多数业务的核心。时代华纳销售额的一大块都来自传统来源：广告，以及管道公司和院线支付的费用。

Netflix及Amazon Prime这种以互联网为基础的服务正在利用这一缺陷。它们绕过中间商，直接向消费者出售内容。Netflix的会员月费约为10美元，而一个有线电视套餐最高却要100美元。它们收集了大量的观众数据，以便更好地为他们服务。为争取制作出最好的电视节目，一场战争正在激烈地进行着：每年有400多部原创节目被制作出来，大约是五年前的两倍。与此同时，人们花在社交媒体及YouTube上的时间也越来越多。18到24岁的美国人收看电视直播的时间大约只有2010年的一半。

你也许会以为，像时代华纳这样的公司现如今已经被对手打得落花流水，但在过去五年里，它在内容产业整体（从广义上说，包括渠道公司、传媒集团以及谷歌、亚马逊这样的互联网平台公司）产生的自由现金流中所占的份额已从3%上升到4%。比克斯捍卫公司业务的手段包含若干要素。他在内容上投入重金，每年会向《真探》（True Detective）这样的电视节目投资125亿美元。他提高了向管道公司收取的价格（后者所交的费用在去年上涨了12%），同时对已售出的电视节目加以改进，并制作出更多的影片以供点播。时代华纳也一直都愿意向互联网公司出售内容。它还仿照Netflix，推出了新的互联网服务HBO Now。该服务目前的用户数量只有200万，不过正在迅速增长。

不过比克斯一定明白，和最好的电视节目一样，电视产业并不会永远繁

荣，起码不会继续赚取丰厚的利润。新进入者财力雄厚，再者，时代华纳及其他传媒公司向渠道公司提高的费用随后还是会被转嫁到消费者头上。到了某个时候，美国电视观众一定不会再忍受有线电视公司向他们漫天要价。

| 时代的警示

AT&T的收购要约出价极高，其中一半是现金。默多克的公司福克斯曾在2014年提出收购时代华纳，但出价比如今的AT&T低得多。比克斯当时明智地拒绝了。时代华纳能通过AT&T与观众建立起直接的联系。一个用户如果在移动设备上收看华纳出品的电影，时代华纳就可追踪该用户并利用所获数据出售精准广告。反垄断监管机构也许会坚持要求将这些数据向其他内容公司开放，导致数据的价值降低。即便如此，这两家公司仍声称并购是明智之举，因为这样它们便能更快地推出新服务。斥CNN为“假新闻”的唐纳德·特朗普在大选之前曾猛烈抨击这一并购交易，称其有损消费者的利益。不过，最近政府释放出的信号却变得缓和起来。华尔街的套利者估计，今年该交易获批的可能性超过75%。

对比克斯来说，那将会是一个感慨万千的时刻。一个富有创造力的大企业将归一个受监管的庞然大物所有，而后者的专长是在地下铺设电缆，其二十多万名员工中没有一个人的工作是探讨剧情转折和推拉镜头。然而事实是，紧抓住自己的企业王国不肯放手的传统媒体大亨还得证明自己的商业模式能够顶住互联网的冲击。不管是在比克斯的办公室里，还是它外面的阳台上，都已容不得矫情的感伤了。■



The Arctic

Polar bare

The Arctic as it is known today is almost certainly gone

THOSE who doubt the power of human beings to change Earth's climate should look to the Arctic, and shiver. There is no need to pore over records of temperatures and atmospheric carbon-dioxide concentrations. The process is starkly visible in the shrinkage of the ice that covers the Arctic ocean. In the past 30 years, the minimum coverage of summer ice has fallen by half; its volume has fallen by three-quarters. On current trends, the Arctic ocean will be largely ice-free in summer by 2040.

Climate-change sceptics will shrug. Some may even celebrate: an ice-free Arctic ocean promises a shortcut for shipping between the Pacific coast of Asia and the Atlantic coasts of Europe and the Americas, and the possibility of prospecting for perhaps a fifth of the planet's undiscovered supplies of oil and natural gas. Such reactions are profoundly misguided. Never mind that the low price of oil and gas means searching for them in the Arctic is no longer worthwhile. Or that the much-vaunted sea passages are likely to carry only a trickle of trade. The right response is fear. The Arctic is not merely a bellwether of matters climatic, but an actor in them.

The current period of global warming that Earth is undergoing is caused by certain gases in the atmosphere, notably carbon dioxide. These admit heat, in the form of sunlight, but block its radiation back into space, in the form of longer-wavelength infra-red. That traps heat in the air, the water and the land. More carbon dioxide equals more warming—a simple equation. Except it is not simple. A number of feedback loops complicate matters. Some dampen warming down; some speed it up. Two in the Arctic may speed it up quite a lot.

One is that seawater is much darker than ice. It absorbs heat rather than reflecting it back into space. That melts more ice, which leaves more seawater exposed, which melts more ice. And so on. This helps explain why the Arctic is warming faster than the rest of the planet. The deal on climate change made in Paris in 2015 is meant to stop Earth's surface temperature rising by more than 2°C above pre-industrial levels. In the unlikely event that it is fully implemented, winter temperatures over the Arctic ocean will still warm by between 5° and 9°C compared with their 1986-2005 average.

The second feedback loop concerns not the water but the land. In the Arctic much of this is permafrost. That frozen soil locks up a lot of organic material. If the permafrost melts its organic contents can escape as a result of fire or decay, in the form of carbon dioxide or methane (which is a more potent greenhouse gas than CO₂). This will speed up global warming directly—and the soot from the fires, when it settles on the ice, will darken it and thus speed its melting still more.

| *Dead habitat walking*

A warming Arctic could have malevolent effects. The world's winds are driven in large part by the temperature difference between the poles and the tropics. If the Arctic heats faster than the tropics, this difference will decrease and wind speeds will slow—as they have done, in the northern hemisphere, by between 5 and 15% in the past 30 years. Less wind might sound desirable. It is not. One consequence is erratic behaviour of the northern jet stream, a circumpolar current, the oscillations of which sometimes bring cold air south and warm air north. More exaggerated oscillations would spell blizzards and heatwaves in unexpected places at unexpected times.

Ocean currents, too, may slow. The melting of Arctic ice dilutes salt water moving north from the tropics. That makes it less dense, and thus less inclined to sink for the return journey in the ocean depths. This slowing of

circulation will tug at currents around the world, with effects on everything from the Indian monsoon to the pattern of El Niño in the Pacific ocean.

The scariest possibility of all is that something happens to the ice cap covering Greenland. This contains about 10% of the world's fresh water. If bits of it melted, or just broke free to float in the water, sea levels could rise by a lot more than today's projection of 74cm by the end of the century. At the moment, the risk of this happening is hard to assess because data are difficult to gather. But loss of ice from Greenland is accelerating.

What to do about all this is a different question. Even if the Paris agreement is stuck to scrupulously, the amount of carbon dioxide already in the atmosphere, together with that which will be added, looks bound eventually to make summer Arctic sea ice a thing of the past. Some talk of geoengineering—for example, spraying sulphates into the polar air to reflect sunlight back into space, or using salt to seed the creation of sunlight-blocking clouds. Such ideas would have unknown side-effects, but they are worth testing in pilot studies.

The hard truth, however, is that the Arctic as it is known today is almost certainly gone. Efforts to mitigate global warming by cutting emissions remain essential. But the state of the Arctic shows that humans cannot simply undo climate change. They will have to adapt to it. ■



北极

裸露的北极

几乎可以肯定，今天人们熟知的北极已经消失

怀疑人类有多大能耐改变地球气候的人应该看看北极，看过之后他们会不寒而栗。不需要仔细查阅温度和大气中二氧化碳浓度的记录，仅从北冰洋上冰面的日益缩减就可以明显观察到这一变化。过去30年，夏季海冰的最小覆盖面积已经缩减了一半，体积缩小了四分之三。按照目前的趋势，到2040年夏季，北冰洋上的海冰将基本消失。

气候变化怀疑论者会不以为然。有些人可能还会欢呼：北冰洋如果没有了冰，亚洲太平洋沿岸与欧美大西洋沿岸之间就有了一条海运捷径，还有可能勘探到地球上五分之一的未探明油气资源。但这样的反应大错特错。且不说由于石油和天然气价格低廉，在北极开采已经不再划算，也不论被大肆吹嘘的海上通道可能只会承担极少的贸易量，正确的反应应该是恐惧。北极不仅仅是气候问题的风向标，更是气候问题的作用因素。

目前地球正在经历的全球变暖是由大气中的某些气体引起的，尤其是二氧化碳。这些气体容许热量以太阳光的形式透过大气层，但阻挡其以波长更长的红外线辐射到太空。这样一来热量就被留存在空气中、水里和陆地上。二氧化碳增多就等于变暖加剧，这是个简单的等式。只不过它其实并不简单。一些反馈循环让情况变得更复杂：有些抑制了变暖，有些则令其加速。北极的两大反馈循环可能让气候变暖大幅加快。

一是海水的颜色比冰深得多。海水吸收热量而不是将其反射回太空。这会融化更多冰面，让更多海水暴露出来，继而融化更多的冰，如此循环。这可以解释为什么北极比地球上其他地方变暖得更快。2015年在巴黎达成的气候变化协议旨在将地球表面温度较工业化前水平的升幅控制在 2°C 之内。假使这一协议真的能完全落实，比起1986年至2005年的平均水平，北冰洋的冬季温度仍会升高 5°C 到 9°C 。

第二个反馈循环与水无关，而是有关陆地。北极的陆地表面大部分是永久冻土层，这些冻土锁住了大量的有机物。如果永久冻土融化，其中的有机物便会因起火或腐烂而以二氧化碳或甲烷的形式逸出，而甲烷是一种比二氧化碳更强的温室气体。这将直接加速全球变暖，而且起火产生的烟灰一旦落在冰上就会染黑冰面，从而让冰融化得更快。

| 死寂栖息地不复存

北极变暖可能会有极恶劣的后果。世界上的风很大程度上是因两极和热带地区的温差而形成的。如果北极比热带地区升温更快，这一温差会减小，风速就会减慢。这种情况已经出现——过去30年来，北半球的风速减缓了5%到15%。风减少听起来也许令人向往，实则不然。后果之一就是北半球的急流发生紊乱。急流是一种环极气流，它的振荡有时会将冷空气带到南方，或将暖空气带到北方。如果急流振荡幅度过大，可能会在意想不到的时间给意想不到的地方带来暴风雪和热浪。

洋流也可能减缓。北极冰面融化，稀释了从热带地区流向北方的海水。这导致海水密度降低，因而不易下沉至深海进行回流。这一循环放缓会拖慢全球的洋流，从印度的季风到太平洋厄尔尼诺现象的规律，一切都会因此受到影响。

在可能发生的情形中，最恐怖的是覆盖格陵兰岛的冰盖发生变化。格陵兰岛包含了全球约10%的淡水，如果这里的冰盖融化一点，或者只是破裂后漂浮到海面上，那么到本世纪末海平面升高的水平将远远超过今天所预计的74厘米。目前很难评估这一情况发生的风险，因为数据太难收集。但格陵兰岛冰盖的融化正在加速。

如何应对这一切也是个问题。即便严格执行了巴黎协定，大气中已有的二氧化碳，再加上未来将会增加的，看起来最终仍会让夏季的北冰洋海冰成为过去。有些人谈到地球工程，比方说向极地大气中喷洒硫酸盐，从而将阳光反射回太空，或是撒盐来促使水汽凝结成云，阻挡日光。这样的想法可能会有未知的副作用，不过仍值得在试点研究中测试。

然而一个铁的事实是，几乎可以肯定，我们今天所知道的北极已不复存在。通过减排来减缓全球变暖的努力仍然至关重要，但北极的情况表明，人类并不能简单消除气候变化的影响。他们必须去适应这种变化。■



Animal waste

Burning the fat

A Finnish refiner turns slaughterhouses into oil wells

IN ALDOUS HUXLEY'S "Brave New World", the human corpses in Slough Crematorium are turned into a phosphorous-based fertiliser. "Fine to think we can go on being socially useful even after we're dead," a character enthuses.

An engineer at Neste, a Finnish oil company, wryly echoes that observation while showing visitors around a novel diesel refinery in Porvoo, an industrial town 50km (31 miles) east of Helsinki. But the sickly-smelling brown gloop fed into the town's pre-treatment plant has nothing to do with humans. It is made from the rendered fat of slaughtered cattle and pigs, transported by tankers in heated vats to stop it congealing. No reindeer, either. "Too lean," he says.

In a triumph of the "circular economy", Neste has found a way to make transport fuel more sustainable. After heating and filtering the gunk, what is left of it is mixed with hydrogen in a refinery, producing diesel-like hydrocarbons that are then tailored so that they can be poured straight into the tanks of everything from cars to passenger jets. "You could put this in your VW diesel and drive off," says Joshua Stone of Barclays, a bank.

Since BP, a British firm, made its attempt to go "Beyond Petroleum" in the 2000s, many oil companies have sought to become greener. But few have taken a more idiosyncratic route than Neste, which is part-owned by the Finnish state. In the past decade it has invested €1.42bn (\$1.55bn) in "biorefineries" in Porvoo, Singapore and Rotterdam. These process animal waste and recycled cooking fat into renewable diesel, a cleaner form of the fuel than that which, since the scandal at Volkswagen, has tainted the car

industry. It is also a more sustainable alternative than the biofuels made from food crops. Neste has become the world's biggest producer.

For years, Neste's diversification away from fossil fuels terrified investors. "They really didn't believe us," says Matti Lievonon, its chief executive. But since 2013, when its operating profit from renewable diesel turned positive for the first time, to last year, when it reached €469m, its shares have outperformed other refiners. A few competitors, such as Valero, an American refiner, Total of France and Eni of Italy, also produce renewable diesel, but Neste's 2.6m-tonne capacity dwarfs theirs.

The preference for renewable diesel over other biofuels is because it can be "dropped" straight into a tank with no blending. Neste says its products generate less carbon dioxide, nitrogen oxides and particulates than fossil diesel, which is why California, a clean-energy pioneer, is its biggest market. Renewable diesel is more expensive than its traditional counterpart, however, so it relies on clean-energy mandates, fuel standards and tax credits for growth. Demand is thus subject to the whims of regulators, which can fluctuate.

Most intriguing is Neste's impact on slaughterhouses globally. Ryan Standard of *The Jacobsen*, an American journal that tracks the trade in animal fats, says that anticipated global demand from Neste and its smaller American rival, Diamond Green Diesel, is likely to account for the equivalent of almost half the tallow, lard, white grease, poultry fat, used cooking oil and other Dickensian-sounding waste products produced in America. That may put an upper limit on the supply of raw materials, meaning renewable diesel will always remain a niche product.

Yet Neste still sees ample room for growth, as restrictions on cars using fossil diesel increase, and fuel-guzzling heavy vehicles and jet aircraft strive for lower emissions. Petri Lehmus, its head of research and

development, says the firm is exploring new potential feedstocks such as forest residues and algae. However successful it is, Neste will never become the next Saudi Aramco. But what it lacks in natural resources, it will strive to make up for in human ingenuity. ■



动物废料

燃烧脂肪

芬兰炼油厂变屠宰场为油井

在阿道斯·赫胥黎（Aldous Huxley）笔下的《美丽新世界》中，斯劳火葬场把人类尸体转化为一种磷肥。“即便死后我们也能继续造福社会，挺好的。”书中一位人物满腔热情地说道。

在赫尔辛基以东50公里的工业城镇波尔沃（Porvoo），芬兰耐思特石油公司（Neste）的一名工程师半开玩笑地重提了这一说法。他正带领访客参观当地一家新型柴油炼油厂。镇上的预处理厂用作原材料的棕色黏液散发着恶臭，不过与人类并没有什么关系，而是用屠宰后的牛和猪身上提取的脂肪制成。为防止凝固，这种原材料被装在加热的油桶内，再用油罐车运送。驯鹿也派不上用场。“太瘦了。”他说。

耐思特找到一种提升运输燃料可持续性的方法，取得了“循环经济”的一大胜利。将粘稠的原材料加热并过滤后，剩余的物质将在炼油厂中与氢气混合，制成类似柴油的碳氢化合物，然后再按具体需要做调整，最终可将其直接注入汽车以至客机等各种交通工具的油箱中。“你可以把这东西加到你的大众柴油车里，马上就能开走。”巴克莱银行的约书亚·斯通（Joshua Stone）说。

自从英国BP公司在本世纪初进行“超越石油”（Beyond Petroleum）的尝试以来，许多石油公司纷纷寻求更环保的出路。但少有像耐思特（由芬兰政府部分持股）这样另辟蹊径的。过去十年，该公司投资14.2亿欧元（15.5亿美元）在波尔沃、新加坡和鹿特丹设立“生物炼油厂”。这些炼油厂把动物废料及回收的烹饪油脂加工成为可再生柴油，比因大众“排放门”事件而令汽车行业蒙羞的一般柴油更为洁净。相比以粮食作物为原料的生物燃料，这也是更可持续的替代品。耐思特已成为这类柴油的全球最大生产商。

多年来，耐思特大力开拓化石燃料以外的新能源产品，令投资者深感不安。“他们非常不相信我们。”公司首席执行官马蒂·列沃宁（Matti Lievonon）表示。但自2013年起，该公司的可再生柴油产品开始盈利，到去年，营业利润更达到4.69亿欧元，公司股价表现优于其他炼油公司。几家竞争对手也生产可再生柴油，如美国炼油企业瓦莱罗（Valero）、法国的道达尔（Total）和意大利的埃尼（Eni），但耐思特260万吨的产能令它们相形见绌。

相比其他生物燃料，人们偏爱可再生柴油，因为后者无需和其他燃料混合，一股脑儿倒进油箱即可。耐思特表示，其产品生成的二氧化碳、氮氧化物和颗粒物都少于化石柴油，所以清洁能源的先锋——加州成了它最大的市场。但可再生柴油比传统柴油贵，因此其增长依赖清洁能源法规、燃油标准及税收优惠等政策的推动。这样一来，其需求会受制于监管机构的心血来潮，而起伏不定。

最有趣的是耐思特对全球屠宰场造成的影响。追踪动物脂肪交易的美国行业期刊《雅各布森》（The Jacobsen）的瑞安·斯坦德（Ryan Standard）表示，根据耐思特及其小型对手美国戴蒙德绿色柴油公司（Diamond Green Diesel）预期的全球需求量，两者很可能会消耗美国近半的牛油、猪油、白色油脂、家禽脂肪、食用废油及其他听起来肮脏不堪的废料。原材料供应或许会有上限，这意味着可再生柴油始终会是个小众产品。

然而，随着针对化石柴油汽车限制的增加，以及高耗油的重型汽车及喷气飞机努力减排，耐思特自认仍有充分的增长空间。其研发主管佩特里·雷姆斯（Petri Lehmus）表示，公司正探索运用林业废料及藻类等新原料的可能性。无论最终有多成功，耐思特永远也不会成为下一个沙特阿美石油公司（Saudi Aramco）。虽然欠缺自然资源，但耐思特将力求以人类的创造力来弥补。■



Clothing companies

Green is the new black

Looking good can be extremely bad for the planet

STYLE is supposedly for ever. But the garments needed to conjure up eternal chic are spending less time on shop racks and in homes than ever before. Global clothing production doubled between 2000 and 2014, as apparel firms' operations became more efficient, their production cycles became quicker and fashionistas got more for their money. From just a few collections a year, fast-fashion brands such as Zara, owned by Spain's Inditex, now offer more than 20; Sweden's H&M manages up to 16.

Dressing to impress has an environmental cost as well as a financial one. From the pesticides poured on cotton fields to the washes in which denim is dunked, making 1kg of fabric generates 23kg of greenhouse gases on average, according to estimates by McKinsey, a consultancy. Because consumers keep almost every type of apparel only half as long as they did 15 years ago, these inputs quickly go to waste. The latest worry is shoppers in the developing world, who have yet to buy as many clothes as rich-world consumers but are fast catching up (see chart).

Most apparel companies know that sooner or later, consumers' awareness of this subject will rise. That is a worry. Various furores in the 1990s and afterwards over the working conditions of people making goods for firms such as Nike, Walmart and Primark badly damaged brands. The clothing industry cannot afford to appear so ugly again.

One obvious way in which firms can answer environmental concerns is to use renewable energy to power their facilities. Beyond that, they can cut back sharply on water and chemical use; and they can develop new materials and manufacturing processes that reduce inputs.

The record in this regard is mixed. H&M was the largest buyer in the world of “better cotton” last year—that is, cotton produced under a scheme to eliminate the nastiest pesticides and encourage strict water management. It grows in 24 countries and represents about 12% of the 25m tonnes of cotton produced each year globally. Kirsten Brodde of Greenpeace also notes that H&M has eliminated toxic per- and polyfluorinated chemicals from its lines (which are used to make garments waterproof). Nike’s Flyknit method of weaving items, including trainers, reduces waste by 60% in comparison with cutting and sewing. Flyknit products have a large following: revenues from the line came to more than \$1bn in the last fiscal year.

But for many firms, research and development into new materials and methods is not a priority. Plenty do not measure their overall environmental impact. And introducing green collections can even carry a risk for brands, reckons Steven Swartz of McKinsey. It is possible that a shopper will move on from wearing a consciously green T-shirt to viewing other kinds of clothing as the trappings of planetary destruction.

A handful of brands encourage customers to recycle old clothes by returning them to stores. But almost all apparel today is made of a mix of materials—very often including polyester. Separating them out is difficult and mechanical methods of recycling degrade fibres. Chemical methods are too expensive to be viable. Shipping second-hand clothes off to countries in Africa and Asia is also a bust. Even if local markets are large enough to absorb them, the poorer quality of polyester-mixed garbs means they do not survive long.

More durable apparel could help. Tom Cridland, a British designer, creates men’s clothing that is designed to last three decades thanks to strong seams and special treatments to prevent shrinking. He expects revenues of \$1m this year, but admits that his model will be hard to scale. Patagonia, a maker

of climbing and hiking gear, sends vans to campuses to help students patch up jackets and trousers. It helps others with greenery, too. After discovering a type of material for wetsuits that, unlike neoprene, requires no oil to make, Patagonia shared the find with surfing brands such as Quiksilver. Such innovation is badly needed. Style may be forever but today's model of clothing production is not. ■



服装公司

环保最时尚

衣着光鲜可能对地球极为有害

人们一般认为风格是永恒的。但是，打造永恒风格所需的服装在货架和人们家中停留的时间比以往都更短了。随着服装企业运营效率提高，生产周期缩短，时尚潮人们能买到的东西也更多了，全球服装产量在2000年至2014年间翻了一番。快时尚品牌，例如西班牙Inditex集团旗下的Zara，以前一年只推出几个系列，如今增加到20多个，瑞典的H&M经营的系列也多达16个。

穿得亮眼既有环境代价也有财务成本。咨询公司麦肯锡估计，从棉田里喷洒的杀虫剂到浸泡牛仔布用的洗液，每生产1公斤牛仔布平均产生23公斤温室气体。如今，几乎任何类型的服装在消费者那里保留的时间都只有15年前的一半，因此这些投入很快会白白浪费掉。最近让人担心的是发展中国家的购物者。他们买的衣服虽然还不像富裕世界的消费者那么多，但也在迅速赶上（见图表）。

大多数服装公司都明白，消费者迟早会认识到这个问题。这令它们感到担忧。从上世纪90年代起，耐克、沃尔玛和Primark等公司员工工作条件引起的各种轩然大波严重损害了这些品牌。服装业再也经不起大丑闻了。

企业若要回应对环境的担忧，一个显而易见的方法就是利用可再生能源为自己的设施供电。除此之外，还可以大幅减少水和化学品的使用，以及开发新材料和制造工艺来减少投入。

企业在这方面的表现参差不齐。H&M是去年全球最大的“良好棉花”买家。这种棉花按照指定方案生产，杜绝使用高毒杀虫剂并鼓励严格管理水资源。“良好棉花”在24个国家种植，约占全球棉花2500万吨年产量的12%。绿色和平组织的柯尔丝滕·博罗德（Kirsten Brodde）还指出，H&M已经在各系列产品中停止使用有毒的单氟以及多氟化合物（用来使衣服防

水)。耐克用于运动鞋等服饰的Flyknit编织法比裁剪和缝纫减少了60%的浪费。Flyknit产品广受追捧：这一系列在上个财年的收入超过10亿美元。

但对于许多企业来说，新材料和新方法的研发并非头等大事。很多企业并没有衡量自己对环境的总体影响。此外，麦肯锡的史蒂芬·舒瓦茨（Steven Swartz）认为，推出环保系列甚至可能给品牌本身带来风险。购物者可能会从穿环保T恤更进一步，将其他服装都看做是破坏地球的象征。

少数品牌鼓励顾客把旧衣服送到店里回收利用。但现在几乎所有的服装都是由多种材料（通常包括涤纶）混合制成的。要分离这些材料很困难，而机械回收方法又会破坏纤维。化学方法则成本太高，难以实行。把旧衣服运到非洲和亚洲国家也行不通。虽然当地市场足够大，能够消化这些旧衣服，但涤纶混纺的衣服质量较差，不够经久耐穿。

更耐用的服装也许会有帮助。借助牢固的缝合以及特殊的防缩水处理，英国设计师汤姆·克里德兰（Tom Cridland）发明了可以穿30年的男装。他预计今年的收入将达到100万美元，但也承认自己的模式难以规模化。登山和徒步旅行装备制造厂商巴塔哥尼亚（Patagonia）把货车开进校园，帮助学生修补夹克和裤子。它还帮助其他机构追求环保。该公司发现了一种潜水服材料，不像氯丁橡胶那样在生产时需要用到油，它与Quiksilver等冲浪品牌分享了这一发现。这种创新是亟需的。风格也许永恒，但目前的服装生产模式却不持久。■



Renewable energy

New investment in renewable energy globally fell

New investment in renewable energy globally fell by 23% last year, to \$241.6bn. The fall is partly the result of an investment slowdown in China and Japan, after a huge increase in wind and solar capacity that was financed in 2015. But lower capital costs are also responsible: in dollar terms, solar photovoltaics, onshore wind and offshore wind are at least 10% cheaper per megawatt than they were in 2015. Global installed capacity of wind, solar and other renewables rose by a record 11 gigawatts (GW), to 138.5GW, in 2016. The costs of generating these renewables are now comparable with fossil-fuel plants. But their future remains vulnerable to policy changes and to slowing growth in electricity demand. ■



可再生能源

全球可再生能源新增投资减少

去年，全球对可再生能源的新增投资为2416亿美元，下跌了23%。下滑的原因之一是中国和日本的投资放缓；这两个国家在2015年的投资极大增加了风能和太阳能的装机容量。不过资本成本降低也是一个原因：按美元计，太阳能光伏发电和陆地与离岸风电每兆瓦的价格比2015年降低了至少10%。2016年，风能、太阳能和其他可再生能源的全球装机容量升幅创下记录，增加了11千兆瓦，总容量达到138.5千兆瓦。可再生能源的发电成本如今已与化石能源相当。但可再生能源的未来仍然易受政策变化和电力需求增长放缓的影响。■



Railways

The whistle's blowing

Can Hunter Harrison, a railway legend, deliver at CSX?

E. HUNTER HARRISON, a veteran railway executive, tried retiring in 2010, after he made Canadian National (CN), a formerly state-owned company, the best-performing of the large railways in North America. But once he pocketed the gold watch and attended the retirement party he faced a void that raising and training horses for showjumping did not fill. By mid-2012 he was back at the helm of another railway, Canadian Pacific (CP), whose glory days were long past. Once he had turned around CP, he didn't make the same mistake again. On January 18th the 72-year-old Tennessean both announced his departure and entered negotiations with Florida-based CSX to become that railway's CEO.

Just the rumour that Mr Harrison might be moving to CSX caused the share price to rise by 23% in 24 hours. It continued to rise when the negotiations became public. At last, on March 6th, CSX appointed Mr Harrison as CEO and met the condition set by Mantle Ridge, an activist hedge fund with which he has partnered, to name five new board directors. Mr Harrison made long-term shareholders in CP and CN rich, tripling profits at both during his tenures. CSX shareholders expect the same.

Will he deliver? CSX is different from the railways Mr Harrison has run in the past. Its 21,000-mile network is concentrated, spaghetti-like, in heavily-populated eastern America, unlike the linear, continent-spanning networks of roughly similar total length that are operated by CN and CP. And he faces two new and potentially damaging headwinds: the decline of coal, a mainstay of railway-freight volumes; and Donald Trump's views on trade. Both could seriously disrupt business on North American railways.

Mr Harrison certainly knows the industry inside and out. He reportedly started out lubricating the undercarriage of railcars for \$1.50 an hour and worked his way up at Burlington Northern before leaving to work for Illinois Central. He joined CN when it bought Illinois Central in 1998. Along the way he became an evangelist for precision railroading, his concept that freight trains should run on a strict schedule regardless of whether they are near-empty or full. This went against the prevailing trend of adding more locomotives and cars and leaving their schedules flexible. Operating fewer trains, but on time, Mr Harrison showed, meant greater efficiency and better service for customers, who know when their shipments will arrive.

Another part of precision railroading is ditching old equipment and slashing staff. Mr Harrison retired 700 locomotives, or two-fifths of the fleet, at CP; about 6,000 of 20,000 jobs disappeared, largely through attrition. This earned him the ire of some unions, which also questioned the impact on safety of time-saving measures like allowing staff to jump on and off (slow-)moving trains or insisting that managers drive trains if no other staff were available. This reduced some managers to tears, says a former employee: "They weren't afraid of driving the train, they were afraid of crashing it." Mr Harrison thought the hands-on experience would help them do their desk jobs better.

CSX is in better shape than either of his previous two charges. CN was government-owned until 1995 and was hobbled by bureaucracy. CP, created to tie Canada together with a line extending to the west coast, was the laggard among the big North American railways when Mr Harrison arrived. Its operating ratio (operating expenses as a percentage of revenues) was 81.3 at the end of 2011. By 2016 it had been driven down to around 60, although some people quibble that one-off sales may have flattered the ratio. CSX had an operating ratio of 69.4 in 2016, and is already making many of the moves Mr Harrison has used elsewhere, like increasing the ratio of cars to locomotives and cutting staff.

As for coal, revenues from the commodity fell by nearly \$2bn to \$1.7bn between 2011 and 2016. Further falls are expected. The main replacement as a source of revenue is intermodal container freight carrying all manner of goods. Here Mr Trump is a problem. His proposed renegotiation of the North American Free-Trade Agreement (NAFTA) is creating alarm in the industry. Re-imposing borders in the North American market would have a “tremendously negative effect”, says William Vantuono, editor-in-chief of *RailwayAge*.

Accepting the job, Mr Harrison confirmed that he will bring precision railroading to CSX. Might he have grander ambitions? Mr Vantuono believes that his ultimate goal is to arrange one of the mergers that eluded him in the past and to create a transcontinental railway. Others think he just wants to show—again—that his way is the right way. “There isn’t a railroad that Hunter Harrison couldn’t improve,” says Anthony Hatch, a New York-based analyst. But it will be difficult to repeat his previous successes or to match sky-high shareholder expectations. ■



铁路

汽笛声声

铁路界传奇亨特·哈里森能否在CSX再创辉煌?

铁路界资深高管亨特·哈里森（E. Hunter Harrison）2010年曾尝试过退休。在这之前他将原归国有的加拿大国家铁路（Canadian National，以下简称CN）打造成了北美业绩最好的大型铁路公司。不过当他功成身退、加入退休一族时，他却陷入了空虚，即使驯养马匹参加马术障碍赛也无法填补。2012年年中，他重操旧业，执掌另一家早已辉煌不再的铁路公司加拿大太平洋（Canadian Pacific，简称CP）。在扭转了CP的经营状况之后，他没有重蹈覆辙。1月18日，这位72岁的田纳西人宣布从CP离职，同时与总部设在佛罗里达的CSX谈判，意在担任该铁路公司的CEO。

仅仅是哈里森可能入主CSX的传言就让该公司的股价在24小时内上涨了23%。谈判公开后，股价继续攀升。最终在3月6日，CSX任命哈里森为CEO，并满足了他担任合伙人的维权对冲基金Mantle Ridge提出的条件，任命了五位新董事。哈里森让CP和CN的长期股东财源滚滚，在他任期内，两家公司的利润也都增加了两倍。CSX的股东也怀抱同样的期望。

他能否不负所望？CSX与哈里森过去经营的铁路公司不同。它长达21,000英里的网络像意粉一样错综复杂，集中在人口密集的美国东部，而CN和CP两家运营的铁路虽然总长度与CSX相近，但都是跨越整个北美大陆的线型网络。他面临着两大有潜在破坏性的新阻力：作为铁路货运中流砥柱的煤的衰落，以及特朗普对贸易的观点。这两点都可能严重损害北美铁路的业务。

哈里森当然对这一行业了如指掌。据说他刚入行时的工作是为轨道车底盘加润滑油，时薪1.5美元。后来他在北伯林顿铁路公司（Burlington Northern）一路升职，之后又去了伊利诺斯中央铁路公司（Illinois Central）。1998年伊利诺斯中央铁路被CN收购，他随之加入CN。一路走来，他积极倡导精准铁路运输（precision railroading）这一理念，即货运

列车必须按照严格的时刻表运行，无论是近乎空载还是满载。这与增加机车和车厢、灵活调整时刻表的主流趋势相悖。哈里森向人们表明，运营列车数量减少但准时，就能向客户提供更高的效率和更好的服务，因为他们知道自己的货物何时抵达。

精准铁路运输的另一个方面是淘汰旧设备和裁员。在CP，哈里森报废了700辆机车，占整个车队的五分之二；两万名员工减少了约六千人，其中大部分是通过自然减员。这引发了一些工会对他的愤怒，这些工会还质疑省时措施对安全的影响，例如允许员工从（缓慢）行驶的列车上跳上跳下，或坚持让管理人员在其他员工都没空的时候驾驶列车——这把一些人弄哭了。一位前雇员说：“他们不是怕开火车，是怕撞车。”哈里森则认为实际动手经验有助于他们更好地完成办公室里的工作。

CSX的现状要好过他之前掌管的两家。CN在1995年之前还属国有，被官僚作风束缚。CP的创建是为了用一条延伸至西海岸的铁路线贯穿整个加拿大，当哈里森入主时，它还在北美大型铁路公司中吊车尾。2011年末它的营运比率（营运支出占收入的百分比）为81.3。到了2016年已降至约60%，不过有些人挑剔说一次性出售可能粉饰了这一比率。2016年CSX的营运比率为69.4，它已经开始采用哈里森曾在别处用过的很多招数，例如增加车厢对机车的比率、裁员等。

说到煤炭，2011年至2016年铁路货运源自这一大宗商品的收入下跌了近20亿美元，至17亿美元。预计未来还会继续下跌。替代煤炭作为收入来源的主要是运送各类商品的联运集装箱运输。在这一点上特朗普是个麻烦。他提出重新协商《北美自由贸易协定》（NAFTA），这在业内拉响了警报。

《铁路时代》（RailwayAge）的总编威廉·万图奥诺（William Vantuono）认为，在北美市场重新征收关税会产生“极大的负面影响”。

接受这份工作后，哈里森证实他会将精准铁路运输带到CSX。他会不会还有更大的抱负？万图奥诺相信哈里森最终的目标是筹备他之前未能达成的某项合并，成立横跨北美大陆的铁路公司。其他人认为他只是想再一次证明他的方法是对的。“没有亨特·哈里森不能提升的铁路。”纽约的分析师

安东尼·哈奇（Anthony Hatch）说。但要重现他之前的辉煌，或是满足股东极高的期望，都非易事。■



Paying for infrastructure

Private matters

How and when to use private capital in infrastructure projects

WHEN the Indiana Toll Road was opened in 1956, there were eight pairs of travel plazas, or rest stops, along the 156-mile (250km) stretch linking Chicago to Ohio and points eastward. As cars became faster and less thirsty, travellers had less reason to stop regularly for petrol or snacks. Three of the travel plazas closed in the 1970s. Restaurants shuttered, even if offered free rent. The remaining plazas, dwindling in number, fell into disrepair. The abiding memory some road users had of Indiana was of grubby toilets along the toll road.

Those rest-stops are at last getting a makeover. IFM, an Australian infrastructure fund, is investing \$34m in the toll-road's plazas, part of a \$200m-plus upgrade. Half of the road's length, with 57 bridges, is being resurfaced, using a treatment known as "crack-and-feed", which lasts longer than simply patching the top. IFM, which acquired a 66-year lease on the road in a \$5.8bn deal in 2015, says a private-sector operator has the right incentives to invest for the long term. Fewer tyre blowouts mean less gridlock, more road users and more revenue.

Politicians across the spectrum agree on the need to upgrade America's crumbling roads and bridges. President Donald Trump has promised a \$1trn infrastructure package. His commerce secretary, Wilbur Ross, is keen to involve the private sector. His vice-president, Mike Pence, was governor of Indiana when the toll-road upgrade was announced. It was not a smooth ride. The 2006 legislation to sell the road barely passed: concerns had been raised that a private owner would cut corners on maintenance and service. Then a plan to levy tolls on a new road built with the privatisation proceeds failed. The debt-heavy consortium which first acquired the Indiana toll

road went bust (IFM subsequently bought it). The tale shows the promise of private-public partnership, or PPP, in infrastructure—but also the perils.

Linking public-sector need with private-sector capital ought to be a perfect match. Around \$2.5trn is spent worldwide each year on roads, railways, ports, sewers, telecoms systems and other infrastructure, but that is still short of the roughly \$3.3trn required each year from now until 2030, according to McKinsey Global Institute, a think-tank. The average national shortfall is 0.4% of GDP (see chart). When public finances start to creak, capital spending is often the first thing to go.

Meanwhile, the pitiful yields on government bonds, plus longer lifespans, mean pension funds are desperate for fairly safe assets that offer a stable, inflation-plus return to provide the income they have promised to the retired. The steady, fee-based revenue generated by airports, toll roads, seaports and utilities seems ideal. Asset managers, such as the Ontario Teachers Pension Fund, have built up know-how in infrastructure investment. Others put money to work through specialist fund managers, such as IFM. These have raised more than \$260bn over the past decade, including \$47bn last year (see chart).

PPP thus promises to deal with a host of shortages: of infrastructure; of fiscal space; of long-lived and safe securities; and of aggregate demand and jobs. If it is done correctly, the public users of infrastructure gain from the innovation and efficiency of private-sector firms. But the shortish history of PPP is littered with examples where private provision did not live up to its promises. Problems fall broadly into three categories: the behavioural barriers that turn off consumers; political interests that often turn projects sour; and the difficulty of finding financial and incentive structures that align the interests of all parties.

Start with public opposition. Anxieties about privatising essential services

are present in all countries but tellingly are not always consistent. Britain seems fairly relaxed about private water companies but is cool on privately run toll roads. In contrast, private toll roads are a feature of Australian life but water privatisation remains controversial. A lot depends on what the public has become used to. It is typically more comfortable with the private ownership of telecoms and electricity assets, which is established, than with highways. Yet cable and power networks are at least as critical as roads, perhaps more so.

Whatever the logic, a touchy public makes for jumpy politicians. A change of administration can often kill a project or drain public support for it. For instance, last year legislators in North Carolina voted down a PPP toll-road project agreed in 2014. It is now under independent review. The East-West link, a PPP toll way in Melbourne, Australia, was cancelled after public opposition. Politicians' desire for quick results is also at odds with the detailed preparation and long gestation period needed for good infrastructure projects. "Everyone wants to cut the ribbon," says Kyle Mangini of IFM. "But the political cycle is four to five years while the infrastructure cycle is five to ten years." Public support for private infrastructure can, however, be built up. Industry experts rave about the "Australian model", for instance, in which proceeds from privatisations of ports and roads go towards new hospitals, schools and so on.

That leaves the third substantial difficulty, of getting the financial structure of PPP deals right, so that taxpayers, politicians, banks and fund managers are all content. The first need is to work out whether, and how, private capital will provide benefits that public finance cannot. Too often, the main reason for a government to bring in private capital is a bad one: to follow fiscal rules that cap public borrowing or debt. "If the starting-point is to keep a commitment off the public-sector balance-sheet, it's hard to negotiate a good deal," says Andy Rose of the Global Infrastructure Investor Association.

The right way is to allocate risk where it can best be managed. Governments can borrow cheaply. The cost of private capital is higher. Commercial incentives often make private companies better at pushing construction and operating costs down while keeping users happy with the service. PPP typically works best when there is a stream of revenue from fees, road tolls, airport charges or utility bills. It works less well where returns need to be enhanced by a public subsidy, the terms of which are liable to change. And it works badly wherever there are risks that private capital cannot gauge or reasonably bear, such as cost overruns due to delays in regulatory clearance or to “tail risks” which the state simply cannot lay off, such as nuclear decommissioning. Politicians might see PPP as a way of pushing all risks onto private contractors. But the wise ones shun such deals.

There is a spectrum of procurement options. At one end are projects financed from taxes. For instance, last year Los Angeles voted to raise its local sales tax by 0.5% to pay for infrastructure. At the other end are private projects, such as London Gateway, a deepwater port on the Thames built by DP World, a Dubai-based port operator. In between lie privatised utilities that are subject to public regulation; or concessions where a private operator is asked to build, say, a hospital or airport terminal and then operate or manage it for a fixed period in return for the revenue it generates or an agreed fee. Crossrail, a massive project in London (pictured), is an example of another sort of hybrid, where the asset is built by the private sector, but ownership remains public. The right procurement model depends on the individual project, says Mr Rose. Ultimately, however, the taxpayer pays, whether in taxes, fares, tolls or bills.

The PPP model, though more established in Australia, Britain and Canada, is slowly gaining adherents in America. One example is the new terminal at La Guardia airport in New York. Will Mr Trump’s infrastructure plans give PPP a big push? The only specific detail that seems to be agreed on is a tax credit for equity investors. But a shortfall of private capital is not the main

bottleneck, says the head of the PPP infrastructure business at a big construction firm. Rather, pots of money are chasing a paucity of projects that are ready and fit for private-sector participation.

A lot of groundwork, such as environmental studies and detailed risk-assessments, are needed before a private company will bid on a project. One reason Canada and Australia have a good record on infrastructure is that they have agencies dedicated to grooming projects. It is far harder to get projects going in America, where contractors must deal with a plethora of regulators in different departments, both federal and local. Streamlining planning and permits is painstaking work. Does Mr Trump have the patience for it? ■



为基础设施买单

私营事务

如何及何时在基础设施项目中利用私营资本

1956年印第安纳收费公路通车时，这条156英里（250公里）长、连接芝加哥与俄亥俄州并向东延伸的公路共有16个休息站。随着汽车速度提升、耗油减少，旅行者们已不大需要时不时停下来加个油或买点零食了。上世纪70年代，这些休息站关掉了三个。即便免收租金，一家家饭馆也关门大吉。剩下的休息站则年久失修，并且也在陆续关闭。一些旅行者对印第安纳难以磨灭的记忆便是收费公路边脏兮兮的厕所。

如今这些休息站终于要整修一番了。澳大利亚的一家基础设施基金IFM向这条收费公路的休息站投资3400万美元，而整个升级改造共将耗资超过两亿美元。占公路总长度一半的路面（包含57座桥）都会重新铺设。工程采用的是一种名叫“开槽灌缝”的处理方法，比简单地局部修补路面效果要更持久。IFM在2015年投资58亿美元获得了该公路为期66年的租约。该基金称，私营部门运营商具备合适的动力进行长期投资。爆胎的情况减少了，交通阻塞便会减少，公路上的车辆就会增加，带来的收入也就更多。

不管各自的政治立场如何，政客们都同意美国破破烂烂的道路桥梁需要升级改造。总统特朗普许诺要实施一万亿美元的基建计划。他的商务部长威尔伯·罗斯（Wilbur Ross）热切地想让私营部门参与进来。整修印第安纳收费公路的计划宣布时，副总统麦克·彭斯（Mike Pence）正是该州的州长。这项计划并非一帆风顺。准许出售该公路运营权的法规在2006年只是勉强获得通过：人们担心私营业主会在维护保养及服务上偷工减料。之后，另一项计划——向一条用私有化的收益修建而成的新公路收费——也失败了。一开始获得印第安纳收费公路运营权的财团负债累累，最终破产（而后被IFM收购）。从这个故事可以看出，公私合作制（或称PPP）参与基础设施建设既有前景，但也存在重大风险。

将公共部门的需要与私营部门的资金联系起来，应该会成就一个完美的结

合。据智库麦肯锡全球研究院计算，全世界每年在公路、铁路、港口、下水道、通讯系统以及其他基础设施上的支出约达2.5万亿美元，但从现在到2030年，每年在基建上所需的资金约为3.3万亿美元，眼下的支出水平还是不够。各国基建资金缺口平均占各自GDP的0.4%（见图表）。一旦公共财政开始运转不灵，首先被砍的通常都是资本支出。

与此同时，由于政府债券的收益少得可怜，再加上人们寿命的延长，养老基金迫切需要相当安全的资产来产生稳定、抗通胀的回报，这样才可向退休人员支付当初承诺的养老金。机场、收费公路、海港以及公用事业所产生的基于付费的稳定收入看起来很理想。安大略省教师退休基金

（Ontario Teachers Pension Fund）等资产管理机构已积累起关于基础设施投资的专门知识，其他的则通过IFM这样的专门基金管理公司进行投资。在过去十年中，这些机构已募集超过2600亿美元的资金，包括去年的470亿美元（见图表）。

由此看来，PPP模式有望解决一大堆的短缺问题：有关基础设施、财政空间、持久而安全的证券、总需求以及工作机会等。如果这一模式执行得当，基础设施的公共用户便可因私营部门的创新与效率而受益。然而在PPP模式并不算长的历史中，不乏私营部门在提供服务时未达预期的例子。问题主要有三类：行为习惯的阻碍致使消费者不买账、政治利益常令项目状况恶化，以及难以找到可协调各方利益的金融及激励架构。

先从公众的反对说起。将至关重要的服务私有化在所有国家都会引起人们的忧虑，不过这种忧虑在各国显然并不总是一致。英国人对私营自来水公司的态度似乎颇为淡定，但对私人运营的收费公路却较冷淡。相反，私营收费公路在澳大利亚司空见惯，但水务私有化在该国却依然会引发争议。这在很大程度上取决与公众已经习惯了什么。与公路私有化相比，他们对由来已久的电信及电力资产私有化要更放心些。但电缆及电网起码同公路一样关键，或许还更重要。

不管背后的逻辑如何，若公众难伺候，政客们便会提心吊胆。政府的更迭常常会扼杀一个项目或耗尽民众对项目的支持。例如，去年北卡罗莱纳州

立法者否决了一个2014年通过的收费公路PPP项目。该项目如今正在接受独立审查。澳大利亚墨尔本的收费公路PPP项目“东西连线”（East-West link）也因公众反对而被取消。此外，政客渴望迅速出成果，而好的基础设施项目需要细致的准备工作以及长期的酝酿，二者间便产生了冲突。“人人都想剪彩，”IFM的凯尔·曼基尼（Kyle Mangini）说，“但一个政客的任期是四到五年，而基础设施的周期则要五到十年。”不过，还是可以想办法加强公众对私营基础设施的支持。业内专家对“澳大利亚模式”大为赞赏。在这种模式下，港口及公路私有化的收益会用于投资新的医院和学校等公共项目。

还有第三个大难题，那就是要合理制定PPP协议的融资架构，好让纳税人、政客、银行以及基金管理机构都满意。首先需要弄清的是私营资本是否会以及如何能带来公共财政难以提供的好处。政府引进私营资本的主要原因通常也是很糟糕的一个：遵循公共借贷或债务上限的财政规则。全球基础设施投资者协会（Global Infrastructure Investor Association）的安迪·罗斯（Andy Rose）表示：“如果出发点是要把一项资本投入排除在公共部门的资产负债表之外，那么就很难在谈判中达成一个很好的协议。”

正确的做法是将风险分配到最能妥善管控风险的地方。政府能够以低成本借贷，私营资本的成本则较高。由于商业上的激励，私营企业往往更擅长在保证用户对服务满意的同时压低建设及运营的成本。通常，PPP模式应用于持续产生服务费、路桥费、机场费用以及水电费的地方最为行之有效，而在收益需政府提供补贴的地方表现差些，毕竟补贴政策很有可能会变。一旦出现了私营资本无法估量或合理承担的风险，例如监管部门拖延发放许可造成的成本超支，或是国家无法放手不管的“尾部风险”（例如核设施停止使用后的管理）造成的成本超支，PPP模式的表现就会很糟糕。对政客们来说，PPP模式也许是个将风险一股脑儿推给私营承包商的办法，但明智的承包商会这样的交易敬而远之。

进行基础设施建设有一系列的采购选择。最保守的选择是利用税收为基础设施提供资金。例如，去年洛杉矶通过表决，将消费税提高0.5%来支付基建费用。最激进的则是完全私营的项目，例如伦敦门户港（London

Gateway)。这是迪拜的港口运营商环球港务集团（DP World）在泰晤士河建设的一个深水港。介于两种方案之间的是受到公共监管的私营公用事业，或者特许经营权。所谓特许经营权，就是让私人运营商来建造例如一所医院或航站楼，接着在固定期限内对其进行运营或管理，以此换取该设施产生的利润或之前商定的费用。伦敦的一项庞大工程“横贯地铁”（Crossrail，如图）则属于另一种性质的公私合营：工程由私营部门负责建造，但所有权仍归公共所有。罗斯说，到底哪种采购模式为好，要视具体的项目而定。不过，归根结底买单的还是纳税人，不管是以何种形式买单——交税、付车费和过路费，还是付账单。

PPP模式在澳大利亚、英国和加拿大更为成熟，在美国也慢慢赢得了支持者。纽约拉瓜迪亚机场的新航站楼便是一个例子。特朗普的基础设施计划能否大大推进PPP模式？看上去，目前唯一商定下来的具体细节就是针对股权投资者的税收抵免。不过，一家大型建筑公司的PPP基础设施业务部门负责人说，私营资本短缺并不是主要的瓶颈。相反，有大笔的钱在追逐着已准备好且适合私营部门参与的零星项目。

在私营公司投标一个项目之前，需要做大量的基础工作，例如环境研究和详细的风险评估。加拿大和澳大利亚之所以在基础设施方面取得了良好成绩，一个原因就是它们有专门从事项目培植的机构。在美国推进项目要困难得多，承包商必须要应对联邦和地方层面各个部门的大量监管者。精简规划和许可流程不是轻松的工作，特朗普有耐心去做吗？ ■



Schumpeter

Government Inc

Microsoft's former boss wants Americans to think about their \$5trn state like a company

WHEN he was running Microsoft, Steve Ballmer was famous for his energy. In a legendary clip of a company meeting that has received almost a million hits on YouTube, he charges onto the stage and launches into his “monkey dance”, before roaring into a microphone: “I love this company!” Mr Ballmer stood down from the software giant in 2014 and has new outlets for his drive. One is the LA Clippers, a basketball team he bought for \$2bn. The other could not be more different: a project to create a Form 10-K, a type of corporate report, for America’s dysfunctional government. That is more revolutionary than it sounds.

In most walks of life, 10-K denotes a long-distance run or a sum of money. In the investment world it refers to the report that American regulators force all listed companies to publish once a year. Investors have a near-religious reverence for 10-Ks. They are the global gold standard of corporate disclosure: 300 or so warts-and-all pages that contain a firm’s financial accounts and describe its objectives, conflicts of interests, governance, risks and flaws. Fund managers scour the documents to ensure that firms’ executives are not fibbing. Bosses study their competitors’ forms.

Mr Ballmer’s aim is for his 10-K on the government to contain everything citizens need to know “without hyperbole and without omission”, as he puts it. This may appear an eccentric ambition, but in an era of fake news and partisan division many Americans have shown themselves to be hungry for objective information. Mr Ballmer published the nation’s first 10-K on a new website, USAfacts.org, that was launched on April 18th. It is already wildly popular, receiving 2.6m page views on its first day.

Treating the government like a company has obvious limitations. Firms exist to maximise profits within the law. The job of governments is to maximise the overall welfare of citizens within financial constraints. Governments can tax, and print money, so they can borrow far more. Companies' governance is child's play compared with running a nation. The government faces many more risks than firms do. Pages 51-54 of the new national 10-K list as dangers riots, war with a powerful adversary and also the fact that "human behaviour cannot be fully regulated or controlled".

Yet there are benefits to looking at Leviathan as you would a firm. A 10-K requires that all activities are "consolidated" together in one place, whereas the government issues millions of documents—GDP accounts, budget documents, crime reports—that rarely cohere and are often gibberish to voters. Mr Ballmer's 10-K aggregates every branch of the state, from Alaska's local governments to the Federal Reserve. It splits the total into four operating divisions, based on the constitution. Each division has its own finances and key performance indicators, as at a company.

The numbers show that, as you might expect, the government is hugely complex, with about 100,000 bodies. Its \$5trn of revenues are 11 times greater than Walmart's, the world's biggest firm by sales. The state's main costs are transfer payments, such as welfare and wages for government employees. Viewed as a firm it has a profit margin of minus 3%, compared with 8% for the aggregate of firms in the S&P 500 index. Even leaving aside education, it invests more in the future than firms. R&D and capital expenditures together take up 12% of revenue, compared with 8% for the S&P 500. But its debts are a whopping 289% of sales (tax revenues) versus 77% for the S&P 500.

An investor considering Leviathan Inc would certainly look askance at its record. Performance over the past decade has been "a mixture of

stagnation, progression towards, and retreat from, achievement of our constitutional objectives”, says the 10-K. And its prospects are dim. As Social Security and health-care costs rise, the deficit and debt levels will deteriorate, even threatening the government’s status as a going concern by around 2046.

Governance is poor. The country is not managed using a coherent taxonomy. So, for example, the House of Representatives, the Senate and the White House each split the job of running America into roughly 20 operating divisions. But their categories are different, meaning crossed wires and insufficient accountability. Investors detest firms with “related-party transactions”, in which executives receive money from customers, the firm or counterparties on top of their compensation package. Page 152 of Leviathan Inc’s 10-K reveals a troublingly high level of such related-party transactions in the form of political funding (much from cash-rich companies as well as from individual donors).

| *I love this country*

The idea that charismatic businesspeople can save the government from itself is a recurring theme in American politics. In 1909 Franklin MacVeagh, the treasury secretary, promised to run the government on a business basis. Ross Perot, a businessman, ran for president twice using the same logic. Donald Trump is the latest adherent to this view. He has filled his cabinet with swaggering tycoons, such as Wilbur Ross, the commerce secretary, hoping they can knock heads together harder than career politicians can.

Economists and policy wonks tend to dismiss the idea that government can learn much from business. That seems odd. Certainly, boardroom bravado is not the answer to America’s problems. But Mr Ballmer draws on a business tradition different from that of Mr Trump—its habit of clever, rational analysis.

A curious fact about America is that, while its government has gradually slid into gridlock and ill-repute, its companies have become more globally dominant than at any point, probably, in history. Of the world's 20 most-valuable firms, 14 are American (including, still, Microsoft). They are ruthlessly effective about meeting their objectives of greater market power and profits. If you want to find a reliance on facts, cold rationality and coherent, purposeful organisation in America, look to its firms rather than to its media or its politicians. The 10-K will appear every year. It should be read widely. ■



熊彼特

政府股份有限公司

微软前总裁希望美国人将收入达五万亿美金的政府当作企业来考量

史蒂夫·鲍尔默（Steve Ballmer）掌舵微软时以精力充沛闻名。有这么一段非常著名的视频，在YouTube上的点击量接近百万：在一次公司集会上，他冲到台上，上演“猴舞”，然后冲麦克风大吼：“我爱这家公司！”鲍尔默在2014年离开这家软件巨头，现在已找到释放活力的新途径。一个是他以20亿美元买下的篮球队洛杉矶快船，另一个则与此大相径庭：为运作不良的美国政府创建10-K报表（一种企业年报）。这个项目比它听起来更具革命性。

在多数情境中，“10-K”要么意味着一段长跑距离，要么代表一笔钱。在投资界，这个符号指的是美国监管机构规定所有上市公司每年须发布一次的报告。投资者对10-K报表有着近乎宗教般的尊崇。那是全球通行的公司信息披露的黄金标准：300页左右的文件，一览无遗地呈列着公司的财务账目、公司目标、利益冲突、公司治理、风险与缺陷等。基金经理们仔细翻查这些文件，来确定公司高管们所言不虚。企业老板们则认真研究竞争对手的报表。

鲍尔默的目标是在自己的政府10-K报表里包含公民需要了解的一切，就像他所说的那样，“不夸大，也没有遗漏”。这番雄心也许显得古怪，但在假新闻迭出与党派纷争的年头，许多美国人都显现出对客观中立信息的渴望。4月18日，鲍尔默在新网站USAFacts.org上发布了第一份关于美国的10-K报表，结果大受欢迎，第一天便获得260万的网页浏览量。

把政府视作一家公司显然存在局限性。公司存在的目的是在合法范围内实现利润最大化，而政府的职责是在财政限制下实现公民整体福利的最大化。政府可以征税、印发货币，所以债务水平可以高很多。与治理国家相比，公司治理简直是小儿科。政府面临的风险比公司要多得多。新公布的美国10-K报表在第51到54页列出了暴动、与强大敌国的战争等风险，以及

“人类行为无法被完全监管或控制”这一事实。

但把国家这头巨兽当作一家公司来看待也有好处。10-K报表要求把所有活动“整合”到一处，而政府发布的GDP核算、预算文件、犯罪报告等数百万份文件鲜少统一，且对选民来说往往有如天书。鲍尔默的10-K报表则把政府所有部门的情况聚合起来，涵盖阿拉斯加州各级政府到美联储等各个机构。报表依照宪法，把政府分为四个运营部门，每个部门有自己的财政及关键绩效指标，就像一家公司那样。

你可能料到了，数字显示美国政府结构极为复杂，拥有约十万个机构，年收入五万亿美元，是世界销售额最高的企业沃尔玛的11倍。美国政府的主要成本是政府雇员的福利及工资等开支。若将它视作一家公司，它的利润率为-3%，相比起来，标普500成分企业总体为8%。即使不算上教育，美国政府对未来的投资比例也高于企业。其研发及资本支出共占收入的12%，而标普500企业为8%。但政府的债务惊人，高达销售额（即税收）的289%，而标普500企业为77%。

考虑投资“巨兽公司”的人看到这番记录肯定会心生动摇。10-K报表中写道：过去十年来，“面对宪法目标，我们有时停滞，有时前进，有时倒退”。而前景也是黯淡的。随着社会保障和医疗成本上升，政府赤字及债务水平将恶化，到2046年前后甚至会威胁美国政府这家“公司”的持续经营。

“公司”的治理也较差。美国的经营管理没有运用协调一致的分类体系。例如，众议院、参议院及白宫把管理美国的职责各自分配到约20个职能部门。但它们的分类方法各不相同，导致交叉重复及问责不足。投资者厌恶存在“关联交易”的公司，这些公司的高管除了本身的薪酬福利外，还从顾客、公司或交易对手那里获得钱财。“巨兽公司”10-K报表的第152页揭露了美国政府中程度惊人的这类“关联交易”，以政治献金的形式存在，大多来自财力雄厚的企业，也有个人捐献。

| 我爱这国家

魅力非凡的商人可拯救政府免于自毁，这是美国政治中反复出现的主题。1909年，美国财政部长富兰克林·麦克维（Franklin MacVeagh）承诺以商业原则来管理政府。商人罗斯·佩罗（Ross Perot）以同样的逻辑两次角逐美国总统之位。最近则有特朗普追随这一理念。他的内阁里满是派头十足的商界大亨，例如商务部长威尔伯·罗斯（Wilbur Ross）。特朗普希望他们能比职业政客更有号召力。

对于政府运作可以多多借鉴商业经营的观点，经济学家和政策专家往往不以为然。这似乎很奇怪。当然了，董事会里的虚张声势并非解决美国政府当前问题的答案。但是鲍尔默运用的商业传统和特朗普那一套不同，他利用的是商业中巧妙和理性分析的习惯。

美国有个奇特的现象。尽管其政府已逐渐陷入僵局，声名不佳，美国企业在全球的主导地位却进一步巩固，可能达到前所未有的水平。世界20家最具价值的公司中，有14家来自美国（依然包括微软）。它们果决地追逐更大的市场支配力和利润，成果卓越。如果想在美國寻找讲求事实、冷酷理性、调和统一、目标明确的组织，请把目光投向美国的公司而非媒体或政客。该10-K报表将每年发布，应广泛传阅。■



Parking

Aparkalypse now

The average car moves just 5% of the time. To improve transport and cities, focus on the other 95%

IN IRELAND people ask St Anthony to help them find parking spaces. In Chicago, if you shovel the snow from a space, it belongs to you. In Shanghai people beg their parents to reserve spaces by sitting in them. Everywhere parking is a big reason law-abiding people pay fines to the government and a cause of screaming rows between strangers. More important, it profoundly shapes cities—usually for the worse.

Parking spaces seem innocuous, just a couple of lines painted on asphalt. Multiplied and mismanaged, though, they can create traffic jams, worsen air pollution and force cities to sprawl. The cost and availability of parking affects people's commuting habits more than the rapid buses and light-rail lines that cities are so keen to build (see Briefing). Next to other worthy policies like congestion-charging and road-tolling, parking is also easy to change. The fast-growing metropolises of Africa and Asia, especially, need to get it right, before they repeat the West's debilitating mistakes.

In many cities people can park on the street for nothing, or a pittance. In Boston most parking meters charge just \$1.25 an hour; in Chennai the rate is 20 rupees (30 cents) a day. Because the number of people who would take advantage of such terrific deals, rather than pay a market rate to park in a garage, exceeds supply, drivers end up circling the block. Researchers have found that much traffic consists of drivers looking for spaces. The record is held by the German city of Freiburg—in one study 74% of cars were on the prowl.

Having concluded that the chaos on their streets is the result of a shortage

of parking spaces, many cities have set about creating more. Countries including Australia, China, India and the Philippines require developers to create parking spaces whenever they put up a new building. In America these schedules have become ludicrously exact. St Paul, in Minnesota, demands four spaces for every hole on a golf course and one space for every three nuns in a convent. It is because of these requirements that, in many office developments and shopping centres, more space is given over to cars than to people.

Europeans often take a different approach to scarce parking, by reserving many spaces for residents who pay almost nothing. Around the Economist tower in London, parking costs £4.90 (\$6.10) an hour—with the result that most of us cycle or join the public-transport crush. Locals, who are not obviously in need of charity, pay just £145 a year to park in the same streets. A public resource is being allocated highly inefficiently.

That everybody is used to these arrangements does not mean they make sense. Flooding cities with parking works, in that finding a space becomes easier. But the overall cost is enormous. Because parking is so plentiful, it is free, and because it is free, people invariably overuse it. One study of Washington, DC, found that the availability of free parking is associated with a 97% chance somebody will drive to work alone. Generous parking requirements create asphalt deserts, sapping cities of vigour and beauty. The money and land wasted on car parks make life costlier for everyone, even those who do not drive. Parking adds 67% to the cost of building a shopping centre in Los Angeles—and a lot more if the spaces are underground.

Cities should stop trying to increase the supply of parking and rigging the market in favour of homeowners. Instead, they should raise prices until the streets and the car parks are nearly, but not quite, full—and charge everybody. Residents will complain about the loss of their privileges. But if

they live in an area of high demand, the revenues from the streets will be enormous. Local governments could spend the money on whatever they like, from beautiful gardens to security guards.

| *Lovely Rita, meter maid*

Another reason to charge fully for parking is that it will speed a welcome transport revolution. If self-driving cars are eventually allowed to trundle around by themselves, picking up and dropping off person after person, they might render many car parks unnecessary. That would be wonderful. But this future will arrive more quickly if governments raise the price of parking. Autonomous vehicles will be nice for everyone, because they will let people get on with something worthwhile as they travel. But another big advantage is that they need not be parked—which is only a boon where parking costs money.

Many Western cities have already been bent out of shape by excessive, poorly priced parking. But it is not too late for the African and Asian cities that could be this century's great metropolises. In most, driving is not yet so widespread that motorists can dictate planning rules, and residents are not used to free parking. So roll out the meters and the wardens. Cities should be for people, not for stationary metal boxes. ■



停车

停车启示录

汽车平均只有5%的时间在移动。改善交通发展城市，就要关注其余95%的时间

在爱尔兰，人们祈求圣安东尼保佑他们找到停车位。在芝加哥，如果你把一个车位上的雪铲干净，这个车位就归你了。在上海，有人央求自己的父母蹲守在停车位上占位子。在世界各地，停车都是平时遵纪守法的人向政府缴纳罚款的一大原因，也是令陌生人大吵大闹的一大导火索。更重要的是，它深刻地塑造了城市，且通常都是拖后腿。

停车位看似并无危害，不过是在沥青地面上画几条线。但如果它们成倍增加且管理不善，就会造成交通堵塞、空气污染加重，还会迫使城市扩张。比起各个城市如此热衷建造的快速公交和轻轨，停车的成本和便利性对人们出行方式的影响更大。和其他有价值的政策差不多，如拥堵收费和路桥收费，停车状况也很容易改变。非洲和亚洲快速发展中的大都市尤其需要正确处理这一问题，避免再犯西方那些削弱城市活力的错误。

在很多城市，人们可以免费或者花很少的钱将车停在路边。在波士顿，大部分停车计费器每小时只收1.25美元；在印度金奈（Chennai），一天的停车费是20卢比（30美分）。太多人都想占这个大便宜而不想按市场价把车停进车库里，结果路边停车位供不应求，车主们最终只能在街上兜圈。研究人员发现很大一部分交通流量都是由在路上找车位的司机造成。这方面的记录由德国的弗莱堡保持，一项调查显示，该市74%的车辆都在路上徘徊。

很多城市推断道路拥堵是停车位短缺所致，于是着手创造更多车位。澳大利亚、中国、印度、菲律宾等国家要求开发商在建造新大楼时提供停车位。在美国，这类规定已经精确到滑稽可笑的地步。明尼苏达州的圣保罗要求为高尔夫球场上的每个洞提供四个车位，为修道院的每三位修女提供一个车位。正是因为有了这样的规定，在很多写字楼和购物中心，给车预留的空间比给人的还多。

欧洲人通常会采取另一种方法来解决车位的短缺：为住户保留很多车位，而且几乎是免费供他们使用。伦敦《经济学人》办公大厦附近的停车费为每小时4.9英镑（6.1美元），所以我们大部分人都骑自行车或挤公共交通上下班。而并不明显需要救济的当地人在同一街区停车每年只要付145英镑。如此分配公共资源，效率非常低下。

人人都习惯了这些安排并不意味着它们就合理。让停车位遍布城市的确管用，因为人们更容易找到地方停车了。但这样做花费的总成本巨大。因为停车位充足，所以免费；因为免费，人们必然会滥用。华盛顿特区的一项调查表明，如果有免费停车位，人们就有97%的可能单独开车上班。过多的停车位要求产生了沥青沙漠，削弱了城市的活力和美感。在停车上浪费的资金和土地让每个人的生活都变得更昂贵，包括那些不开车的人。停车位使得在洛杉矶建造一座购物中心的成本增加了67%，如果车位在地下，花费还要更多。

城市不应再努力增加车位供应，也不应继续操纵市场让有房子的人受益。相反，它们应当提价，直到街道和停车场接近饱和但未完全停满，并且还应向所有人收费。居民会抱怨自己失去了特权。但如果他们住在一个对停车位需求很大的区域，街道上便会产生巨额收入。当地政府可以任意支配这些收入，无论是建造美丽的花园，加强安保，还是其他。

| 可爱的停车监管员丽塔

建议对停车全面收费的另一个原因是这会加速一场受人欢迎的交通革命。如果自动驾驶汽车最终获批自行上路并逐个接送客人，可能很多停车场就会因此而变得多余。那可真是太好了。不过如果政府提高停车费，这样的未来会来得更快些。自动驾驶汽车对每个人来说都是好事，因为它们能让人在旅行途中做一些有意义的事。而另一个巨大的优势是它们可以一直开着而无需停车位，这只有在停车要花钱时才算得上是福利。

很多西方城市都因过多的低价停车场而让人苦不堪言。但对可能成为本世纪伟大都市的非洲和亚洲城市来说为时未晚。在大多数这样的城市中，驾车出行还不是非常普遍，因而车主还不足以影响规划，另外居民也未习惯

免费停车。所以，推行停车计费器和监管员吧。城市应为人而建，而不是为那些趴着不动的金属盒子。■



The office of tomorrow

Sofas and surveillance

Tech firms are on a building spree. Their offices provide clues to the future of work

FROM the 62nd floor of Salesforce Tower, 920 feet above the ground, San Francisco's monuments look piddling. The Bay Bridge, Coit Tower and Palace of Fine Arts are dwarfed by the steel-and-glass headquarters that will house the software company when it is completed later this year. Subtle it is not. Salesforce plans to put on a light show every night; its new building will be visible from up to 30 miles away.

It is not the only technology company erecting a shrine to itself. Apple's employees have just begun moving into their new headquarters in Cupertino, some 70 kilometres away, which was conceived by the firm's late founder, Steve Jobs. The four-storey, circular building looks like the dial of an iPod (or a doughnut) and is the same size as the Pentagon. At a price tag of around \$5bn, it will be the most expensive corporate headquarters ever constructed. Apple applied all its product perfectionism to it: the guidelines for the wood used inside it reportedly ran to 30 pages.

Throughout San Francisco and Silicon Valley, cash-rich technology firms have built or are erecting bold, futuristic headquarters that convey their brands to employees and customers. Another example is Uber, a ride-hailing company, which is hoping to recast its reputation for secrecy and rugged competitiveness by designing an entirely see-through head office. It is expected to have some interior areas, as well as a park, that will be open to the public.

The exteriors of the new buildings will attract most attention, but it is their interiors that should be watched more closely. The very newest buildings, such as Apple's, are mostly still under wraps, but they are expected to be

highly innovative in their internal layout. Some of that is because of fierce competition within the tech industry for the best engineering and other talent: firms are particularly keen to come up with attractive, productive environments. But these new office spaces will also signal how work is likely to evolve. Technology companies have already changed the way people behave in offices beyond their own industry, as a result of e-mail, online search and collaboration tools such as Slack. They are doing the same for physical spaces.

The big idea championed by the industry is the concept of working in various spaces around an office rather than at a fixed workstation. Other industries have experimented with “activity-based working”, but tech is ahead. Employees may still have an assigned desk but they are not expected to be there, and they routinely go to different places to do various tasks. There are “libraries” where they can work quietly, as well as coffee shops, cafés and outdoor spaces for meetings and phone calls. The top two floors of Salesforce Tower, for example, will be used not as corner offices for executives but as an airy lounge for employees, where they can work communally and gaze out at the views over a latté.

A fluid working environment is meant to allow for more chance encounters, which could spur new ideas and spark unexpected collaborations. Facebook’s central building is the world’s largest open-plan office, designed to encourage employees to bump into one another in its common spaces and in a nine-acre rooftop garden. Communal areas are meant to be casual and alluring. John Schoettler, head of real estate at Amazon, says he aims to make them into “living-room-like spaces”. For offices to feel like home, it helps to hire a designer with expertise in residential real-estate, says Elizabeth Pinkham of Salesforce. In common areas at the firm’s offices, there are TVs, couches and bookshelves. Framed photos of a few employees add to the effect.

| *The new “working at home”*

For those who scoff at the creative benefits of being surrounded by pictures of Colin from accounts, there are more tangible payoffs. The lack of fixed workstations shrinks the amount of expensive real estate given to employees without leaving them feeling too squeezed. Tech firms devote around 14 square metres to each employee, around a quarter less than other industries, according to Randy Howder at Gensler, a design firm. Young workers are thought to be more productive in these varied environments, which are reminiscent of the way people study and live at university. One drawback, however, is that finding colleagues can be difficult. Employees need to locate each other through text messages and messaging apps.

Collaborative spaces can also expose generational tensions, says Louise Mazingo, an architecture professor at the University of California, Berkeley. Tech firms' elderly employees (otherwise known as the over-40s) can struggle to adjust to moving around during the day and to the frequent disruptions that come from large, open-plan offices. Many of Facebook's employees do not like their office because it is noisy, and some Apple employees are hesitant to move into their new building for the same reason. Plenty also balk at the massive distances they will need to walk.

That may not be the only thing to cause employees concern. Tech firms are increasingly keen to use their own products in their headquarters. Jensen Huang, the chief executive of Nvidia, a chipmaking firm whose graphics processing units are widely used in artificial-intelligence programmes, says his firm plans to introduce facial recognition for entry into its new headquarters, due to open later this year.

Nvidia will also install cameras to recognise what food people are taking from the cafeteria and charge them accordingly, eliminating the need for a queue and cashier. A self-driving shuttle will eventually zip between its various buildings. And Nvidia's own AI will monitor when employees

arrive and leave, with the ostensible aim of adjusting the building's heating and cooling systems.

The data that firms can collect on their employees' whereabouts and activities are bound to become ever more detailed. Another way of keeping tabs on people is through company-issued mobile phones. "Every employee has their own tracking device," observes Mr Howder at Gensler. "Technology firms will sooner or later take advantage of that."

Few of them are willing to share details of their future plans because of concerns about employees' privacy. However, some of their contractors signal what sort of innovations may be in the pipeline. Office-furniture makers, for example, are experimenting with putting sensors in desks and chairs, so that firms will be better able to monitor when workers are there.

Such data could be anonymised to allay privacy concerns. They could also save electricity or help people find an empty room to hold a meeting. But it is not hard to imagine how such data could create a culture of surveillance, where employees feel constantly monitored. "Technology firms could be an indicator of what will happen with privacy in offices more generally," says David Benjamin of Autodesk, a company that sells software to architects, among other clients.

| *Silent discos and Bedouin tents*

A less controversial trend is for unusual office interiors. These can distinguish companies in the minds of their employees, act as a recruiting tool and also give staff a reason to come into the office rather than work from home. For companies that do not ship a physical product, such offices can serve as important daily reminders of culture and purpose.

Last year LinkedIn, a professional social network, for example, opened a new building in San Francisco that is full of space set aside for networking,

and that includes a “silent disco”, where people can dance to music with headphones on. Instead of offering generic meeting rooms with portentous names, Airbnb, a tech firm that lets people rent out their homes, has designed each of its meeting spaces after one of its rental listings, such as a Bedouin tent from Morocco. It also has a meeting room that is an exact replica of the rental apartment where the founders lived when they came up with the idea for Airbnb. Every detail, including the statue of Jesus in red velvet on top of the fireplace, is accurate, says Joe Gebbia, one of the company’s founders.

Nvidia is obsessed with triangles, the basic element of computer graphics used to create lifelike scenes in video games and movies. Its new headquarters, which cost \$370m, is shaped like one (see picture), and its interior is full of them. Everything, from the skylights to the benches in the lobby, is triangular. “At this point I’m kind of over the triangle shape, because we took that theme and beat it to death,” admits John O’Brien, the company’s head of real estate, who pointedly vetoed a colleague’s recent suggestion to offer triangle-shaped water bottles in the cafeteria.

Such workspaces remind staff that they are choosing not just an employer but a way of life. In the tech bubble of the late 1990s companies disrupted the workplace by offering foosball tables, nap pods, blow-up castles and free lunches. Now the emphasis is on amenities that help employees save time. Larger firms, including Facebook, Alphabet and LinkedIn, offer their staff something akin to the services used by the extremely wealthy, helping employees to find places to live, adopt pets and the like. Some large tech groups offer on-site health care.

The effect of all this is that the typical office at a technology firm is becoming a prosperous, self-contained village. Employees have fewer reasons than ever to leave. With the spare cash they can throw at their employees, tech giants have vastly raised the bar for other kinds of

company, which also want to recruit clever engineers and techies for their projects.

Other industries would be wise to take time to watch how tech firms are structuring their work environments. There is certainly a chance of a backlash against those that use their products to watch employees too closely. Workers may like free lunches and other perks associated with the tech business, but probably not enough to surrender their privacy entirely. ■



未来的办公室 沙发与监视

科技公司掀起建造新总部的热潮。从它们的办公室可以窥见未来的工作形态

Salesforce大厦的62层距地面920英尺（约280米）。从这里向外看去，旧金山的一众标志性建筑都变得很渺小。海湾大桥、科伊特塔（Coit Tower）和艺术宫都成了小矮人。这栋玻璃和钢结构大楼将在今年晚些时候竣工，届时将成为Salesforce这家软件公司的总部。含蓄内敛是谈不上的一—该公司计划每晚都要上演一场灯光秀，从30英里外就能看见这幢新大楼。

Salesforce并不是唯一一家为自己打造出一座圣殿的科技公司。70多公里外，苹果的员工也刚刚开始迁往位于库比蒂诺的新总部。新总部的构想是由公司已故创始人乔布斯提出的。这幢四层的环形建筑看起来就像一个iPod的转轮（或者甜甜圈），和五角大楼一样大。约50亿美元的造价将使它成为有史以来最昂贵的公司总部。苹果将体现于其产品之中的完美主义全面贯彻到这栋建筑中：据说关于建筑内部所用木材的参考指南就长达30页。

在旧金山和硅谷，到处都是资金充裕的科技公司已经建成或正在建造的总部大楼。它们既大胆又富未来感，向员工及客户传递着公司的品牌精神。还有一个例子是网约车公司优步，它设计了一个完全透明的总部办公室，希望能以此改写自己遮遮掩掩又粗野好斗的名声。预计总部内部的某些区域连同—个公园将会向公众开放。

这些新建筑的外观将会吸引最多的目光，然而，应多加仔细关注的其实是它们的内部空间。那些最新的建筑，例如苹果的总部，大多数仍处于保密状态，不过可以料想它们的内部布局会非常具有创新性。这在某种程度上是因为科技行业内部激烈地争夺最优秀的工程师及其他人才，各家公司尤其想要打造出吸引人的、能提高工作效率的环境。不过这些新办公空间也预示着工作在未来可能将如何演变。科技公司已经用电子邮件、在线搜

索，以及Slack这类协作工具改变了其他行业人们的办公方式。如今，它们对实体办公空间的改造也会有同样的效果。

科技行业倡导的一个重大理念是让员工在办公室的不同空间工作，而不是守着一个固定的办公桌。其他行业已尝试了“移动式办公”（activity-based working），不过科技行业还是领先一步。公司也许仍会给员工分配办公桌，不过他们大可不必守在那儿，而是会常常跑去不同的地方做不同的事。在“图书馆”可以安静地工作，在咖啡店、小餐馆，以及户外空间可以和人碰面、开会和打电话。例如，Salesforce大厦顶部的两层楼将不会为高管们安排转角大办公室，而是会用作超大的员工休息室。在那里，他们可以和同事一起工作，还可以端着一杯拿铁欣赏外面的风景。

设计流动的工作环境是为了让人们能更多地偶遇，由此激发新的创意，促成意想不到的合作。Facebook的中心大楼是世界上最大的开放式办公室，其设计初衷就是创造机会，让员工们在公共空间以及九英亩的屋顶花园中不期而遇。公共区域就应该轻松随意，令人向往。亚马逊房地产主管约翰·舍特勒（John Schoettler）称，他打算把公共区域打造成“类似起居室的空間”。Salesforce的伊丽莎白·平卡姆（Elizabeth Pinkham）说，要想让办公室有家的感觉，聘请一位有住宅设计专长的设计师很有帮助。这家公司各间办公室的公共区域里有电视机和沙发，还有书架。一些嵌着员工照片的相框增添了“家”的氛围。

| 新型的“在家办公”

也有人对此表示不屑。开放办公空间里摆着财务部张三李四的照片，这对创造力有什么好处？不过它们确实带来了更切实的回报。不设置固定的办公桌能减少提供给员工的昂贵不动产，又不会让他们觉得太过拥挤。建筑设计公司Gensler的兰迪·霍德（Randy Howder）称，科技公司为每位员工提供的空间约为14平方米，比其他行业差不多要小四分之一。一般认为，年轻员工在这种多样化的环境中工作效率会更高，因为这种环境会让人回想起在大学里学习和生活的情景。不过这也有一个缺点，那就是要找到其他同事会很难。员工们需要发短信或利用即时消息应用来确定彼此的位置。

加州大学伯克利分校的建筑学教授路易斯·莫辛格（Louise Mozingo）指出，协作空间也会令代际冲突暴露出来。科技公司年长的员工（亦即40岁以上的员工）可能难以适应成日四处走动的状态，或忍受宽阔的开放式办公室内时时出现的干扰。很多Facebook的员工都不喜欢他们的办公室，觉得那里很吵。苹果的一些员工也因为同样的原因不太愿意搬去新总部。还有很多人不乐意长距离地走动。

这也许并不是唯一令员工担忧的地方。科技公司还越来越热衷于将自家产品用在自己的总部内。芯片制造商英伟达的新总部将于今年晚些时候投入使用。该公司的图像处理器被广泛应用于人工智能程序中。总裁黄仁勋说，公司计划在新总部的入口采用人脸识别系统。

英伟达还将安装摄像头来辨认人们从餐厅拿取的食物并收取相应的费用，免去排队和收银的麻烦。最终还会有一辆自动驾驶班车穿行于各个建筑之间。此外，英伟达自己的人工智能还会监控员工们什么时候到岗及离开，表面上看，目的是为了调节大楼的供暖和制冷系统。

各家公司从员工的行踪和活动中搜集到的数据必定会越来越详细。另外它们还可以通过分发给员工的移动电话来密切注意他们的举动。“每个员工都有自己的跟踪装置，”Gensler的霍德说，“科技公司迟早都会利用这一点。”

出于员工隐私方面的顾虑，这些公司大多不愿披露未来计划的细节。不过或许可从它们的某些承包商那里看出它们正在酝酿怎样的计划。例如，办公家具制造商正尝试在桌椅内安装传感器，这样，当员工坐在办公桌前，公司便能更好地监控他们。

为缓和人们对隐私的疑虑，可将这些数据匿名化。这些数据还可节省电力，或帮助人们寻找开会用的空房间。不过，不难想象这样的数据也会形成一种监视文化，员工们会感觉自己时时都在受监控。“科技公司或许是个风向标，从中可看出未来办公空间的隐私问题会如何发展。”Autodesk的大卫·本杰明（David Benjamin）说。这家公司向建筑师等客户销售软

件。

| 无声迪斯科和贝都因帐篷

将办公室内部设计得别具一格，这个潮流倒不那么有争议。与众不同的办公室内部装饰可以令员工感受到公司的独特，还可作为吸引新员工的手段，员工们也会更有理由来办公室而不是在家工作。对于并不出售实体产品的公司来说，这样的办公室有着重要的作用，那就是令员工时时谨记公司的文化与目标。

去年，职业社交网站领英（LinkedIn）在旧金山的新总部投用，里面辟出多处场地供员工社交，其中包括一个“无声迪斯科”空间，在那里人们可以头戴耳机，随着音乐起舞。在帮助人们出租房屋的科技公司Airbnb，并没有那种安上个煞有介事的名字的普通会议室。每一个会议场地都被设计成公司租屋列表上某个住所的样子，例如位于摩洛哥的一个贝都因

（Bedouin）式帐篷。它还有一间办公室，原原本本地复制了公司几位创始人想出创办Airbnb这个主意时正租住的那间公寓。创始人之一的乔·杰比亚（Joe Gebbia）说，每一处细节都准确无误，包括壁炉上身披红丝绒的耶稣雕像。

英伟达对三角形十分痴迷。三角形是计算机图像的基本元素，计算机图像则用于创造视频游戏及电影中的逼真场景。英伟达耗资3.7亿美元的新总部就很像一个三角形（见图），内部也随处可见这个形状。从天窗到大堂里的凳子，什么都是三角形。公司的房地产主管约翰·奥布莱恩（John O'Brien）坦言：“眼下我对三角形差不多已经没什么热情了。这个主题我们已经用到头了。”近期有同事建议在餐厅里提供三角形的瓶装水，他不由分说地否决了。

这样的工作场所提醒员工们，他们不单单选择了一位雇主，更是选择了一种生活方式。上世纪90年代末的高科技泡沫时期，各家公司为员工提供桌上足球、打盹舱、充气城堡以及免费午餐，颠覆了传统的工作场所。如今科技公司的重点是为员工提供能够帮助他们节省时间的便利设施。

Facebook、Alphabet和领英这样较大的公司为员工提供类似于巨富们所享

受到的那种服务。它们会为员工找房子住，还会帮他们领养宠物等等。有些大型科技集团还现场提供医疗保健服务。

以上种种手段的效果就是，科技公司里典型的办公室正变成繁荣且自给自足的小村庄。员工们从未像现在这样，找不出什么离职的理由。科技巨头将大笔闲钱花在自家员工身上，结果大幅推高了其他类型的公司招聘时所需提供的福利。毕竟它们也想为自己的项目招募优秀的工程师和技术人员。

其他行业如果肯花点时间观察科技公司如何构建自己的工作环境，会是个明智的做法。那些利用自家产品过度监控员工的公司无疑可能遭到抵制。员工们可能确实喜欢科技行业提供的免费午餐和其他特殊待遇，但或许并没有喜欢到愿意完全放弃自己隐私的程度。 ■



Regulating the data economy

The world's most valuable resource

Vast flows of data give some firms unprecedented power. To keep them in check, antitrust rules must catch up

A NEW commodity spawns a lucrative, fast-growing industry, prompting antitrust regulators to step in to restrain those who control its flow. A century ago, the resource in question was oil. Now similar concerns are being raised by the giants that deal in data, the oil of the digital era. These titans—Alphabet (Google's parent company), Amazon, Apple, Facebook and Microsoft—look unstoppable. They are the five most valuable listed firms in the world. Their profits are surging: they collectively racked up over \$25bn in net profit in the first quarter of 2017. Amazon captures half of all dollars spent online in America. Google and Facebook accounted for almost all the revenue growth in digital advertising in America last year.

Such dominance has prompted calls for the tech giants to be broken up, as Standard Oil was in the early 20th century. This newspaper has argued against such drastic action in the past. Size alone is not a crime. The giants' success has benefited consumers. Few want to live without Google's search engine, Amazon's one-day delivery or Facebook's newsfeed. Nor do these firms raise the alarm when standard antitrust tests are applied. Far from gouging consumers, many of their services are free (users pay, in effect, by handing over yet more data). Take account of offline rivals, and their market shares look less worrying. And the emergence of upstarts like Snapchat suggests that new entrants can still make waves.

But there is cause for concern. Internet companies' control of data gives them enormous power. Old ways of thinking about competition, devised in the era of oil, look outdated in what has come to be called the "data economy". A new approach is needed.

| *Quantity has a quality all its own*

What has changed? Smartphones and the internet have made data abundant, ubiquitous and far more valuable. Whether you are going for a run, watching TV or even just sitting in traffic, virtually every activity creates a digital trace—more raw material for the data distilleries. As devices from watches to cars connect to the internet, the volume is increasing: some estimate that a self-driving car will generate 100 gigabytes per second. Meanwhile, artificial-intelligence (AI) techniques such as machine learning extract more value from data. Algorithms can predict when a customer is ready to buy, a jet-engine needs servicing or a person is at risk of a disease. Industrial giants such as GE and Siemens now sell themselves as data firms.

This abundance of data changes the nature of competition. Technology giants have always benefited from network effects: the more users Facebook signs up, the more attractive signing up becomes for others. With data there are extra network effects. By collecting more data, a firm has more scope to improve its products, which attracts more users, generating even more data, and so on. The more data Tesla gathers from its self-driving cars, the better it can make them at driving themselves—part of the reason the firm, which sold only 25,000 cars in the first quarter, is now worth more than GM, which sold 2.3m. Vast pools of data can thus act as protective moats.

Access to data also protects companies from rivals in another way. The case for being sanguine about competition in the tech industry rests on the potential for incumbents to be blindsided by a startup in a garage or an unexpected technological shift. But both are less likely in the data age. The giants' surveillance systems span the entire economy: Google can see what people search for, Facebook what they share, Amazon what they buy. They own app stores and operating systems, and rent out computing power to startups. They have a "God's eye view" of activities in their own markets and

beyond. They can see when a new product or service gains traction, allowing them to copy it or simply buy the upstart before it becomes too great a threat. Many think Facebook's \$22bn purchase in 2014 of WhatsApp, a messaging app with fewer than 60 employees, falls into this category of "shoot-out acquisitions" that eliminate potential rivals. By providing barriers to entry and early-warning systems, data can stifle competition.

| *Who ya gonna call, trustbusters?*

The nature of data makes the antitrust remedies of the past less useful. Breaking up a firm like Google into five Googlets would not stop network effects from reasserting themselves: in time, one of them would become dominant again. A radical rethink is required—and as the outlines of a new approach start to become apparent, two ideas stand out.

The first is that antitrust authorities need to move from the industrial era into the 21st century. When considering a merger, for example, they have traditionally used size to determine when to intervene. They now need to take into account the extent of firms' data assets when assessing the impact of deals. The purchase price could also be a signal that an incumbent is buying a nascent threat. On these measures, Facebook's willingness to pay so much for WhatsApp, which had no revenue to speak of, would have raised red flags. Trustbusters must also become more data-savvy in their analysis of market dynamics, for example by using simulations to hunt for algorithms colluding over prices or to determine how best to promote competition.

The second principle is to loosen the grip that providers of online services have over data and give more control to those who supply them. More transparency would help: companies could be forced to reveal to consumers what information they hold and how much money they make from it. Governments could encourage the emergence of new services by opening up more of their own data vaults or managing crucial parts of the

data economy as public infrastructure, as India does with its digital-identity system, Aadhaar. They could also mandate the sharing of certain kinds of data, with users' consent—an approach Europe is taking in financial services by requiring banks to make customers' data accessible to third parties.

Rebooting antitrust for the information age will not be easy. It will entail new risks: more data sharing, for instance, could threaten privacy. But if governments don't want a data economy dominated by a few giants, they will need to act soon. ■



监管数字经济

世界上最宝贵的资源

巨大的数据流让一些公司获得了前所未有的权力。要约束它们，反垄断法规需要与时俱进

一种新商品催生出一个盈利丰厚、发展迅速的行业，促使反垄断监管机构介入，以约束那些掌控这种商品流转的从业者。一百年前石油就是这样一种资源。现在，一些巨头公司引发了类似的担忧，它们经营的是数据——数字时代的石油。这些巨头包括Alphabet（谷歌的母公司）、亚马逊、苹果、Facebook和微软，看起来势不可挡。它们是全球市值最高的五家上市公司，利润也在飙升：2017年第一季度它们的净利润总和超过250亿美元。亚马逊占据了美国在线消费总额的一半，谷歌和Facebook几乎包揽了美国去年数字广告收入的全部增长。

如此的统治地位引发了要求拆分科技巨头的呼声，就像20世纪初标准石油公司（Standard Oil）面临的境地一样。本刊过去曾经反对过这样的极端举措。规模本身并不是罪过。巨头们的成功也让消费者受益。没人想要自己的生活里没有谷歌搜索、亚马逊一日送达和Facebook的动态消息流。以标准的反垄断测试衡量，这些公司也并未触达警戒线。它们没有向消费者乱开价，而是免费提供很多服务（实际上，用户以提交更多数据的方式来交换免费服务）。考虑到线下的对手，它们的市场份额看起来就没那么令人担忧了。而Snapchat这类新贵公司的出现表明新入行的公司仍能卷起风浪。

不过仍然有理由担心。互联网公司对数据的掌控给了它们极大的权力。在所谓的“数字经济”时代，有关竞争的旧思维已显得不合时宜。因为那种思维方式产生于石油时代，而现在需要新的思考方法。

| 数量本身也是质量

什么发生了改变？智能手机和互联网让数据丰富充裕、无处不在、价值飙升。无论你在跑步、看电视，甚至只是在旅途中安坐，几乎每项活动都会

产生数字痕迹，这就为数据提炼厂提供了更多的原料。随着从手表到汽车等各种设备接入互联网，数据量还在持续增长：有估算称一辆自动驾驶汽车每秒会产生100G的数据。与此同时，像机器学习这样的人工智能（AI）技术从数据中提取了更多的价值。算法能预测客户何时下单、喷气发动机何时需要维护，或是某人何时可能罹患某种疾病。GE和西门子等工业巨头现在则把自己包装成了数据公司。

数据之丰富改变了竞争的本质。科技巨头一向受益于网络效应：Facebook的注册用户越多，就会吸引越多人加入。有了数据后，还会带来更大的网络效应。通过收集更多数据，公司会有更大的空间来改进产品，从而吸引更多用户，产生更多数据，如此循环。特斯拉从它的自动驾驶汽车那里收集的数据越多，就越能改进自动驾驶技术——特斯拉第一季度只卖出了2.5万辆车，但目前市值比卖出230万辆车的通用汽车还高，这便是原因之一。因此，巨大的数据池可以充当护城河。

能够获取数据也从另一方面保护了公司免受竞争对手的威胁。在技术行业里，对竞争持乐观态度的理由是认为既有公司可能会被在车库里的创业公司打个措手不及，或是在意想不到的技术转型中受挫。但这两种情况在数字时代都更不太可能发生。巨头们的监控系统覆盖了整个经济：谷歌能看到人们在搜索什么，Facebook能看到人们分享了什么，亚马逊能看到人们购买了什么。它们有自己的应用商城和操作系统，并把计算能力出租给创业公司。对于自己市场内外发生的活动，它们都拥有“上帝视角”。当某个新产品或服务越来越受欢迎时，它们能够及时模仿，或干脆在这一新贵变成更大的威胁前出手收购。很多人认为，2014年Facebook以220亿美元收购雇员不到60人的即时通讯应用公司WhatsApp就属于消灭潜在竞争对手的“击毙式收购”。通过设置准入门槛和预警系统，数据可以抑制竞争。

| 你打算盯谁，反垄断者？

数据的特性让过去的反垄断措施不那么有效。把谷歌这样的公司拆解成五个“小谷歌”并不能阻止网络效应重现：假以时日，它们当中的某个会再度确立霸主地位。现在需要彻底反思。随着新方法的轮廓逐渐清晰，两大想法脱颖而出。

其一是反垄断机构要从工业时代步入21世纪。例如，在考虑并购时，它们以往习惯根据规模来确定何时介入。现在，在评估交易影响时它们需考虑公司数据资产的范围。收购价格也是个信号，可能预示既有公司意在吞掉新生威胁。根据这些衡量标准，Facebook愿意出如此高价收购并无收入可言的WhatsApp，已经发出了危险信号。反垄断机构在分析市场动态时也必须变得更擅长利用数据，例如通过模拟来寻找合谋控制价格的算法，或是确定怎样能最好地促进竞争。

第二条原则是削弱在线服务供应商对数据的掌控力，让提供数据的一方拥有更大的控制权。更高的透明度会有帮助：可以强制要求公司向消费者展示它们掌握的信息，以及从中获利多少。政府可以开放更多自身的数据资源库，或是将数据经济的关键部分作为公共基础设施来管理，从而鼓励新服务的产生，就像印度推动数字身份系统Aadhaar那样。政府还可以规定在征得用户同意的情况下，分享某些类型的数据；欧洲正在金融服务中采用这种方法，要求银行让第三方能够获取客户数据。

在信息时代重启反垄断绝非易事。这会产生新的风险：比如，信息分享增多会威胁到隐私。但如果政府不希望由几大巨头掌控数字经济，那么它们就要尽快行动。■



Economic development

Shrink wrap

Why the history of economic growth should be all about recessions

“THROUGHOUT history, poverty is the normal condition of man,” wrote Robert Heinlein, a science-fiction writer. Until the 18th century, global GDP per person was stuck between \$725 and \$1,100, around the same income level as the World Bank’s current poverty line of \$1.90 a day. But global income levels per person have since accelerated, from around \$1,100 in 1800 to \$3,600 in 1950, and over \$10,000 today.

Economists have long tried to explain this sudden surge in output. Most theories have focused on the factors driving long-term economic growth such as the quantity and productivity of labour and capital. But a new paper* takes a different tack: faster growth is not due to bigger booms, but to less shrinking in recessions. Stephen Broadberry of Oxford University and John Wallis of the University of Maryland have taken data for 18 countries in Europe and the New World, some from as far back as the 13th century. To their surprise, they found that growth during years of economic expansion has fallen in the recent era—from 3.88% between 1820 and 1870 to 3.06% since 1950—even though average growth across all years in those two periods increased from 1.4% to 2.55%.

Instead, shorter and shallower slumps led to rising long-term growth. Output fell in a third of years between 1820 and 1870 but in only 12% of those since 1950. The rate of decline per recession year has fallen too, from 3% to 1.2%.

So why have these “growth reversals” decreased in length and depth? In another paper** Messrs Broadberry and Wallis find that conventional explanations—such as demographic change or a sectoral shift from volatile

agriculture to the more stable services sector—do not fully explain the shift.

More important is the rise of the rule of law, enabling disputes to be settled by impartial courts. Before the modern era, elites would fight between themselves for the spoils of growth and send the economy back to square one through wars, corruption and the like. Respect for courts to resolve disputes prevents this from happening. With populist politicians challenging the authority of judges once again across the world, that is food for thought.

* “Growing, Shrinking and Long Run Economic Performance: Historical Perspectives on Economic Development” by S. Broadberry and J. Wallis

** “Shrink Theory: The Nature of Long Run and Short Run Economic Performance” ■



经济发展

收缩效应

为何经济增长史的关键在于衰退

“纵观历史，贫穷是人们的常态。”科幻作家罗伯特·海因莱因（Robert Heinlein）写道。直到18世纪，全球人均GDP一直停留在725美元至1100美元之间，这个收入水平大致相当于目前世界银行划定的贫困线：每天1.9美元。但从那时起，全球人均收入水平开始加速增长，从1800年的1100美元左右上升至1950年的3600美元，现在已超过10,000美元。

经济学家长期以来一直试图解释何以出现这一产出的激增。大多数理论都聚焦于驱动长期经济增长的因素，如劳动力和资本的数量和生产率。但一篇新论文*采用了不同的方法加以探究，认为增长加快并非缘于繁荣期更加蓬勃发展，而是因为衰退期的收缩程度减弱。牛津大学的斯蒂芬·布劳德伯利（Stephen Broadberry）和马里兰大学的约翰·沃里斯（John Wallis）收集了来自欧洲和美洲共18个国家早至13世纪的数据。他们惊奇地发现，经济扩张期的增长率在近期反而是下降的：在1820至1870年间，经济扩张年份的增长率为3.88%，而从1950年至今，这一数字为3.06%，尽管这两个时期里所有年份的平均增长率从1.4%上升到了2.55%。

相反，是衰退期缩短及其程度的减轻带来了更快的长期增长。1820年至1870年间，三分之一的年份出现产出下降，但自1950年以来，产出下降的年头仅占12%，每一个衰退年份的下降幅度也从3%减至1.2%。

这些“增长逆转期”为何在时间和程度上出现下降？在另一篇论文**中，布劳德伯利和沃里斯发现，常规推论（如人口结构变化或经济部门转移，即从波动较大的农业转向更稳定的服务业）并不能完全解释这种变化。

更重要的是法治的兴起，使人们可以通过公正的法庭解决争议。现代之前，精英之间会为了瓜分经济增长带来的利益而争斗不休，因此产生的战争、贪腐等更是会令经济崩塌归零。尊重法院解决纠纷则可以防止这种情

况发生。随着当今全球各地民粹主义政客再次挑战法官的权威，上述观点值得我们深思。

* 《增长、收缩和长期经济表现：从历史角度看经济发展》，斯蒂芬·布劳德伯利及约翰·沃里斯著

** 《收缩理论：长期及短期经济表现的本质》 ■



Free exchange

Donaldson's difficult idea

The law of comparative advantage at 200: still winning prizes

IN 1853 the government of India, then directed by Britain's East India Company, began construction of a vast rail network, continued by the British Raj, established in 1858. At the time, most inland transport in India was hauled by draught animals: with carts where roads existed and were passable; packed on animals' backs when they were not, which was often. Moving goods across the great expanse of the subcontinent was costly and painfully slow. That changed with the arrival of the railway. Between 1853 and 1930 more than 67,000km (42,000 miles) of rail was laid across India, providing transport that was fast, cheap and reliable. A bullock could carry a pack 30km a day; an engine could haul freight 600km over the rails in the same time.

Working out the impact of this took Dave Donaldson (a PhD candidate at the London School of Economics when he started trying) nearly a decade. He dug through mountains of yellowed colonial-era records that had never before been collated and digitised. He found that eight different kinds of salt were sold across India, each sourced from just one region: this quirk allowed him to use local differences in the price of salt to calculate transport costs. He painstakingly plotted water, road and rail routes to work out how to ship from any place in India to any other most cheaply. He found that the introduction of the railway dramatically reduced costs and increased trade. Connecting to it led to significant increases in real local annual incomes: of about 16%. That compares with an increase in real income across India as a whole of just 22% between 1870 and 1930. The railway was a big deal.

In April the American Economic Association (AEA) chose to honour Mr

Donaldson, now at Stanford University, with the John Bates Clark medal, which is awarded annually to a leading economist under the age of 40. He is a deserving winner: his paper on the railroads of the Raj is a particular marvel. But the AEA's decision is particularly apt given Mr Donaldson's focus on trade and, more narrowly, on comparative advantage. This counter-intuitive idea was first set out by David Ricardo, a great British political economist, in a book published 200 years ago on April 19th 1817. It is fundamental to Ricardo's argument that trade is not a zero-sum affair but creates opportunities for mutual gain. Mr Donaldson's work provides an opportunity to reflect on precisely what that means.

An isolated community has to do everything for itself. It must grow whatever cotton it wants, however poorly suited the local land and climate. But, as it comes into contact with other places, it can stop doing the things it is especially bad at relative to people elsewhere. Instead, it can focus on things where it is comparatively more productive, and trade some of what it is good at making for whatever else it needs. This process can make everyone better off, even when one community is worse at doing everything than its trading partners. By specialising in the task at which it is least bad, the unlucky community frees other places to focus on what they are best at. Through trade everyone can obtain more of everything than they could produce for themselves.

Economists labour to explain comparative advantage—"Ricardo's difficult idea", as Paul Krugman, an American economist, once put it. They often use simplified examples, such as the classroom staple of a desert island with only two inhabitants, who can either both gather coconuts and fish or specialise in one pursuit and then trade. Ricardo himself used an example with just two goods: English cloth and Portuguese wine.

Mr Donaldson, in another paper, written with Arnaud Costinot of the Massachusetts Institute of Technology, is more ambitious. At a very fine

level of geographic detail, the UN's Food and Agriculture Organisation produces estimates of how productive different kinds of land are at producing different crops. That allows the authors to work out patterns of comparative advantage in agriculture across American counties. Using historical data on what counties produced and when, and on wholesale crop prices, the authors calculate the benefits of economic integration. They are big. Between 1880 and 1920, for instance, their work suggests that integration lifted real output per worker by 79%. Between 1880 and 1997, integration added as much to American agricultural output as did growth in its productivity.

After two centuries, the theory of comparative advantage can seem lacking in relevance. It relies on bedrock economic assumptions, like flexible labour markets, which look increasingly questionable. Economists have theoretical windows other than comparative advantage through which to examine trade. And most people are no longer engaged in the production of basic commodities; trade increasingly involves parts and components rather than finished goods. The age in which one person weaves cloth and the other makes wine is long past.

| *All together now*

Yet Mr Donaldson's work is a refreshing reminder of important truths. Trade is not just something countries do, but is the product of increased interaction between communities of all sorts: be they American counties or Indian provinces or neighbourhoods in a great metropolis. Expanding the possibilities for trade need not take messy corporatist agreements; new technologies can do it, too. Investments—in railways, say, or shared industrial standards or new housing in big cities—that lower barriers to trade increase the size of the market within which exchanges take place.

Finally, the promise of expanded trade is that people can stop doing things at which they are comparatively hopeless: sparing them frustration or

indeed privation. Markets cannot always deliver this possibility on their own, any more than India's railways were the work of an invisible hand. But they have a (comparative) advantage over isolationism. ■



自由交流

唐纳森的深奥思想

相对优势理论：200年后仍获嘉奖

1853年，印度政府在当时英国东印度公司的指挥下开始建造庞大的铁路网。1858年英属印度殖民政府成立后，铁路建设继续推进。那时候，印度大部分内陆运输都依赖畜力：如果有可通行的道路，就在车上套上牲口拉货，不然就驮在牲口背上，而后一种情况居多。横跨这片宽广次大陆的货物运输成本高昂，而且慢得磨人。铁路网的建成改变了这一切。在1853年至1930年间，印度总计铺设了超过67,000公里的铁路，提供了快速、廉价又可靠的运输服务。一头犍牛拉着货物每天可走30公里，而火车能在同样时间内能把货物运输600公里。

戴夫·唐纳森（Dave Donaldson）在伦敦政治经济学院读博士时开始研究这一转变的影响，花了近十年时间才得出结论。他一头扎进堆积如山的资料中，这些殖民时期的资料已经泛黄，从未经整理或数字化。他发现当时印度有八种不同的盐在售，而每种盐都只在一个地区出产：这一奇特的现象让他可以运用各地盐价的差异来计算运输成本。他精心绘制出水路、公路和铁路运输线路，计算出从印度任一一处运往另一处最便宜的方式，最后发现铁路的引入令运输成本大大降低，促进了贸易。在连接到铁路网的地区，地方实际年收入也显著增长，约增加了16%。相比之下，1870年至1930年间印度整体的实际收入增长也仅为22%。铁路的作用举足轻重。

4月，如今供职于斯坦福大学的唐纳森被美国经济学会（AEA）评为本年度约翰·贝茨·克拉克奖得主（John Bates Clark Medal，每年颁发给一位40岁以下的优秀经济学家）。他当之无愧——他有关英属印度时期铁路效益的论文的确令人赞叹。由于唐纳森研究的重点是贸易，更具体地说是“相对优势”理论，美国经济学会的这一决定尤为恰当。相对优势这一有违直觉的概念最初由英国政治经济学大师大卫·李嘉图（David Ricardo）在1817年4月19日出版的一本书中提出，距今刚满200年。李嘉图认为贸易并非零和游戏，反而能创造机会实现共赢互利。相对优势这一概念对该观点

非常重要。唐纳森的研究为人们思考其内涵提供了机会。

一个孤立的地区不得不自力更生，自行种植所需的棉花，无论当地的土壤和气候有多么不适宜。但随着该地区与其他地方有了交流，便无需继续从事相较其他地区特别逊色的工作，转而专注在自己相对高效的事情上，并以其中部分成果交换自己所需。这一过程可令所有人都获益，即便一个地区在各方面都不如贸易伙伴。通过专注在自己还过得去的方面，这个不走运的地区也能令其他地方得到解放、让它们专注发展其优势所在。和自行生产一切所需相比，通过贸易，所有人都能得到更多的产品。

经济学家们煞费心思地解释“相对优势”的概念，即美国经济学家保罗·克鲁格曼（Paul Krugman）所说的“李嘉图的深奥思想”。他们常以简化的例子来说明问题，如课堂上常举的例子：一个荒岛上只有两位居民，可以两人都摘椰子和捕鱼，也可以一人专门负责一项任务然后交易各自所得。李嘉图本人曾仅以两种商品举例：英国布料和葡萄牙葡萄酒。

在与麻省理工学院的阿诺·科斯蒂诺（Arnaud Costinot）合著的另一篇文章中，唐纳森更是雄心勃勃。联合国粮农组织在极为细致的地理层面对不同种类的土地种植不同作物的产出情况做了估算。这使科斯蒂诺和唐纳森可描绘出美国各县农业的相对优势模式。运用有关各县生产农作物的品种、时间、批发价的历史数据，两位作者计算出经济一体化带来的效益。那是巨大的效益。例如，该研究显示，在1880年至1920年间，一体化令每个工人的实际产出提高了79%。在1880年至1997年间，一体化为美国农业产出带来的增长与农业生产力增长的作用相当。

两个世纪后，相对优势理论可能已显得不合时宜。它赖以为基础的经济假设，如“灵活劳动市场”，日益受到质疑。除了相对优势理论，经济学家们如今可透过其他理论窗口来审视贸易问题。而且，大部分人都不再从事基本商品的生产；贸易中越来越多的是零部件而非成品。那种一人织布一人酿酒的时代已一去不复返。

| 大家一起来

但唐纳森的研究重申了一些重要的事实，令人耳目一新。贸易不仅仅是国家活动，还是各类社区之间互动加强的产物：无论是美国州县还是印度省份或是大都市的街区之间。拓展贸易的可能性不必依赖签订复杂的社团主义协议，新技术也能做到。有助降低贸易壁垒的投资，如修建铁路、建立共享工业标准或是在大城市新建住房，也能够扩大交易市场的规模。

最后，贸易扩大的前景让人们可以停止从事自己做得相对较差的工作，这让他们免受挫败，或说到底，免受贫困之苦。市场不总是全凭自身就能创造这一可能性，正如印度的铁路并非完全出于无形之手。但比起孤立主义，它们还是拥有（相对）优势。■



Cognitive science

Mind meld

how can human thinking be so powerful, yet so shallow?

DO YOU know how a toilet works? What about a bicycle, or a zipper? Most people can provide half answers at best. They struggle to explain basic inventions, let alone more complex and abstract ones. Yet somehow, in spite of people's ignorance, they created and navigate the modern world. A new book, "The Knowledge Illusion" sets out to tackle this apparent paradox: how can human thinking be so powerful, yet so shallow?

Steven Sloman and Philip Fernbach, two cognitive scientists, draw on evolutionary theory and psychology. They argue that the mind has evolved to do the bare minimum that improves the fitness of its host. Because humans are a social species and evolved in the context of collaboration, wherever possible, abilities have been outsourced. As a result, people are individually rather limited thinkers and store little information in their own heads. Much knowledge is instead spread through the community—whose members do not often realise that this is the case.

The authors call this the illusion of understanding, and they demonstrate it with a simple experiment. Subjects are asked to rate their understanding of something, then to write a detailed account of it, and finally to rate their understanding again. The self-assessments almost invariably drop. The authors see this effect everywhere, from toilets and bicycles to complex policy issues. The illusion exists, they argue, because humans evolved as part of a hive mind, and are so intuitively adept at co-operation that the lines between minds become blurred. Economists and psychologists talk about the "curse of knowledge": people who know something have a hard time imagining someone else who does not. The illusion of knowledge works the other way round: people think they know something because

others know it.

The hive mind, with its seamless interdependence and expertise-sharing, once helped humans hunt mammoths and now sends them into space. But in politics it causes problems. Using a toilet without understanding it is harmless, but changing the health-care system without understanding it is not. Yet people often have strong opinions about issues they understand little about. And on social media, surrounded by like-minded friends and followers, opinions are reinforced and become more extreme. It is hard to reason with someone under the illusion that their beliefs are thought through, and simply presenting facts is unlikely to change beliefs when those beliefs are rooted in the values and groupthink of a community.

The authors tentatively suggest that making people confront the illusion of understanding will temper their opinions, but this could have the opposite effect—people respond badly to feeling foolish. Messrs Sloman and Fernbach show how deep the problem runs, but are short on ideas to fix it.

“The Knowledge Illusion” is at once both obvious and profound: the limitations of the mind are no surprise, but the problem is that people so rarely think about them. However, while the illusion certainly exists, its significance is overstated. The authors are Ptolemaic in their efforts to make it central to human psychology, when really the answer to their first question—how can human thought be so powerful, yet so shallow?—is the hive mind. Human ignorance is more fundamental and more consequential than the illusion of understanding. But still, the book profits from its timing. In the context of partisan bubbles and fake news, the authors bring a necessary shot of humility: be sceptical of your own knowledge, and the wisdom of your crowd. ■



认知科学

头脑融合术

人类思维何以如此强大却又如此肤浅？

你知道抽水马桶是如何工作的吗？自行车呢？拉链呢？大部分人顶多算是一知半解。他们难以解释最基本的发明，更不用说那些更复杂和抽象的事物。然而，尽管人们如此无知，他们仍设法创造出了现代世界并遨游其中。新书《知识幻觉》（The Knowledge Illusion）试图解释一个显而易见的矛盾：人类思维何以如此强大却又如此肤浅？

史蒂文·斯洛曼（Steven Sloman）和菲利普·费恩巴赫（Philip Fernbach）这两位认知学家从进化论和心理学入手。他们认为，人脑已经进化成只会费最少的力去改善主人的健康。人是一种群居物种，他们在一种协作的环境里进化；只要有可能，人类总是将技能外包给他人。结果，人类个体的思维能力都非常有限，在自己的头脑里存储的信息也很少。大量知识通过群体传播，而群体成员通常并未意识到这一点。

作者将其称为“理解的幻觉”（illusion of understanding），他们用一个简单的实验来证明这一点：请实验对象就自己对某个事物的了解程度评分，然后写下对该事物的详细介绍，最后重新打分。几乎无一例外，实验对象的第二次自我评估的得分都下降了。作者认为这种效应无处不在，从马桶到自行车，再到复杂的政策议题。他们指出，这种幻觉之所以存在，是因为人类的进化符合蜂巢思维——出于直觉，他们非常擅长合作，因而令头脑和头脑之间的界限变得模糊。经济学家和心理学家谈论“知识的诅咒”：懂得某个事物的人难以想象另一个人居然不懂。而知识的幻觉则是相反的情况：人们因为别人了解什么就以为自己了解。

蜂巢思维的特点是严密的相互依赖和专长分享，它曾帮助人类猎杀猛犸象，现在又将他们送入太空，但在政治领域却带来了问题。使用抽水马桶却不了解它的原理并无危害，但不理解医疗系统就着手改造却是危险的。然而人们常常对知之甚微的议题持有强烈的意见。而在社交媒体上，我们

被思维相近的朋友和粉丝包围，观点因而被进一步强化，变得更为极端。你很难与一个错误地以为自己已经透彻思考过自身观念的人理论，而如果这些观念扎根于一个团体的价值观和集体思维，只靠摆事实就不大可能改变它。

作者们试探性地提出，让人们直面这种理解的幻觉会让他们的观点变得温和。但这可能产生反效果——一旦感觉到自己的愚蠢，人们的反应就会很糟糕。斯洛曼和费恩巴赫展示了问题的严重性，但并未提出什么解决办法。

“知识幻觉”的问题既明显又严重：大脑存在局限，这并不奇怪；问题在于人们极少去思考这种局限性。不过，虽然这种幻觉确实存在，作者却夸大了它的重要性。他们错误将它视为人类心理的核心，而实际上关于他们那个最初的问题——“人类思维何以如此强大却又如此肤浅？”——答案就在“蜂巢思维”本身。比起理解的幻觉，人类的无知是更根本、影响也更重大的问题。不过，本书出版的时机为它加了分。在党派偏见激化、假新闻迭出的年代，他们带来了一剂必须的“谦逊”之药：对你自己的知识和你所在群体的智慧保持怀疑。 ■



Airlines in America

Whack-a-passenger

Americans are treated abysmally by their airlines. They should look to Europe for lessons

DECADES ago travelling by air in America was a glamorous affair. Today it signals delays, discomfort, extra charges and the threat of violence. A video of a passenger being forcibly dragged from a United Airlines flight on April 9th, after too few people volunteered to give up their seats, has sparked an outpouring of complaints about flying in America. Passengers are right to moan. America's airlines really do compare badly with foreign ones. European carriers are the best point of reference.

Air fares are higher per seat mile in America than in Europe. When costs fall, consumers in America fail to enjoy the benefits. The global price of jet fuel—one of the biggest costs for airlines—has fallen by half since 2014. That triggered a fare war between European carriers, but in America ticket prices have hardly budged. Airlines in North America posted a profit of \$22.40 per passenger last year; in Europe the figure was \$7.84.

Standards of service are also worse. Only one operator based in America can be found in the world's 30 best carriers, as rated by Skytrax, an aviation website, compared with nine from Europe. When Ryanair, currently Europe's largest and cheapest airline, cut service to the bone, it began to lose customers and money. That prompted it to perform a U-turn and be "nicer" to customers, in order to protect its market share from rivals like easyJet, Wizz Air and Norwegian.

This happy combination of low fares and reasonable service has a simple explanation: competition. American policymakers have presided over a wave of mergers in the past few years. The biggest four carriers in America

between them now control 80% of the market, compared with just 48% a decade ago. Warren Buffett, a man who knows an oligopoly when he sees one, bought nearly \$10bn-worth of airline stock in 2016. In Europe, where the top four carriers have around 45% of the market, policymakers have got three things right.

First, European regulators have tried harder to preserve competition between existing carriers. The EU has been willing to block mergers, such as a proposed tie-up between Ryanair and Aer Lingus, and to prevent airlines from building monopoly positions at airports. Not so in America: at 40 of its 100 biggest hubs, a single carrier now accounts for more than half of capacity. That pushes up prices. The merger of American and US Airways in 2013 increased American's market share at Philadelphia's airport to 77%. Fares rose from 4% below the national average in 2013 to 11% above after the merger.

Second, Europe has made it easier for foreigners to boost competition by entering new markets. There are no ownership limits at all between European countries; and the EU lets airlines with a non-EU owner that has a stake of up to 49% fly anywhere within the bloc. America caps foreign ownership at 25%. Foreign joint ventures, such as Virgin America (which was acquired by Alaska Air Group last year) struggle to take off.

Third, Europe has also encouraged competition between different airports and their main operators. Breaking up the ownership of London's biggest three airports has saved passengers £420m (\$628m) in fares since 2009, according to ICF International, a consultancy. In contrast, most American cities have only one airport, many of them publicly owned.

| *Dogfighters*

Some of Europe's advantages are hard to replicate. Distances between big cities are shorter, making road and rail transport serious rivals. Yet that is

all the more reason for America to promote competition in the sky. America's regulators should loosen the cap on foreign ownership, take away slots from incumbents and promote the use of secondary airports to give new entrants a leg-up. If that doesn't yield dividends, regulators should consider breaking up the big airlines. Allowing competition to wither was a huge mistake. It should be rectified. ■



美国的航空公司

殴打乘客

美国人受到本国航空公司的恶劣对待。他们应该向欧洲取经

几十年前，在美国乘飞机旅行是件神气的事，如今它却意味着延误、不舒适、额外收费以及暴力威胁。4月9日，美国联合航空（United Airlines）的一个航班因自愿放弃乘机的人数不足，一位旅客被强行拖走。这段视频令人们对在美国飞行的各种不满倾泻而出。乘客们确有理由抱怨。与外国同行相比，美国的航空公司确实糟糕。欧洲的公司就是最好的参照物。

美国每座英里（per seat mile）机票价格要高于欧洲。成本下降时，美国消费者并没有享受到好处。自2014年以来，全球航空燃油的价格（航空公司最大的成本之一）下降了一半。这引发了欧洲航空公司之间的价格战，但美国的票价却几乎没有变动。去年，北美航空公司的客均利润为22.40美元，而欧洲公司的数字仅为7.84美元。

美国的服务水平也比较差。在航空评级网站Skytrax评定的全球最佳30家航空公司中，美国只有1家，欧洲则占了9家。瑞安航空（Ryanair）是目前欧洲最大的廉价航空公司。它曾大幅削减服务，结果客源便开始流失并出现亏损。这促使瑞安航空彻底转变，更善待乘客，以保护自己的市场份额免遭易捷航空（easyJet）、Wizz Air和挪威航空（Norwegian）等竞争对手的抢夺。

这种低票价和合理服务的愉快结合有一个简单的理由：竞争。过去几年里，美国的政策制定者主导了一轮并购浪潮。目前，美国最大的四家航空公司控制了80%的市场，10年前这个数字仅为48%。巴菲特很善于发现寡头垄断，2016年，他买入了价值近100亿美元的航空公司股票。在四大航空公司占据大约45%市场份额的欧洲，政策制定者有三件事做得很妥当。

首先，欧洲的监管机构更为努力地维护现有航空公司之间的竞争。欧盟一向愿意阻止合并，防止航空公司在机场建立垄断地位，例如它曾叫停瑞安

航空与爱尔兰航空（Aer Lingus）的合并计划。美国的情况则不同：在100个最大的枢纽机场中，有40个机场超过一半的容量都属于某一家航空公司。这推高了票价。美国航空（American Airlines）和全美航空（US Airways）于2013年合并，导致美国航空在费城机场的市场份额上升至77%。该公司票价在2013年较全国平均水平低4%，合并后则比平均水平高出11%。

其次，欧洲让外国人更容易进入新市场，以此促进竞争。欧洲国家之间不存在任何持股限制，而且只要航空公司的非欧盟股东持股在49%以内，它就可以在欧盟的任何地方飞行。美国的外资持股上限为25%。维珍美国航空（Virgin America，去年被阿拉斯加航空集团收购）等外国合资企业步履维艰。

第三，欧洲还鼓励不同机场及其主要运营商之间的竞争。根据咨询公司ICF国际（ICF International）的数据，自2009年以来，拆分伦敦最大的三个机场的所有权为乘客节省了4.2亿英镑（6.28亿美元）的机票费用。相比之下，大多数美国城市都只有一个机场，其中有许多是归政府所有。

| 空中大作战

欧洲的一些优势很难复制。欧洲大城市之间的距离较短，使公路和铁路运输成为飞机的劲敌。然而，这也让美国更有理由推动天空中的竞争。为了帮助新进者，美国的监管机构应该放松对外资持股的限制，减少现有企业独占的起降时段，并促进支线机场的使用。如果这样做没有产生回报，监管机构应该考虑拆分大型航空公司。放任竞争减少是一个巨大的错误，应该予以纠正。 ■



Banking and the elderly

Not losing it

Banks need strategies to help customers suffering cognitive decline

“THE older the wiser” may ring true for much of life, but not for our ability to handle money. Studies suggest financial decision-making ability tends to reach its peak in a person’s mid-50s, after when deterioration sets in. “Age-friendly” banks are beginning to learn how to protect vulnerable older customers.

The most dramatic forms of age-related mental deterioration are neurodegenerative diseases, like Alzheimer’s. But even “normal” ageing can cause cognitive change. Financial-management skills are often early casualties, because they demand both knowledge and judgment.

Older people are more likely to struggle with day-to-day banking and are more susceptible to poor investment decisions. They are also more vulnerable to fraud or to financial exploitation, often by relatives. In 2010 the over-65s in America made up 13% of the population but had over a third of the wealth. British pensioners became especially vulnerable when reforms in April 2015 allowed them to withdraw savings previously locked up. Newspapers fretted that people would splurge their pensions on Lamborghinis. A greater concern should have been that they became easy prey for scammers. By March 2016 cold-callers had approached more than 10m people about their pensions, according to Citizens’ Advice, a charity.

It is difficult to monitor financial abuse, because victims rarely report it. True Link Financial, a financial-services firm, estimates annual losses in America from financial exploitation and abuse of the elderly at between \$3bn and \$37bn. In Britain the Financial Conduct Authority has issued warnings about investment-fraud schemes, coaxing the elderly into trading

their savings for shares, wine or diamonds (which never arrive).

The older brain seems more susceptible to “too good to be true” scams, from lotteries to dating schemes. According to the “Scams Team” at Britain’s National Trading Standards, a consumer-protection body, the average age of victims of mass-marketing scams is 75. Louise Baxter, the team’s manager, says cognitive decline in older people is a risk factor that criminals exploit, and the dangers are likely to rise in tandem with the incidence of dementia. Phil Mawhinney, from Age UK, a charity, says people living alone, as half of Britons over 75 do, are more likely to be befriended by a fraudster. So-called “sucker lists” of easy targets circulate among criminals.

Banks have been slow to respond, at first seeing these risks as purely a matter for customers. (As one manager puts it, they “have the liberty to make dumb financial decisions.”) Most “age-friendly” measures have focused on physical limitations (such as talking ATMs for the blind) or helping people get online. However, many banks are recognising cognitive decline as their problem, too. Barclays, a British bank, uses voice recognition to help customers who have trouble with passwords. Banks are training staff in how to spot dementia and signs of financial abuse. First Financial Bank, in America, gives staff who uncover a scam a “Fraud Busters” pin. And better ways to identify fraud are popping up: algorithms can help staff detect changes in spending patterns. Barclays used data from old cases to pinpoint 20,000 high-risk customers, whom it monitors and advises.

The trickiest issue for banks, ethically and legally, is how and when to act on concerns over a client’s ability to manage money. The last-resort measure, most commonly used for the incapacitated, is a power of attorney, usually given to a family member chosen in advance. But this can put people at risk of opportunistic relatives. It may also curtail autonomy

too severely. Banks are experimenting in this grey area, for example by giving relations “read-only” access to accounts, so they can monitor payments, or by allowing the bank to delay a payment and contact advisers if it is worried. A limited form of power of attorney, with authorisation for only certain payments, is also emerging.

Much of the financial damage done by cognitive decline results from late detection of problems. A decline in someone’s financial skills can be an early warning of dementia or other problems. Jason Karlawish, an expert on Alzheimer’s at the University of Pennsylvania, thinks banks—and their technology—are uniquely placed to identify older people who are at risk and refer them to doctors or social workers. He coined the phrase “Whealthcare” to describe how looking after people’s money can give insights into their health. “If you do it right, I think customers will like it,” he adds. “Nobody wants to lose their money and certainly not their brain.” ■



银行业与老年人

莫失莫忘

银行需要采取策略帮助年老昏聩的客户

生活中大多数时候，“岁长智增”可能都是真的，不过在理财这方面却并非如此。研究表明，人在50来岁的时候在财务方面的决策能力达到顶峰，之后便会走下坡路。“关爱老年人”的银行正开始学习如何保护它们脆弱的老年客户。

与年龄有关的心智衰退中，最严重的是神经退行性疾病，如阿尔茨海默症。但即使是“正常”的衰老也可能导致认知的变化。财务管理技能往往会先行退化，因为这种能力既需要知识也需要判断力。

老年人在处理日常银行业务时更容易遇到困难，也更容易受不当投资决策的影响。此外，他们还更容易被欺诈，或遭受财务剥削——往往来自亲属。2010年，美国65岁以上人口占总人口的13%，但却拥有超过三分之一的财富。2015年4月，英国的养老金政策改革允许养老储蓄者全权支配其养老金，这让他们变得尤其易受伤害。媒体担心人们会挥霍养老金来买兰博基尼跑车。然而更值得担心的一点是，他们会成为骗子眼中待宰的羔羊。慈善机构公民咨询（Citizens' Advice）的数据显示，截至2016年3月，已有超过1000万人接到过陌生人询问养老金的电话。

老年人在财务上遭受的欺凌很难监测，因为受害人很少报案。金融服务公司True Link Financial估计，美国每年因老年人遭受财务剥削和欺凌所造成的经济损失在30亿到370亿美元之间。在英国，金融市场行为监管局（Financial Conduct Authority）发布了投资欺诈圈套的警告，这些圈套会诱骗老年人用储蓄来换购股票、葡萄酒或钻石（实际上这些东西永远也拿不到）。

大脑老化后似乎更容易相信“天上掉馅饼”的骗局——从彩票中奖到欺诈约会，花样繁多。英国消费者保护机构国家交易标准（Britain's National

Trading Standards)的“反欺诈小组”表示，大规模欺诈事件的受害者平均年龄在75岁。该小组组长露易丝·巴克斯特(Louise Baxter)说，老年人认知衰退是犯罪分子会利用的一个风险因素，而且风险会随痴呆的发病率上升而增加。慈善机构Age UK的菲尔·莫西尼(Phil Mawhinney)说，独居老人(英国75岁以上的老人半数都独居)更有可能被骗子套近乎。所谓的“傻子清单”在罪犯中广泛流传。

银行一向对此反应迟缓，起初它们认为这些风险纯粹是客户个人的问题。(正如一位经理所说，“他们有做出愚蠢的财务决策的自由。”)大多数“关怀老年人”的措施都集中在身体缺陷(例如具有语音导航服务的盲人ATM机)或帮助人们使用网上银行方面。然而，如今许多银行开始认识到客户认知衰退也是它们的问题。英国巴克莱银行使用语音识别功能来帮助搞不清密码的客户；各家银行都在培训工作人员如何识别痴呆患者和财务欺凌的迹象；美国第一金融银行(First Financial Bank)会给发现骗局的工作人员胸前别一枚“欺诈破坏者”的胸针。同时也出现了更好的方法来识别欺诈：算法可以帮助工作人员发现支出模式的变化。巴克莱银行利用旧案件的数据确定了两万名高风险客户，监控他们的财务行为，并提供建议。

银行在道德和法律方面最棘手的问题是如何以及何时出于对客户理财能力的担忧而采取行动。万不得已的措施(最常用于无行为能力的人)是授权他人代理，通常是提前选好的家庭成员。但这也可能让伺机而动的亲属有机可乘，也可能会过分限制自主权。银行正在这个灰色地区进行尝试，例如授予亲属对账户的“只读”访问权限，让他们可以监控支付情况，或者在有疑虑的情况下允许银行延迟付款并联系顾问。有限授权的形式(即仅授权某些支付行为)的方式也出现了。

大多由认知衰退造成的财务损失是由于健康问题被发现得过晚。一个人财务能力的下降可能是痴呆或其他疾病的前兆。宾夕法尼亚大学的阿尔茨海默症专家杰森·卡拉威什(Jason Karlawish)认为，银行及其技术具备特殊的优势，能够识别面临欺诈风险的老年人，并将他们转介给医生或社会工作者。卡拉威什创造了“财富保健”(Whealthcare)一词来描述如何通过看管人们的钱来了解他们的健康状况。“如果处理得当，我认为客户会

喜欢这种方式，”他补充道，“没人会想要把钱弄丢，当然也不会想失去头脑。”■



Popularity

Recipe for success

The psychology behind and economics of pop culture

WHAT makes a hit? Many assume it has to do with artistry or luck. Not so, says Derek Thompson, a writer and editor at the *Atlantic*. In his first book, “Hit Makers”, he analyses the psychology and economics of pop culture and argues that “hits”—the things that get everybody talking—are based on three rules that rely on more than creative genius alone.

First, consumers crave “familiar surprises”. Studies show that people opt for things they recognise over things they do not. Maybe there is an evolutionary explanation for this: survival taught humans that if they had seen an animal before, it had not killed them yet. This familiarity was comforting. The evidence for people’s response to recognition is everywhere: the Star Wars franchise, for example, is an amalgam of characters and themes from older films. But it remains a fine balance, as people enjoy thinking they have found something new—the “aha” moment, as Mr Thompson calls it.

Second, going “viral” overnight is a myth. Hits rely on a series of closely connected events: a celebrity picking up a tweet and sharing it with countless followers, for example. Friends and family alone are unlikely to help you reach the scale you need (unless, of course, they are extremely influential). “Rock Around the Clock”, a rock’n’roll classic, floundered when it was first released. Yet thanks to one music-obsessed teenager and his movie-star father, the song was picked as the opening track to a notorious film called “Blackboard Jungle”, which helped it achieve international renown.

Third, technology may evolve, but people’s longing for the popular does

not. Music labels used to bribe radio stations to play their songs, thus ensuring their success. This meant the labels could dictate the hits. Today the internet offers a seemingly infinite repertoire of readily available music, yet people tend to stick to songs that other people like. One study from Columbia University found that a song at the top of the charts stayed there precisely because people assumed it was good. When the charts were inverted, those previously at the bottom achieved similar success. The quality of the song is not as important as its perceived popularity.

Mr Thompson's thesis might seem obvious—a fact he readily admits. Exposure and connections are important. But the extent to which nearly all blockbusters and pop sensations owe their success to this may be less clear-cut than is generally believed. Mr Thompson's knack for supporting each point with colourful tales and examples helps make the book worthwhile. He explains how "Bal du Moulin de la Galette" by Pierre-Auguste Renoir, which is revered as one of the masterpieces of the Impressionist movement, would not have been so without Gustave Caillebotte, a fellow artist. Caillebotte died at 45 and left nearly 70 of his friends' paintings to the French state, including several by Renoir, thus helping ensure his exposure and eventual critical acclaim.

Readers may despair at the injustice of publicity bearing more fruit than pure talent, but there are enough unlikely examples to foster hope. Indeed, in theory, anyone with the right mix of "optimal newness", wide reach and repeated exposure can get their lucky break. Better still, it might just be a hit. ■



流行

成功之道

流行文化背后的心理学与经济学

怎样才能打造出热门作品？很多人觉得要靠技艺或是运气。《大西洋月刊》（the Atlantic）的撰稿人兼编辑德里克·汤普森（Derek Thompson）认为并非如此。在他的第一本书《热门炮制者》（Hit Makers）中，汤普森分析了流行文化背后的心理学和经济学，并指出“大热门”（也就是人人议论的东西）的产生要遵循三条法则，所依赖的不止创意天赋。

首先，消费者渴望“熟悉的惊喜”。研究表明，比起陌生的东西，人们会更倾向于选择自己认得出的事物。这或许可以用进化论来解释：生存经验告诉人类，如果他们曾经见过某种动物，就说明这种动物还没伤害过他们的性命。这种熟悉感令人安心。人们响应这一识别感的证据随处可见：比如，《星球大战》系列就是多部老电影里的人物和主题的混合。但是它保持着一种微妙的平衡，因为人们喜欢发现新东西的感觉，汤普森称之为“啊哈”时刻。

第二，一夜爆红是个神话。作品走红靠的是一系列紧密联系的事件：比方说某位名人发现一条推文，然后转发跟无数粉丝分享。单靠朋友和家人则不太可能让你火到你需要的程度（当然，除非他们有极大的影响力）。摇滚乐经典《昼夜摇滚》（Rock Around the Clock）首次发行时跌跌撞撞几乎要被埋没。多亏了一位少年乐迷和他的电影明星父亲，这首歌被选为广为人知的影片《黑板丛林》（Blackboard Jungle）的片首曲，这帮助它风靡全球。

第三，技术可能会进化，但人们对流行事物的渴望不会变。唱片公司以前常常会收买电台，让它们播放自己的歌曲，以此便可确保成功。这意味着唱片公司能够决定哪些单曲会火。今天互联网提供了看上去无穷无尽的曲库，想听什么都唾手可得，但人们还是喜欢紧跟别人喜欢的歌。哥伦比亚

大学的一项研究发现，一首歌能在榜单上排在前列就是因为人们想当然地以为它是好歌。把榜单倒转过来后，那些本来垫底的歌也获得了类似的成功。比起人们以为一首歌有多流行，歌曲本身的质量并没那么重要。

或许汤普森的论点看起来是显而易见的常识——他自己也欣然承认这一点。曝光和关系都很重要。但是，几乎所有的热门大片和流行现象在多大程度上应该归功于这些因素，可能并不像人们普遍认为的那么显而易见。汤姆森用生动的故事和例子支持每个观点，这种能力让这本书值得一读。他解释了为什么说如果没有艺术家朋友居斯塔夫·卡耶博特（Gustave Caillebotte），雷诺阿（Pierre-Auguste Renoir）所绘的《煎饼磨坊的舞会》（Bal du Moulin de la Galette）便不会被尊为印象派运动代表作之一。卡耶博特45岁去世，为法国政府留下了其多位友人的近70幅画作，其中就包括雷诺阿的几幅。这确保了雷诺阿为世人所知，并最终赢得评论界的赞誉。

公众的关注比纯粹的才能赢得的成果更多，这种不公正可能让读者绝望，但也有大量意料之外的例子孕育着希望。其实，理论上说，只要恰当地搭配“最优新鲜感”、广泛接触面和重复曝光，任何人都能交上好运、取得突破。说不定还会风靡一时呢。■



Wall Street

Stevie wonder

The rise, fall and rise of Steven Cohen

IN THE late 1990s your reviewer worked on the trading floor of a bank. It was understood there that if you walked out of a meeting with profitable gossip about, say, a takeover, one client should always get the first phone call: SAC Capital, an American hedge fund, run by Steven Cohen. “Stevie” was, according to his legend, a day-trading idiot savant, a bully and a moneymaking genius who, when he wasn’t staring at his screens, was trying to prove his sophistication by paying top dollar for trophy works of art, such as Damien Hirst’s pickled shark (pictured). He paid so much in fees that the banks ate out of his hands.

Almost 20 years on Mr Cohen’s strange ascent to the pinnacle of American society, and the efforts of regulators to jail him for insider dealing, are the subject of Sheelah Kolhatkar’s excellent new book, “Black Edge”. Earlier books on Wall Street, such as “Barbarians at the Gate” and “Liar’s Poker”, describe the macho era of junk bonds and leveraged buy-outs in the 1980s. “Too Big to Fail”, which came out in 2009, recounts the bail-out of those banks. “Black Edge” tackles the rise of speculative hedge funds over the past two decades, of which SAC was, for a while, perhaps the most powerful.

In the late 1990s it became harder for investors to beat the market. The “Reg FD” rule, passed in 2000, required companies to disclose information to all investors at the same time. Computing and brain power rose on Wall Street, with the cream of the Ivy League crunching data for nuggets that others had not spotted. In the arms race to find a new “edge”, some firms installed their computer cabling close to the stock exchange to get data a millisecond faster. Mr Cohen took a different route.

Having learned the ropes at an old-school firm, he set up SAC as a kind of corporate espionage agency. He paid huge commissions to banks for information. By 1998 he was Goldman Sachs's biggest equities client. And he hired analysts to befriend talkative strangers at companies or watch factory gates in Taiwan; anything to get an advantage to help Mr Cohen's trades. Before the financial crisis SAC had \$17bn of assets and an average annual return of 30% for 18 years, an enviable record.

Too good, concluded regulators, who laid siege to SAC to try to prove that the firm was profiting from insider information. Eventually, several traders and analysts pleaded guilty or were convicted. Mathew Martoma, a habitual liar who had been expelled by Harvard Law School for faking his grades, and who made huge illegal trades on pharmaceutical firms, was jailed. But Mr Cohen always managed to be several steps away from the insider information. In 2013 SAC at last agreed to say that it had engaged in fraud, to close its doors to outside money and pay a fine. Mr Cohen, who has not admitted guilt, will be free to open a new fund next year.

Three themes stand out in "Black Edge". One is the hollow life of the protagonist. Clad in a fleece, surrounded by 12 screens, masseuses, a manipulative wife, a hostile ex-wife and a cast of millionaire sycophants whom he periodically culls, Mr Cohen cuts a sad figure. The second theme is the decay of the industry's ethics. The banks still do business with Mr Cohen, and if he opens a new fund, supposedly reputable firms will line up to give him money. The last theme is the feebleness of enforcement. Mr Cohen's government pursuers were comprehensively outwitted by his lawyers. In fictional accounts of high finance—in Tom Wolfe's novel, "The Bonfire of the Vanities", or "Wall Street", directed by Oliver Stone—the courts ultimately bring the biggest egos crashing down. In real life the law has much less power. ■



华尔街

神奇史蒂维

史蒂芬·科恩沉浮录

20世纪90年代末，笔者在一家银行的交易大厅工作。那里的惯例是，如果你刚开完一个会，听到了有利可图的八卦——比如一项收购，你应当总是最先打电话给一个客户——由史蒂芬·科恩（Steven Cohen）运营的美国对冲基金SAC资本。传说中的“史蒂维”是一个日间交易的奇才（但其他方面如同白痴），一个霸凌者，还是一个挣钱天才。他不盯着屏幕时，会在艺术战利品上一掷千金来证明自己的老练，比如达明·赫斯特（Damien Hirst）的腌鲨鱼（如图）。他支付的手续费高到让银行都听凭他摆布。

在近20年的时间里，科恩诡异地崛起并升至美国社会巅峰，而监管者试图以内幕交易将他送进监狱——这是希拉·科尔哈特卡（Sheelah Kolhatkar）出色的新书《黑色优势》的主题。此前关于华尔街的书籍，如《门口的野蛮人》和《说谎者的扑克牌》，描述的都是20世纪80年代垃圾债券和杠杆收购的峥嵘岁月，2009年出版的《大到不能倒》则回忆了为银行纾困的经历。《黑色优势》介绍了过去20年中投机性对冲基金的崛起，而SAC也许是一段时期内最强大的一个。

到了90年代末，投资者要战胜市场变得更难了。2000年通过的“公平披露规则”要求公司同时向所有投资者披露信息。华尔街的计算力和脑力同步上升，常青藤的精英鼓捣数据，以发掘其他人尚未发现的金块。在寻求新“优势”的军备竞赛中，一些公司把自己的电脑电缆安装到靠近交易所的地方，以求早一毫秒获取数据。而科恩选择了另外一条路。

在一家老派公司摸到了门道后，他成立了SAC，算是一种商业间谍机构。他向银行支付巨额佣金以获取信息。到了1998年，他是高盛最大的股票客户。他聘请了分析师到各个公司结识健谈的陌生人，或观察台湾工厂的大门——做任何能让他的交易获得优势的事情。在金融危机之前，SAC拥有170亿美元资产，18年来的平均年回报率为30%，这是一个令人羡慕的纪

录。

监管者判断这好得太过分了，随后围攻SAC，试图证明其通过内幕信息获利。最终，几名交易员和分析师表示认罪或被判有罪。因伪造成绩被哈佛大学法学院开除的惯骗马修·马托玛（Mathew Martoma）因非法交易制药企业股票谋取暴利而获刑。但科恩总是能设法与内幕信息保持一点点距离。2013年，SAC终于承认曾从事欺诈，不再接受外来资金并支付罚款。科恩并未认罪，明年即可再开设一个新的基金。

《黑色优势》中有三个主题尤为醒目。一个是主角空虚的生活。身着丝绒、12个屏幕环绕、专业按摩师、善于摆布的妻子、充满敌意的前妻和他定期从身边剔除的一撮身价百万的马屁精，科恩的身影可谓悲凉。第二个主题是行业道德的衰败。各家银行仍然与科恩有业务往来，如果他再开设一个新的基金，很多知名公司应该都会排队给他送钱。最后一个主题是执法的无能。追击他的大量政府人士在智谋上完全不是他律师的对手。在汤姆·沃尔夫的小说《虚荣的篝火》或奥利弗·斯通执导的《华尔街》这类有关高端金融的虚构故事中，法院最终都让最狂妄自大的人轰然倒地。但在现实世界里，法律的权力要小得多。■



Markets

Evolving ideas

Humans are not always rational, which explains much about the economy

ECONOMISTS have been accused of “physics envy”, an obsession with constructing precise mathematical models instead of studying the real, messy, world. But a new book suggests that economists have been looking at the wrong science; they should have focused on biology.

The idea stems from the school of “behavioural economics” which observes that humans are not the kind of hyper-rational calculating machines that some models rely on them to be. As a result, markets are not always “efficient”—accurately pricing all the available information.

When Andrew Lo was a young academic, he presented a paper at a conference which showed that one of the key assumptions of the efficient market hypothesis was not borne out by the data. He was instantly told that he must have made a programming error; his results could not possibly be right.

Mr Lo, who is now a professor at MIT, has spent much of his career battling to steer economics away from such narrow-minded thinking. His grand idea is the “adaptive markets hypothesis”. The actions of individuals are driven by intellectual short cuts—rules of thumb that they use to make decisions. If those decisions turn out badly, they adapt their behaviour and come up with a new rule to follow.

The theory is bolstered by experiments that show how humans make decisions. Psychological quirks include an unwillingness to take losses and a tendency to make patterns out of random data. These traits may once have been useful in evolutionary terms (that rustle in the bushes might not

be a predator, but better safe than sorry) but are less helpful when making financial decisions.

Research has also shown what happens inside our brains when we make decisions. Winning money has the same effect on a brain as a cocaine addict getting a fix, while losing money has the same effect on risk-averse people as a nasty smell or pictures of bodily mutilation. Furthermore, it seems that emotion plays a significant part in gauging risks, and not always a negative one, acting as a “reward-and-punishment system that allows the brain to select an advantageous behaviour”. If we do not fear the consequences of failure, we may act irresponsibly, just as small children need to learn to be wary of cars before crossing the road. Studies of people with brain damage show that “when the ability to experience emotions is removed, human behaviour becomes less rational.”

When we apply our behavioural quirks to the markets, the result is a kind of fast-track evolution in which investment strategies are tested in a fast-changing environment. Mr Lo describes the hedge-fund industry as the “Galapagos islands of finance”; many thousands have been set up but the extinction rate is very high.

The theory may also explain why the economy can see long periods of stability followed by sudden crisis. Mr Lo writes that “Economic expansions and contractions are the consequences of individuals and institutions adapting to changing financial environments, and bubbles and crashes are the result when the change occurs too quickly.”

The same process of adaptation occurs between the finance industry and its regulators, with the regulators always one evolutionary step behind the regulated. One answer, suggests Mr Lo, is to create a financial equivalent of America’s National Transportation Safety Board (NTSB). Because the NTSB is not itself a regulator, it feels able to criticise both transport companies

and regulations; that makes its conclusions genuinely independent.

Mr Lo makes a convincing argument and he also uses the book to lay out some interesting ideas—such as a huge, diversified fund that would invest in a range of potential cancer treatments. But while readers may nod their heads in agreement with the author, it is not clear what they should do next. The adaptive-markets theory does not really produce any testable propositions, or market-beating strategies. And regulators might benefit from his suggestions on monitoring financial risk but might still struggle to know what to do in response. Perhaps that is the point; evolution doesn't have an end game in mind. ■



市场

进化中的思想

人类并不总是理性的，这也解释了很多经济现象

有人批评说经济学家们有一种“羡慕物理学”情结——沉迷于构建精确的数学模型，而不是去研究凌乱的现实世界。但一本新书认为，经济学家一直以来找错了对标的科学方向，他们本应该专注于生物学。

这一思想源自“行为经济学”学派。该学派指出，人类并不是某些模型所依赖的那种超级理性的计算机器。这就导致市场并不总是“有效”——“有效”意味着对所有可用的信息进行准确的定价。

罗闻全（Andrew Lo）还是个年轻学者时，在一次会议上介绍了一篇论文，称有效市场假说的一个关键假设没有数据支持。有人立刻告诉他肯定是程序写错了，他的研究结果不可能是正确的。

罗闻全现在是麻省理工学院的教授，他职业生涯的大部分时间都在努力将经济学从这种狭隘的思维中扭转过来。他的宏伟构想是“适应性市场假说”。推动个人行为的是思想“捷径”，也就是用以做出决策的经验法则。如果这些决定导致的结果不佳，人们会调整自己的行为并总结出新的规则来遵守。

该理论得到了实验支持，这些实验展示人们是如何做决策的。人类的心理怪癖包括不愿意承担损失，以及要倾向于在随机数据中找出模式。这些特征在进化过程中可能曾经是有用的（灌木丛发出沙沙声可能并不是因为有猛兽，但还是小心为上），但对于财务决策则帮助不大。

研究还展示了我们在做决策时大脑里发生了什么。赢钱与可卡因瘾君子嗨了一把对于大脑的效果是一样的，而赔钱对于风险厌恶者的效果则类似于恶心的气味或是残肢的图片。此外，情绪似乎在衡量风险上有起重大影响，并且并不总是负面的，而是一个“让大脑选择有利行为的奖惩机制”。

如果我们不害怕失败的后果，就可能会做出不负责任的行为，就像小孩子要经过学习才知道过马路的时候要小心汽车。对脑损伤者的研究显示“在体验情绪的能力被去掉后，人的行为变得更不理性了”。

当我们把行为怪癖用在市场中，其结果类似于快速进化，而投资策略就在这个快速变化的环境中经受考验。罗闻全把对冲基金行业描述为“金融的加拉帕戈斯群岛”。建立的基金有成千上万，但灭绝率非常高。

该理论也可以解释为什么经济可以在长期稳定后突然出现危机。罗闻全写道：“经济扩张和收缩是个人和机构适应不断变化的金融环境的结果，变化太快时会导致泡沫和崩溃。”

同样的适应过程也发生在金融业和其监管机构之间，监管者的演化总是比被监管者晚一步。罗闻全建议，一种方案是创造一个与美国国家运输安全委员会（NTSB）相当的金融委员会。NTSB本身不是一个监管机构，因此可以同时批评运输公司和法规，这使得它的结论可以真正独立。

罗闻全给出了一套令人信服的理由，也在这本书中提出了一些有趣的想法，比如建立一个庞大的多样化的基金来投资于一系列有潜力的癌症治疗方法。不过，虽然读者可能会认同作者的想法，他们下一步应该做什么还不清楚。自适应市场理论并没有真正提出任何可检验的命题或是能打败市场的策略。监管者或许可以从他监测金融风险的建议中获益，但可能仍不清楚该怎样应对。也许就是这么一回事：进化并没有预设一个最终目标。





Oil and technology

Data drilling

The oil industry struggles to enter the digital age

IT SOUNDS like a spectacular feat of engineering. Employees of Royal Dutch Shell located in Calgary, Canada, recently drilled a well 6,200 miles (10,000km) away in Vaca Muerta, Argentina. In fact, the engineers of the Anglo-Dutch oil major were using computers to perform what they call “virtual drilling”, based on their knowledge of Fox Creek, a shale bed in Alberta, which has similar geological features to Argentina’s biggest shale deposit. They used real-time data sent from a rig in Vaca Muerta to design the well and control the speed and pressure of the drilling. On their second try, they completed the well for \$5.4m, down from \$15m a few years ago. “It’s the cheapest well we’ve drilled in Argentina,” says Ben van Beurden, Shell’s chief executive.

Shell is not alone in deploying computer wizards alongside geologists in an attempt to lower costs in an era of moderate oil prices. The industry as a whole is waking up to the fact that digitisation and automation have transformed other industries, such as commerce and manufacturing, and that they have been left behind. Technology firms and consultancies are knocking on their doors peddling alluring concepts like the “digital oil rig” and the “oilfield of the future”. Some argue that the embrace of digital technologies could be the next big thing after the shale revolution that started to transform oil and gas production in America a decade ago. But this is an industry that embraces new technologies only in fits and starts.

Once, Big Oil was at the forefront of digitisation, pioneering the use of 3-D seismic data and supercomputers to help find resources. But priorities changed, especially during the past decade when oil prices rose above \$100 a barrel and the primary goal was to find more of it, whatever the cost.

Whizzy new technology took second place. Ulrich Spiesshofer, chief executive of ABB, a Swedish-Swiss automation-technology company, says the oil industry puts to use in exploration activities barely 5% of the seismic data it has collected. During production of oil, less than 1% of data from an oil rig reaches the people making decisions, reckons McKinsey, a consultancy.

It is the process of extracting oil and gas that is considered most ripe for digitisation and automation. Drilling often takes place miles below the surface in rock formations where drill bits and pipes can be broken or snagged, which halts activity for long periods. Baker Hughes, an oil-services firm, has recently developed what it calls the first automated drill bit, capable of self-adjusting depending on the nature of the rock. McKinsey says undersea robots are also being deployed to fix problems.

Above the surface, efforts are under way to reduce the amount of people and plant on oil rigs, helping improve safety in a dangerous industry. James Aday, a veteran oil driller now at Wood Mackenzie, a consultancy, says that on the drilling platform itself, automation is not new. Others say that more rigs are being controlled semi-remotely; in the Gulf of Mexico, engineers in Houston use real-time data from oil rigs to make decisions, reducing the cost of shuttling them by helicopter to rigs. “The aim is to bring the data to the expert, not the expert to the data,” says Peter Zornio of Emerson, an automation firm. “There’s a huge incentive to get the people and the choppers off the platform.”

Wider use of data, sensors and automation will produce new challenges for the industry. It will have to learn about cyber-security—oil rigs are critical infrastructure—and invest in ways to prevent theft of data. But digitisation may also attract millennials to replace an ageing workforce, where mass retirement is a looming threat.

As to whether the workforce could shrink across the industry in the digital age, ultimately geologists and engineers believe technology will not put them out of a job, because producing oil is art as well as science. Nor will tech startups be likely to overcome the barriers to entry—such as high capital requirements—that protect incumbents. But they add to a sense, born out of the shale revolution, that innovation will make oil and gas more accessible and that the days when oil was considered a scarce resource are long gone. ■



石油与科技

数字钻探

石油工业艰难迈向数字时代

这听上去是一个令人叹为观止的工程壮举——身在加拿大卡尔加里（Calgary）的荷兰皇家壳牌公司员工最近在10,000公里之外的阿根廷瓦卡姆尔塔（Vaca Muerta）油田远程钻探了一口油井。实际上，这家英荷合资石油巨头的工程师是使用计算机完成了这次“虚拟钻井”。他们的操作是基于对加拿大阿尔伯塔省页岩矿区福克斯溪（Fox Creek）的了解，该矿区与瓦卡姆尔塔这个阿根廷最大的页岩沉积区具有相似的地质特征。他们运用瓦卡姆尔塔的一个钻井平台传送的实时数据来设计油井并控制钻探的速度和压力。在第二次尝试时，他们以540万美元的成本完成了钻井，低于几年前的1500万美元。“这是我们在阿根廷成本最低的钻井。”壳牌首席执行官本·范伯登（Ben van Beurden）表示。

在油价不高的时代，部署计算机能手来配合地质学专家工作以降低成本的不只壳牌一家。整个石油业如梦初醒，意识到数字化和自动化已彻底改变了商业和制造业等其他行业，而自己却已然落后。科技公司和咨询公司正在敲石油业的大门，推销“数字化石油钻井平台”和“未来油田”等诱人的概念。有人认为，继十年前开始改变美国油气生产的页岩革命后，积极运用数字科技可能成为又一件大事。但石油业在接受新技术上总是断断续续。

石油巨头集团曾一度处于数字化前沿，开创使用三维地震数据和超级计算机来辅助资源勘探。但后来首要任务发生了改变，尤其是在过去十年。当时油价升至每桶超过100美元，不惜一切代价寻找更多石油成为了主要目标，高新技术则退居次席。瑞典瑞士合资自动化技术公司ABB的首席执行官乌利齐·史毕福（Ulrich Spiesshofer）表示，石油业收集的地震数据中只有不到5%被用于勘探活动中。咨询公司麦肯锡认为，在石油开采过程中，石油钻井平台收集的数据只有不足1%为决策层所知悉。

如今，油气开采的过程被认为最适合应用数字化和自动化。钻探通常在岩

层表面下方几英里处进行，钻头和钻杆可能会破损或卡住，这会导致钻探作业长期停顿。油田服务公司贝克休斯（Baker Hughes）最近开发出了号称全球首创的自动化钻头，能根据岩石的性质自我调节。麦肯锡表示，海底机器人也正用于解决问题。

在地面上，人们正努力减少石油钻井平台上的工作人员和机械数量，以提高这一高危行业的安全性。资深钻探人员詹姆斯·阿代（James Aday）现任职咨询公司伍德麦肯兹（Wood Mackenzie），他表示，就钻井平台而言，自动化并非新鲜事。其他人也表示，更多钻井平台已转为半远程操控。在墨西哥湾，身在休斯敦的工程师们使用石油钻机的实时数据做决策，从而减少了用直升机运送他们往返钻井平台的成本。“这么做的目的是把数据传送给专家，而不是把专家送到数据发生地，”自动化公司艾默生电气的彼特·左尼欧（Peter Zornio）说道，“石油企业有着巨大的动力去减少派往钻井平台的人员和直升机。”

数据、传感器和自动化更广泛的应用将为该行业带来新挑战。业界将不得不去了解网络安全（石油钻井平台是至关重要的基础设施）并在数据防盗技术上投资。而数字化也可能吸引到千禧一代的加入，取代老化的劳动队伍。后者大规模退休的威胁正逐渐逼近。

至于在数字化时代整个石油业的劳动力队伍会否缩小的问题，地质学家和工程师们还是相信科技并不会让他们失业，因为石油开采既是科学也是艺术。科技创业公司也不大可能跨越保护既有企业的进入门槛，例如高资本要求。但这些改变深化了源于页岩革命的一种认知——创新技术将使石油和天然气开采变得更容易，石油被视作稀缺资源的时代早已过去。■



Algorithmic retailing

Automatic for the people

How Otto, a German e-commerce firm, uses artificial intelligence

A GLIMPSE into the future of retailing is available in a smallish office in Hamburg. From there, Otto, a German e-commerce merchant, is using artificial intelligence (AI) to improve its activities. The firm is already deploying the technology to make decisions at a scale, speed and accuracy that surpass the capabilities of its human employees.

Big data and “machine learning” have been used in retailing for years, notably by Amazon, an e-commerce giant. The idea is to collect and analyse quantities of information to understand consumer tastes, recommend products to people and personalise websites for customers. Otto’s work stands out because it is already automating business decisions that go beyond customer management. The most important is trying to lower returns of products, which cost the firm millions of euros a year.

Its conventional data analysis showed that customers were less likely to return merchandise if it arrived within two days. Anything longer spelled trouble: a customer might spot the product in a shop for one euro less and buy it, forcing Otto to forgo the sale and eat the shipping costs.

But customers also dislike multiple shipments; they prefer to receive everything at once. Since Otto sells merchandise from other brands, and does not stock those goods itself, it is hard to avoid one of the two evils: shipping delays until all the orders are ready for fulfilment, or lots of boxes arriving at different times.

The typical solution would be slightly better forecasting by humans of what customers are going to buy so that a few goods could be ordered ahead of

time. Otto went further and created a system using the technology of Blue Yonder, a startup in which it holds a stake. A deep-learning algorithm, which was originally designed for particle-physics experiments at the CERN laboratory in Geneva, does the heavy lifting. It analyses around 3bn past transactions and 200 variables (such as past sales, searches on Otto's site and weather information) to predict what customers will buy a week before they order.

The AI system has proved so reliable—it predicts with 90% accuracy what will be sold within 30 days—that Otto allows it automatically to purchase around 200,000 items a month from third-party brands with no human intervention. It would be impossible for a person to scrutinise the variety of products, colours and sizes that the machine orders. Online retailing is a natural place for machine-learning technology, notes Nathan Benaich, an investor in AI.

Overall, the surplus stock that Otto must hold has declined by a fifth. The new AI system has reduced product returns by more than 2m items a year. Customers get their items sooner, which improves retention over time, and the technology also benefits the environment, because fewer packages get dispatched to begin with, or sent back.

The initiative suggests that an important role of AI in business may be simply to make existing processes work better. Otto did not fire anyone as a result of its new algorithmic approach: it hired more, instead. In many cases AI will not affect a firm's overall headcount, but will perform tasks at a level of productivity that people could not achieve. Otto's experience also underlines that ordinary companies can use AI, not just giants such as Amazon and Google, notes Dave Selinger, a retailing-technology expert and former data scientist at Amazon. The degree to which the company has yielded control to an algorithm, he says, is extremely unusual. But it may not be long before others catch up. ■



算法零售

自动化为人服务

德国电子商务公司奥托集团是如何利用人工智能的

从汉堡一间不大的办公室里便可瞥见零售业的未来。在那里，德国电子商务公司奥托集团（Otto）正利用人工智能来改善自身的经营。该公司利用这一技术来做决策，在规模、速度和准确性方面均超越人类员工。

大数据和“机器学习”应用于零售业已有多多年，电子商务巨头亚马逊是个突出的例子。这些技术被用于收集和分析大量信息，以便了解消费者的喜好、向人们推荐产品，并为顾客生成个性化的网站。奥托则独树一帜，对顾客管理之外的业务决策也实行了自动化。最重要的一项是努力减少退货——该公司每年因退货损失数百万欧元。

奥托的常规数据分析表明，商品如能在两天内送达，顾客就不太可能退货。一旦超过两天，麻烦就来了：顾客可能会在商店里发现这种商品比网购便宜一欧元，就买了下来。奥托将被迫撤销订单还要承担运费。

但顾客也不喜欢分批发货，他们更喜欢同时收到所有东西。由于奥托销售的是其他品牌的商品，自己并无库存，这就难免出现以下两种糟糕情形之一：等所有订购商品都准备好后才发货，或者分成多个包裹在不同时间送达。

通常的解决方案是略微改进工作人员对销售的预测，这样就能提前订购一些商品。奥托则更进一步，利用了自己参股的创业公司Blue Yonder的技术创建了一个系统。有一种深度学习算法，最初是为日内瓦的欧洲粒子物理研究所（European Organization for Nuclear Research）实验室的粒子物理实验而设计的，如今为奥托承担起繁重的工作：它分析大约30亿次交易记录和200个变量（如过往销售、奥托网站上的搜索记录，以及天气信息等），在顾客下单前一周就预测出他们会买什么。

这套人工智能系统已被证明非常可靠——对于未来30天内会卖出什么，它预测的准确率达到了90%。于是奥托允许该系统每月从第三方品牌自动采购大约20万件商品，而不加以人为干预。机器下单的产品种类、颜色和尺寸繁多，要人来仔细检查是不可能的。人工智能投资人内森·博纳奇（Nathan Benaich）指出，网上零售是机器学习技术的必由之路。

总的来说，奥托必须持有的库存已减少了五分之一。新的人工智能系统每年减少了200多万件退货。客户更早拿到商品，这逐渐留住了更多的顾客。这种技术也有利于环境，因为一开始就能减少发货或退货所用的包装。

奥托的方法表明，人工智能在商业上的一个重要作用可能是让现有流程更好地运作。奥托没有因为使用新算法而解雇任何人，相反它还雇用了更多人。在很多情况下，人工智能并不会影响一家公司的员工总数，但会以工人无法达到的生产率水平来完成工作。曾在亚马逊担任数据科学家的零售技术专家戴夫·塞林格（Dave Selinger）指出，奥托的经验也突显出，不只是亚马逊和谷歌等巨头，普通公司也可以利用人工智能。他表示，奥托把控制权交给算法的程度之高，十分罕见。但说不定不久之后，其他人也会迎头赶上。■



China's internet giants

Three kingdoms, two empires

China's internet giants battle at home and abroad

THERE was a time, not that long ago, when China's big internet companies were dismissed by investors in Silicon Valley as marginal firms with a tendency to copy Western products. Not any more. Today they are monsters with increasingly hefty international ambitions.

Alibaba, China's biggest e-commerce group, handles more transactions each year than do eBay and Amazon combined. Jack Ma, its chairman, pledges to serve 2bn consumers around the world within 20 years. Tencent, which specialises in online games and social media, is now the world's tenth most valuable public firm, worth some \$275bn. Pony Ma (no relation), its chairman, wants China to "preside over the global tech revolution of the future". But as the two firms become global forces, the third member of China's "BAT" trio of internet giants, Baidu, an online-search firm that came to dominate the mainland market after Google left the country to avoid censorship, is lagging behind.

All three firms differ from their Western peers in important ways. First, Western companies usually prefer to focus on a few core areas, whereas Chinese internet firms typically try to do everything from cloud computing to digital payments. When this works, as with Tencent's wildly successful app, WeChat, the results can be impressive.

Second, with the exception of political censorship, the internet sector in China is lightly regulated. Facebook, Apple and Google, in contrast, face increasing scrutiny. Chinese internet firms can achieve market domination of a sort that would attract close attention in other markets.

The third difference is that they can succeed on a rapid and massive scale because the state-dominated economy is so inefficient. Often there is not even a physical infrastructure to leapfrog—so-called third-tier cities, for example, often lack big retail centres. Nationwide there is one shopping mall per 1.2m people.

A huge home market has not stopped the trio from fighting bloody turf wars among each other. The outcome to this battle is rapidly becoming clear. Tencent and Alibaba are surging ahead; a series of own goals has left Baidu far behind. The common jibe about Baidu among local experts is that it is becoming the Yahoo of China, a once-dominant search giant that sank owing to a lack of innovation and a series of management blunders.

Its revenue growth fell to 6.3% in 2016, down from 35% in 2015 and 54% in 2014. The firm gets some nine-tenths of its revenues from online ads, but this income is plunging as marketers redirect spending from search ads on Baidu to social-media networks like WeChat and mobile-commerce platforms run by Alibaba. Meanwhile, Baidu is burning cash trying to keep its various big bets on artificial intelligence (AI), online video, virtual and augmented-reality technologies, and “online to offline” (O2O) services going. One of China’s most respected business consultants is pessimistic about its future: “There is very little chance they’ll be relevant in five years.”

Of the other two giants, Tencent is probably the most fearsome. It already has higher revenues and profits than Alibaba (see chart). Its value is set to climb as it ramps up advertising on WeChat (provided that does not provoke a backlash from users). Its main weapon against Alibaba is its stake in JD.com, the country’s second-biggest e-commerce firm, led by Richard Liu, one of China’s most aggressive and successful serial entrepreneurs.

JD.com has adopted an expensive “asset-heavy” business model akin to Amazon’s in America. Thus far, its vast investments in warehouses,

logistics and couriers have not come anywhere near toppling Alibaba. But last year the company saw its revenues rise to \$37.5bn, up from \$28bn the previous year. Its share of China's business-to-consumer market rose to 25% in 2016, up from 18% at the end of 2014. If Mr Liu's investments in infrastructure start to pay off, much of Alibaba's future domestic growth could be at risk.

That threat may explain why Mr Ma is not content with Alibaba's overall 70% share of the local e-commerce market. In 2016 it spent \$1bn to win control of Lazada, South-East Asia's biggest e-commerce firm. In March Lazada launched a new service for Singaporeans directly to shop on Taobao, one of Alibaba's two domestic e-commerce platforms (the other is Tmall).

Mr Ma last year persuaded the G20 summit of leading countries to endorse his proposal for an "electronic world trade platform" (eWTP), to make it easier for small businesses to trade across borders. In March Alibaba launched a "digital free-trade zone" as part of the initiative, in Malaysia. This public-private partnership, which involves simplifying both logistics and payments, will help small merchants.

Mr Ma's chief weapon for going global, however, is Ant Financial, which was spun out of Alibaba before the latter's \$25bn flotation in 2014 in New York. In China the unit offers services ranging from online banking to investment products; it even runs the mainland's first proper consumer credit-scoring agency, Sesame Credit, which uses big data to work out the creditworthiness of punters. Ant already has more than 450m customers in China and is going overseas with gusto.

It has investments in local online-payments firms in Thailand, the Philippines, Singapore and South Korea. In America Ant is in a frenzied bidding and lobbying war with Euronet, an American rival, to buy MoneyGram International, a money-transfer firm. On April 17th Ant raised

its initial offer for MoneyGram by over a third to \$1.2bn, topping Euronet's bid.

Tencent is also making bold acquisitions abroad. A consortium that it led spent \$8.6bn to acquire Finland's Supercell last year, a deal that turned Tencent into the world's biggest purveyor of online games. Together with Taiwan's Foxconn, a contract-manufacturing giant, the firm invested \$175m last year into Hike Messenger, an Indian messaging app akin to America's WhatsApp. It was also an early investor in America's Snapchat, another popular messaging app, whose parent company Snap went public in March.

One reason for these purchases is that Tencent's earlier efforts to promote WeChat abroad (including a splashy advertising campaign in Europe featuring Lionel Messi, a footballer) flopped. Established social networks such as Facebook and WhatsApp proved too entrenched to dislodge. They also did some copying of their own: once they adopted some of WeChat's innovations, Western consumers had little reason to switch to the Chinese network.

Such investments have been in Tencent's core areas, away from turf occupied by Alibaba and Baidu. Sometimes, the trio end up co-operating, if not by design. All three BAT firms are backers of Didi Chuxing, a ride-hailing firm with global pretensions of its own. But in other ways their domestic war is spilling into foreign markets.

India is one such battleground. In April, together with eBay and Microsoft, Tencent invested \$1.4bn into Flipkart, a leading Indian online retailer. Alibaba and Ant together are reported to have invested nearly \$900m in Paytm, India's top online-payments firm; in February, Paytm launched an e-commerce portal akin to Alibaba's Tmall to take on Flipkart and Amazon in India.

Elsewhere, Tencent unveiled a service in March that will allow firms in Europe to use WeChat to sell on the mainland. This will let them sell directly into China, avoiding red tape. Tencent also recently invested \$1.8bn in America's Tesla, a pioneer in electric and autonomous vehicles. That is a particular challenge to Baidu, which is betting its future on machine learning and AI.

Baidu's push abroad is mainly a way to get access to talent in these fields. The firm has just started its first recruiting campaign at top American universities, including Stanford University and the Massachusetts Institute of Technology. It has a respected AI laboratory in Silicon Valley, despite the recent departure of Andrew Ng, an AI expert. But Baidu does not have the same firepower as Alibaba and Tencent. It tried but has failed to conquer foreign markets such as Japan with its search engine. In April it opened up its self-driving technology to rivals, as Tesla did in 2014, but it has a long way to go before it makes an impact in autonomous driving.

Grandiose BAT statements about global aims should be taken with a pinch of salt. It would be an error to neglect the profitable domestic market. Goldman Sachs, an investment bank, reckons that China's online retail market will more than double in size by 2020, to \$1.7trn. As Duncan Clark, author of a recent book on Alibaba, points out, whatever headlines Mr Ma and other internet bosses make with their overseas ventures, "it takes a lot to get away from the sheer gravity of China." But at home and abroad, one thing is clear: China's internet titans cannot be ignored. ■



中国的互联网巨头

三国鼎立，两帝称雄

中国互联网巨头在国内外燃起战火

就在不久前，硅谷的投资者还根本不把中国的大型互联网公司放在眼里，认为它们不过是些边缘企业，往往都是照搬西方的产品。时过境迁，今天这些中国互联网公司已经长成了猛兽，在国际市场上的野心不断膨胀。

中国最大的电商集团阿里巴巴每年处理的交易量超过eBay和亚马逊的总和，董事局主席马云承诺要在20年内为全球20亿消费者提供服务。专注网络游戏和社交媒体的腾讯公司现在是世界第十大最有价值的上市公司，市值约2750亿美元。董事长马化腾（和马云不是亲戚）希望中国能“领导未来的全球科技革命”。中国互联网三巨头“BAT”中的第三位是百度。谷歌为避免审查制度退出中国后，百度便称霸中国大陆的在线搜索市场。另外两大巨头已成为国际大公司，百度却落在人后。

这三家公司与西方同行在几个重要方面有所不同。首先，西方公司通常会聚焦几个核心领域，而中国互联网公司一般涉猎广泛，从云计算到数字支付无不尝试。这样的尝试一旦成功，结果便会非常可观，腾讯大获成功的应用微信即是如此。

第二，抛开要接受政治审查这一点，中国互联网行业的监管较为宽松；而Facebook、苹果和谷歌则面临日益严格的审视。以中国互联网企业能达到的市场支配地位，换在其他市场，会受到监管机构的密切关注。

第三个区别是，由于国家主导的经济效率低下，中国互联网企业可以快速取得大规模成功。企业发展过程中通常甚至都没有挡路的实体机构，比如在所谓的三线城市，往往都缺少大型零售中心。中国每120万人才有一个大型购物中心。

国内市场如此巨大，却仍未能阻止这三巨头相互厮杀抢夺地盘。这场战斗

的结果正迅速明朗。腾讯和阿里巴巴遥遥领先，百度则因自己一连串的乌龙球而远远落后。国内专家最常用来挖苦百度的一个说法就是它正在变成中国的雅虎。雅虎一度是占据市场主导地位的搜索巨头，却因缺乏创新和一系列管理失误而沉沦。

百度的收入增长率在2016年下降至6.3%，远低于2015年的35%和2014年的54%。公司收入约九成都来自在线广告，但由于商家把花在百度搜索广告的钱转投至微信这样的社交媒体网络以及阿里巴巴运营的移动商务平台，百度的收入大幅下滑。同时，百度还在烧钱维系它的几个大赌注：人工智能（AI）、在线视频、虚拟和增强现实技术，以及“线上到线下”（O2O）服务。中国最受尊敬的商业顾问之一对百度的未来持悲观态度：“五年以后很可能就没百度什么事了。”

至于其他两个巨头，腾讯可能最令人生畏，其收入和利润都已超过阿里巴巴（见图表）。随着腾讯不断增加微信上的广告投放（只要不引起用户的反对），其价值势必节节攀升。腾讯对付阿里巴巴的主要武器是其在京东的股份。京东是中国第二大电子商务公司，领导人刘强东是中国最富进取心也是最成功的连续创业家之一。

京东采取了成本很高的“重资产”商业模式，与美国的亚马逊类似。到目前为止，京东在仓储、物流和快递方面的庞大投资还远不足以掀翻阿里巴巴。但在去年，京东的收入已从前年的280亿美元升至375亿美元。它在中国B2C市场的份额在2014年底为18%，2016年攀升至25%。如果刘强东对基础设施的投资开始收效，阿里巴巴未来国内增长的大头可能面临风险。

上述威胁也许可以解释为何阿里巴巴在国内电子商务市场的份额虽已高达70%，但马云并不满足。2016年，阿里巴巴斥资10亿美元控股东南亚最大的电子商务公司Lazada。3月，Lazada推出了方便新加坡人直接上淘宝购物的新服务（淘宝是阿里巴巴两个国内电子商务平台之一，另一个是天猫）。

去年，为了便于小企业开展跨境贸易，马云说服二十国集团首脑会议接受

了他提出的“电子世界贸易平台”（eWTP）。3月，阿里巴巴在马来西亚推出了eWTP的一个项目“数字自由贸易区”，通过公私合作来简化物流和支付，为小商户助力。

然而，马云迈向世界的主要武器是蚂蚁金服。2014年阿里巴巴在纽约上市，融资250亿美元，蚂蚁金服就是在这之前从集团剥离的。在中国，蚂蚁金服提供从网上银行到投资产品等各种服务。它甚至还管理着中国大陆第一个严格意义上的消费者信用评分机构——芝麻信用，利用大数据来确定客户的信用状况。蚂蚁金服在中国已拥有超过4.5亿客户，且正热情高涨地走向海外市场。

蚂蚁金服投资了泰国、菲律宾、新加坡和韩国的在线支付公司。在美国，为收购汇款服务供应商速汇金（MoneyGram International），蚂蚁正与美国竞争对手Euronet展开一场疯狂的收购和游说战。4月17日，蚂蚁把对速汇金的首次报价提高了超过三分之一，达12亿美元，高出了Euronet的报价。

腾讯也在国外展开大胆收购。去年，腾讯领衔的财团斥资86亿美元收购了芬兰的Supercell，令腾讯成为世界最大的在线游戏公司。去年腾讯还联合台湾代工巨头富士康共同对印度的即时消息应用Hike Messenger（类似美国的WhatsApp）投资1.75亿美元。腾讯也是另一个流行的即时消息应用——美国的Snapchat——的早期投资者，Snapchat的母公司Snap于3月上市。

这一系列投资动作有一个原因：腾讯早些时候在国外推广微信的努力告败（包括花大价钱在欧洲进行的一次广告宣传活动，当时还请了足球运动员梅西代言）。事实证明Facebook和WhatsApp这样成熟的社交网络的地位已牢不可破。而且那些社交网络自己也照搬了微信的一些做法，而它们一旦采用了微信的创新，西方消费者就更没什么理由改用中国的社交网络了。

腾讯的这些投资一直是在其核心领域，远离阿里巴巴和百度的地盘。有时

候，虽然不是有意为之，三巨头倒也成为了合作者。BAT都投资了本身也
有意打入国际市场的网约车公司滴滴出行。但在其他方面，三巨头在国内
的战火正在向国外市场蔓延。

印度便是它们在海外的一个战场。4月，腾讯与eBay和微软合作，向印度
领先的网络零售商Flipkart投资14亿美元。据报道，阿里巴巴和蚂蚁金服
已对印度最大的在线支付公司Paytm投资近9亿美元。2月，Paytm在印度
推出了一个类似阿里巴巴天猫的电商门户，与Flipkart和亚马逊印度抗
衡。

在其他方面，腾讯于3月推出了一项服务，将允许欧洲的公司通过微信在
大陆展开销售。这样这些公司便可直接进入中国，省去了繁琐的审批程
序。腾讯最近还向电动及自动驾驶汽车先行者美国特斯拉投资18亿美元。
这对把自身未来赌在机器学习和AI上的百度来说尤其是个挑战。

百度推进海外市场主要是为了获得这些领域的人才。最近，百度启动了在
斯坦福大学和麻省理工学院等美国顶尖大学的首次招聘活动。百度在硅谷
有一间颇有声望的AI实验室，尽管AI专家吴恩达最近已离职。不过百度并
没有阿里巴巴和腾讯那样雄厚的资金实力。它的搜索引擎曾尝试征服日本
等国外市场，但未能得手。4月，百度向对手开放了自己的无人驾驶技
术，和特斯拉在2014年的做法一样。但要在这一领域产生影响力，百度还
有很长的路要走。

BAT有关全球目标的豪言壮语不能全信。忽视有利可图的国内市场无异于
犯错。投资银行高盛认为，到2020年，中国的在线零售市场规模将至少翻
一番，达到1.7万亿美元。正如邓肯·克拉克（Duncan Clark）最近在他关
于阿里巴巴的书中指出的那样，不管马云和其他互联网大佬在海外拓展过
程中做出了什么引人瞩目的举动，“要脱离中国市场的强大引力可没那么
容易。”但不论是在国内还是国外，有一点很明确：中国的互联网巨头不
容忽视。 ■



Cloud computing and telecoms

Telecomulonimbus

Turning networks into software will trigger a storm in the telecoms world

IN THE computing clouds, startups can set up new servers or acquire data storage with only a credit card and a few clicks of a mouse. Now imagine a world in which they could as quickly weave their own wireless network, perhaps to give users of a fleet of self-driving cars more bandwidth or to connect wireless sensors.

As improbable as it sounds, this is the logical endpoint of a development that is picking up speed in the telecoms world. Networks are becoming as flexible as computing clouds: they are being turned into software and can be dialled up and down as needed. Such “cloudification”, as it is known, will probably create as much upheaval in the telecoms industry as it has done in information technology (IT).

IT and telecoms differ in important respects. One is largely unregulated, the other overseen closely by government. Computing capacity is theoretically unlimited, unlike radio spectrum, which is hard to use efficiently. And telecoms networks are more deeply linked to the physical world. “You cannot turn radio towers into software,” says Bengt Nordstrom of Northstream, a consultancy.

The data centres of big cloud-computing providers are packed with thousands of cheap servers, powered by standard processors. Telecoms networks, by contrast, are a collection of hundreds of different types of computers with specialised chips, each in charge of a different function, from text messaging to controlling antennae. It takes months, if not years, to set up a new service, let alone a new network.

But powerful forces are pushing for change. On the technical side, the current way of building networks will hit a wall as traffic continues to grow rapidly. The next generation of wireless technologies, called 5G, requires more flexible networks. Yet the most important factor behind cloudification is economic, says Stéphane Téral of IHS Markit, a market-research firm. Mobile operators badly need to cut costs, as the smartphone boom ends in many places and prices of mobile-service plans fall. The shift was evident at the Mobile World Congress in Barcelona in February. Equipment-makers' booths were plastered with diagrams depicting new technologies called NFV and SDN, which stand for "network-functions virtualisation" and "software-defined networks". They turn specialised telecoms gear into software in a process called "virtualisation".

Many networks have already been virtualised at their "core", the central high-capacity gear. But this is also starting to happen at the edges of networks—the antennae of a mobile network. These usually plug directly into nearby computers that control the radio signal. But some operators, such as SK Telecom in South Korea, have begun consolidating these "baseband units" in a central data centre. Alex Choi, SK Telecom's chief technology officer, wants "radio" to become the fourth component of cloud computing, after computing, storage and networking.

| *Spin me up, AT&T*

The carrier that has pushed cloudification furthest is AT&T, America's largest operator. By the end of 2017 it wants to have more than half of its network virtualised. In areas where it has already upgraded its systems, it can now add to the network simply by downloading a piece of software. "Instead of sending a technician, we can just spin up a virtual machine," says Andre Fuetsch, AT&T's chief technology officer.

Even more surprising for a firm with a reputation for caution, AT&T has released the program that manages the newly virtualised parts of its

network as open-source software: the underlying recipe is now available free. If widely adopted, it will allow network operators to use cheaper off-the-shelf gear—much as the rise of Linux, an open-source operating system, led to the commoditisation of hardware in data centres a decade ago.

If equipment-makers are worried about all this, they are not letting it show. Many parts of a network will not get virtualised, argues Marcus Weldon, chief technology officer of Nokia. And there will always be a need for specialised hardware, such as processors able to handle data packets at ever faster speeds. Still, Nokia and other telecoms-gear-makers will have to adapt. They will make less money from hardware and related maintenance services, which currently form a big chunk of their revenues. At the same time, they will have to beef up their software business.

Cloudification may also create an opening for newcomers. Both Affirmed Networks and Mavenir, two American firms, for instance, are developing software to run networks on off-the-shelf servers. Affirmed already claims 50 customers. Mavenir wants to work with underdog operators “to bring the incumbents down”, says Pardeep Kohli, its chief executive. If the history of cloud computing is any guide, the telecoms world may also see the rise of new players in the mould of Amazon Web Services (AWS), the e-commerce giant’s fast-growing cloud-computing arm.

According to John Delaney of IDC, a research firm, the big barrier to cloudification is likely to be spectrum, which newcomers will still have to buy. But a clever entrepreneur may find ways to combine assets—unlicensed spectrum, fibre networks, computing power—to provide cheap mobile connectivity. Startups such as FreedomPop and Republic Wireless already offer “Wi-Fi first” mobile services, which send calls and data via Wi-Fi hotspots, using the mobile network as backup.

As the case of AWS shows, a potential Amazon Telecoms Services does not have to spring from the telecoms world. Amazon itself is a candidate. But carmakers, operators of power grids and internet giants such as Facebook could have a go: they are huge consumers of connectivity and have built networks. Facebook, for instance, is behind the Telecom Infra Project, another effort to open the network infrastructure. However things shake out, expect the telecoms world to become much more fluid in the coming years, just like IT before it. ■



云计算与电信

电信积雨云

网络转变为软件，电信界将卷起风暴

在计算云中，创业公司只需要一张信用卡，点几下鼠标，就可以设置新的服务器，或取得数据存储空间。想象一下，如果这些公司可以同样迅速地打造自己的无线网络，比如给自动驾驶汽车用户更多带宽，或连接无线传感器，那会是什么样子。

尽管听起来不可思议，但电信界正朝着这样的逻辑终点加速发展。网络正在变成软件，可以按需接入或断开，从而变得像计算云那样灵活。这种所谓的“云化”可能会给电信行业带来剧变，恰如它为IT业带来的转变。

IT和电信在几个重要方面有所不同。前者在很大程度上不受管制，后者则受到政府密切监督。计算能力在理论上是无限的，无线电频谱则不同，它难以被高效利用。而且电信网络与物理世界的关联更为紧密。咨询公司Northstream的本特·努德斯特伦（Bengt Nordstrom）说：“无线电塔可没法变成软件。”

大型云计算提供商的数据中心拥有数以千计的廉价服务器，配备标准处理器。而电信网络则包含了配备专用芯片的数百种不同的计算机，每种计算机负责从发送短信到控制天线等不同的功能。建立新服务需要几个月甚至几年的时间，更别提搭建新网络了。

但强大的力量正在推动变革。在技术方面，随着流量持续快速增长，目前的网络建设方式将会碰到天花板，而被称为5G的下一代无线技术需要更灵活的网络。不过市场研究公司IHS Markit的斯特凡·泰拉尔（Stéphane Téral）说，云化最重要的因素还是在经济方面。在许多地方，智能手机热已经结束、移动服务套餐价格下降，移动运营商亟需降低成本。在2月于巴塞罗那举行的世界移动通信大会（Mobile World Congress）上，这一转变非常明显。设备制造商的摊位贴满了描绘新技术NFV（网络功能虚拟

化)和SDN(软件定义网络)的图表,这些技术将专用电信设备通过“虚拟化”转化为软件。

许多网络的“核心”(中央大容量设备)已经虚拟化,但网络的边缘,即移动网络的天线,也已开始虚拟化。这些天线通常直接接入到附近控制无线电信号的计算机。不过有些运营商,比如韩国的SK电讯,已经开始将这些“基带单元”整合到中央数据中心里。SK电讯的首席技术官崔溱成(Alex Choi)希望“无线电”会继计算、存储和联网之后成为云计算的第四个组成部分。

| 启动我吧, AT&T

美国最大的电信运营商AT&T在推动云化方面走得最远,它希望到2017年底能将过半的网络实现虚拟化。在AT&T已经升级了系统的地区,现在只需下载一个软件就可以添加到虚拟网络中。AT&T的首席技术官安德烈·菲尤特施(Andre Fuetsch)表示:“不用派技术人员去,只需启动一部虚拟机就可以了。”

作为一个以谨慎著称的公司,AT&T还有一项举动更出人意料,那就是它开源了自己用于管理网络中新近虚拟化部分的程序,这一基础软件现在可以自由获取。如果得到广泛采用,该程序便可让网络运营商使用便宜些的现成设备。十年前开源操作系统Linux的兴起推动了数据中心硬件的大规模商品化,AT&T此举较之相去不远。

如果说设备制造商对所有这一切心存担忧,它们并没有把这种焦虑表现出来。诺基亚的首席技术官马库斯·威尔顿(Marcus Weldon)认为,网络有许多部分并不会被虚拟化,而且总会需要用到专用的硬件,例如能越来越快地处理数据包的处理器。然而,诺基亚和其他电信设备制造商仍须做出调整以适应变化。硬件和相关维护服务目前占据它们收入的一大部分,以后这方面的收入将会减少。与此同时,它们还必须加强自身的软件业务。

云化也可能会为新进者创造机会。例如,两家美国公司Affirmed Networks

和Mavenir正在开发软件，用以在现成的服务器上运行网络。Affirmed Networks称它已有50个客户。Mavenir的首席执行官帕尔迪普·克里（Pardeep Kohli）表示，Mavenir希望与处于劣势的运营商合作，“将现有巨头拉下马”。电子商务巨擘亚马逊的云计算部门AWS发展迅速，如果云计算的发展历史可以借鉴的话，电信界也会出现和AWS一个模子里发展出来的新玩家。

研究公司IDC的约翰·德拉尼（David Delaney）说，云化的一大障碍可能是频谱，新进者仍然需要购买这些资源。但一个聪明的企业家可能会找到方法组合资产（非授权频谱、光纤网络、计算能力）以提供便宜的移动连接。FreedomPop和Republic Wireless等创业公司已经推出了“Wi-Fi第一”（Wi-Fi First）移动服务，通过Wi-Fi热点打电话和发送数据，而将移动网络作为后备。

AWS的例子显示，如果亚马逊式电信服务有可能出现的话，它不一定要出身于电信行业。亚马逊本身就是一个候选。不过汽车制造商、电网运营商和Facebook这样的互联网巨头也都可一试：它们大量使用移动连接，并建立了网络。例如，Facebook启动了电信基础架构项目（Telecom Infra Project），这是开放网络基础架构的另一尝试。不管情况最终如何发展，可以预期电信界在未来几年的变数将会大增，就像之前的IT业那样。■



Free exchange

Remember the mane

As robots encroach on human work, study the fate of the horse

IN THE early 20th century the future seemed bright for horse employment. Within 50 years cars and tractors made short work of equine livelihoods. Some futurists see a cautionary tale for humanity in the fate of the horse: it was economically indispensable until it wasn't. The common retort to such concerns is that humans are far more cognitively adaptable than beasts of burden. Yet as robots grow more nimble, humans look increasingly vulnerable. A new working paper concludes that, between 1990 and 2007, each industrial robot added per thousand workers reduced employment in America by nearly six workers. Humanity may not be sent out to pasture, but the parallel with horses is still uncomfortably close.

Robots are just one small part of the technological wave squeezing people. The International Federation of Robotics defines industrial robots as machines that are automatically controlled and re-programmable; single-purpose equipment does not count. The worldwide population of such creatures is below 2m; America has slightly fewer than two robots per 1,000 workers (Europe has a bit more than two). But their numbers are growing, as is the range of tasks they can tackle, so findings of robot-driven job loss are worth taking seriously.

The paper's authors, Daron Acemoglu of the Massachusetts Institute of Technology (MIT) and Pascual Restrepo of Boston University, are careful to exclude confounding causes as best they can. Their results are not driven by a few robot-intensive regions or industries, and are distinct from the effect of trade with China, or offshoring in general. Increased robot density does not seem to raise employment among any group of workers, even those with university education. Since relatively few industrial robots are

in use in the American economy, the total job loss from robotisation has been modest: between 360,000 and 670,000. By comparison, analysis published in 2016 found that trade with China between 1999 and 2011 may have left America with 2m fewer jobs than it would otherwise have had. Yet, if the China trade shock has largely run its course, the robot era is dawning.

Economically speaking, this should not be a problem. Automation should yield savings to firms or consumers which can be spent on other goods or services. Labour liberated by technology should gravitate toward tasks and jobs in which humans retain an advantage. Yet that should also have been true of horses. The use of tractors in agriculture rose sharply from the 1910s to the 1950s, and horses were displaced in vast numbers. But some useful horse-work remained (as indeed it does today). The difficulty facing horses was in reallocating the huge numbers displaced by technology to places where they could still be of use.

The market worked to ease the transition. As demand for traditional horse-work fell, so did horse prices, by about 80% between 1910 and 1950. This drop slowed the pace of mechanisation in agriculture, but only by a little. Even at lower costs, too few new niches appeared to absorb the workless ungulates. Lower prices eventually made it uneconomical for many owners to keep them. Horses, so to speak, left the labour force, in some cases through sale to meat or glue factories. As the numbers of working horses and mules in America fell from about 21m in 1918 to only 3m or so in 1960, the decline was mirrored in the overall horse population.

The analogy with horses can clearly be taken too far. Yet the experience is instructive. Automation is reducing human wages; Messrs Acemoglu and Restrepo reckon that one additional industrial robot per thousand workers reduces wages across the economy by 0.5%. Real wage growth in many rich economies has been disappointing for much of the past two decades. Low wages are enabling some reallocation of workers. An overwhelming share

of the growth in employment in rich economies over the past few decades has been in services, nearly half in low-paying fields like retailing and hospitality. Employment in such areas has been able to grow, in part, because of an abundance of cheap labour.

Yet low pay leads to policies that complicate the labour-market adjustment. Instead of bumping off excess labour, rich economies provide some social support: unemployment benefits, social security or disability payments, and assistance with housing and food. When the jobs on offer are poor, that cushion, though meagre, can be enough to draw people out of the labour force into indolence—particularly if families offer extra help.

| *The horses of instruction*

Horses might have fared better had savings from mechanisation stayed in rural areas. Instead, soaring agricultural productivity led to falling food prices, lining the pockets of urban workers with more appetite for a new suit (or car) than anything four-legged. Similarly, the financial returns to automation flow to profitable firms and their shareholders, who not only usually live apart from the factories being automated but who save at high rates, contributing to weak demand across the economy as a whole. Indeed, roughly half of job losses from robotisation (as from exposure to Chinese imports) are attributable to the knock-on effect from reduced demand rather than direct displacement.

Today's horses are not entirely without work. Some still find gainful employment; a few are very valuable indeed. For people to fare better, and retain more than a rump of work reserved for those of exceptional ability, they must prove a better match for clever machines than horses were for mechanical equipment. And societies should perhaps respond with more determination and care than horse-owners did a century ago.

Correction: The chart in last week's column cited the wrong paper by Anne

Case and Angus Deaton as the source. It should have been “Mortality and morbidity in the 21st century”, published this year. Sorry. ■



自由交流

以马为鉴

在被机器人蚕食岗位之时，人类或可以马的命运为鉴

20世纪初时，马看起来一直都会很重要，然而不到50年，汽车和拖拉机就迅速斩断了它们的生计。一些未来学家从马的命运中看到了对人类的警示寓言：它在经济上不可或缺，直到它可被替代。对这类担忧最常见的反驳是人类在认知上的适应性要比役畜强得多。但随着机器人变得越来越灵敏，人类遭受的威胁似乎日益增大。一份新的工作论文总结道，从1990年到2007年，在每千名美国工人中，每配备一台工业机器人就会令将近六名工人失业。人类也许不会被放归草原，但他们的命运跟马匹颇为相似，想来令人不安。

在排挤人类的技术大潮中，机器人只是其中一小波。国际机器人联合会（the International Federation of Robotics）将工业机器人定义为自动化控制的并且可重复编程的机器，而不把单一用途设备计算在内。这类机器人在全球的数量不到两百万台。美国每千名工人平均只有略少于2台机器人（在欧洲略多于两台），但它们的数量在不断增多，能处理的任务也越来越多样化，因此机器人引发失业的相关调查结果值得认真对待。

这篇论文的作者、麻省理工学院的达伦·阿西莫格鲁（Daron Acemoglu）和波士顿大学的帕斯卡尔·雷斯特雷珀（Pascual Restrepo）竭尽所能排除混杂因素。他们的研究结果并不是根据少数几个机器人密集的区域或行业得出的，并且有别于对华贸易或是整体离岸外包所产生的影响。机器人密度增加看来并没有在任何劳动者群体中提升就业，即便是受过大学教育的群体。因为美国经济中使用的工业机器人相对来说非常少，所以因使用机器人而减少的岗位也比较少，总数在36万至67万之间。相比之下，2016年公布的分析指出，1999年到2011年与中国的贸易可能让美国减少了200万个工作岗位。但是，如果说中国贸易的冲击已经接近尾声，那么机器人时代才刚刚开始。

从经济上说，这不该是个问题。自动化应该会为公司或消费者带来节余，可用于购买其他商品或服务。由科技解放的劳动力应当流向人类尚有优势的任务和工作。但对于马来说曾经也是这样的。从20世纪的头十年到50年代，拖拉机在农业上的使用大幅增加，取代了大量马匹。但一些使用马的工作仍有用处，得以保留下来（今天也是一样）。马所面临的困难是把科技所取代的庞大数量的马重新安置到还能用得上它们的地方。

市场发挥作用，缓和了这一转变。随着对传统的马匹劳作的的需求下降，马的价格也在1910年到1950年间下跌了约80%。这减缓了农业机械化的步伐，不过作用很小。即便成本降低了，适合用马的新工作机会仍然太少，无法消化失业的马。价格下跌最终让很多马主觉得养马很不划算。就这样，马可以说是离开了劳动力大军，有些还被卖给肉品厂或制胶工厂。美国役用马和骡的数量从1918年的约2100万减少到1960年的仅300万上下，而马的总数也有类似的下降。

拿马来做类比显然可能会扯得太远，但这一经验仍具有启发性。自动化正在导致人类的工资下降。阿西莫格鲁和雷斯特雷珀认为，每千名工人配备的工业机器人每增加一台，整个经济的工资便下降0.5%。在过去20年的大部分时间里，很多发达经济体实际工资的增长都令人失望。低工资使得一些工人能被重新安置。在过去几十年发达经济体的就业增长中，服务业占有压倒性比例，其中近一半是低工资行业，如零售和餐旅业。这些领域的就业之所以能够增长，充足的廉价劳动力是原因之一。

但是由低工资催生的政策会让劳动力市场的调节变得更加复杂。发达经济体并没有消除过剩的劳动力，而是提供了一些社会支持：失业救济、社保或是残疾人补贴，还有住房和食物援助。当市场上提供的工作报酬很低时，这些缓冲手段即便微薄，也足以让人脱离劳动力队伍，陷入好逸恶劳的状态，尤其是当家人也提供帮助的时候。

| 受训之马

如果机械化带来的节余留在了农村，那么马的境况可能会好一些。然而，飙升的农业生产力导致食品价格下降，口袋鼓起来的城市工人对新衣服

（或新车）比对任何四条腿的东西都更感兴趣。同样，自动化的收益流向了盈利的公司以及它们的股东。这些人的住所通常都远离自动化工厂，而且他们还会以高利率存钱，导致整个经济的需求疲软。其实，在机器人的使用所导致的岗位减少中（因中国进口商品减少的岗位也一样），约有一半是需求减少的连锁反应，而不是直接被替代的结果。

今天的马也不是完全无事可做。有些仍然找到了可以赚钱的活计，少数马还非常贵重。人若想有更好的境遇，而不只是在少数精英分子的后头拣剩，他们必须证明，与马在机械设备面前的命运相比，他们能更好地匹配聪明的机器。而社会的应对方式可能也应该比一百年前的马主们更为坚定和谨慎。





Depopulation in Germany

Fading echoes

Germany is running out of people, starting in the east

WERE it not for the graffiti on abandoned buildings, Bitterfeld-Wolfen, two towns north of Leipzig joined as one in 2007, would seem devoid of young people. Pharmacies, physiotherapy surgeries and shops selling garden gnomes line the sleepy streets. In its heyday the place had a booming chemical industry. Today “the air is much cleaner and we can finally hang out laundry,” says an elderly local out on a morning stroll. “But many jobs were lost and so few children are left.” He points out a building that was once a school; today it is one of many care homes.

Despite an influx of 1.2m refugees over the past two years, Germany’s population faces near-irreversible decline. According to predictions from the UN in 2015, two in five Germans will be over 60 by 2050 and Europe’s oldest country will have shrunk to 75m from 82m. Since the 1970s, more Germans have been dying than are born. Fewer births and longer lives are a problem for most rich countries. But the consequences are more acute for Germany, where birth rates are lower than in Britain and France.

If Germany is a warning for others, its eastern part is a warning for its west. If it were still a country, East Germany would be the oldest in the world. Nearly 30 years after unification the region still suffers the aftershock from the fall of the Berlin Wall in 1989, when millions—mostly young, mostly women—fled for the west. Those who remained had record-low birth rates. “Kids not born in the ’90s, also didn’t have kids in the 2010s. It’s the echo of the echo,” says Frank Swiaczny from the Federal Institute for Population Research, a think-tank in Wiesbaden. The east’s population will shrink from 12.5m in 2016 to 8.7m by 2060, according to government statistics. Saxony-Anhalt, the state to which Bitterfeld-Wolfen belongs, is ahead of the

curve.

Berlin used to pay little attention to the area. But regional decline has already had a political effect. In a state election in March 2016, a populist party, the AfD, came first in Bitterfeld and second in Wolfen. Such places will matter in a federal election in September, which is expected to be tight. Bitterfeld-Wolfen has seen its population plummet from 75,000 in 1989 to 40,500 today. Even after administrators tore down blocks of flats, and cut floors off others, skeletal remains of buildings still await the wrecking ball. Nearly one building in five is empty. A grand Stalinist-era construction, once the town's cultural palace, now stands deserted. Two-thirds of kindergartens and over half the schools have closed since 1990. The number of pupils finishing secondary school has fallen by half. Employers struggle to fill vacancies.

Apprentices—especially in service industries—are hard to find. The one booming industry, care, is desperate for more geriatricians, nurses and trainees. To help fill the gap, the local *Euro-Schulen*, a training institute, has turned to Vietnam. Having studied German in Hanoi, 16 young apprentices started in April, with 20 more expected soon. Nearby Dessau is setting up a similar arrangement with China.

Germany has long relied on migrants to make up for low fertility rates. Unusually high migration in recent years has more than offset the shrinkage of the native-born population. But the EU countries that have traditionally provided the migrants, such as Poland, are also ageing. Migrant flows will slow; competition for labour will increase. And Olga Pöttsch, from the Federal Statistical Office, argues that Germany will need far more migrants to stop population decline, which is predicted to accelerate from 2020.

Uwe Schulze, a senior local official, says that refugees are not filling the

labour shortage. Of the 2,600-odd asylum-seekers who arrived in the area in 2015 and 2016, fewer than a third are now registered as “capable of working” and only 40 are fully employed. From his wood-panelled office in a neoclassical building that once housed one of Europe’s largest colour-film makers, Armin Schenk, Bitterfeld-Wolfen’s mayor, says the problems are mostly to do with language, qualifications and uncertainty about asylum. Asked whether Afghans and Syrians could join the same programme as the Vietnamese, Liane Michaelis, from *Euro-Schulen*, forcefully shakes her head, citing educational, religious and ethical barriers for care jobs. She adds that “those who do have the right papers leave quickly”. According to the OECD, about half of asylum-seekers who started off in eastern Germany in the past moved to places such as Hamburg once they secured their permit.

With the odds seemingly stacked against it, Bitterfeld-Wolfen is at least trying. On a whirlwind tour of the town, Mr Schenk shows how the old coal mine was turned into a lake with a new marina and a promenade. He repeats the town’s mantra: “It’s all about offering good-quality life and leisure.” A brochure shows pictures of smiling children, yachts and tennis. Bitterfeld-Wolfen, it reads, is “one of the youngest cities in Germany”. But even if such marketing did stem departures (and in 2015, for the first time, inward migration slightly exceeded the outflow) the town is still shrinking; more than twice as many die each year as are born.

Across many parts of rural Europe mayors struggle with similar problems, wondering when to turn their school into a care home. By 2050 Greece, Italy, Poland, Portugal and Spain—which, unlike Germany, have all suffered net brain-drains—will be older than Germany by median age and will have shrunk substantially, according to the UN. Ageing and emigration are likely further to dampen growth in central and southern European countries, says the IMF. It calculates that by 2030 GDP per person in several countries may be 3-4% lower than it would have been without emigration.

| *Where Bitterfeld-Wolfen goes...*

In Germany, however, the consequences are particularly acute. With a strong economy and a tight labour market, some employers already struggle to fill vacancies. BCG, a consultancy, predicts that by 2030 the country will be short of between 5m and 7m workers. The triple shock of a smaller workforce, increased social spending and the likely dampening effect of an older workforce on innovation and productivity will drag down future growth, predicts Oliver Holtemöller of the Leipzig Institute for Economic Research. These effects are stronger in the east, he adds. Productivity is 20% lower than in the west; the ageing population and continuing migration to the west will make economic convergence even less likely. ■



德国人口衰减

回声渐弱

德国面临人口枯竭，东德首当其冲

莱比锡以北有座城市叫比特费尔德-沃尔芬（Bitterfeld-Wolfen），由两个小城于2007年合并而成。要不是在一些废弃的建筑上画着涂鸦，简直看不出那里还有年轻人。沿着毫无生气的街道，药店、理疗馆和卖花园精灵雕塑的商店一字排开。在鼎盛时期，这里曾有着蓬勃发展的化工产业。而如今，一个早上出门溜达的当地老人说，“空气干净多了，总算能在外面晾衣服了。”他指了指一座建筑，那里曾是所学校，现在成了当地众多养老院之一。“不过很多工作机会都没了，也没有几个孩子留下来。”

尽管过去两年中涌入了120万难民，德国人口仍面临着几乎不可逆转的萎缩。联合国曾在2015年预言，到2050年，每五个德国人就有两个超过60岁。这个欧洲老龄化最严重国家的人口将从8200万缩减至7500万。自上世纪70年代以来，德国的死亡人数就多过出生的人数。大多数富裕国家都存在着生育率降低而人口寿命变长的问题，但其后果在德国表现得要更为严峻。德国的出生率比英国和法国都要低。

如果说德国对其他国家有所警示，那么德国东部则向其西部敲响了警钟。如果东德今天仍是个国家，它将是世界老龄化最严重的国家。1989年柏林墙倒塌后，数百万人逃往西德，多数是年轻人和女人。那些留下来的人的出生率达到历史最低点。统一近30年后，该地区仍未从柏林墙倒塌的余波中恢复过来。弗兰克·斯威亚兹尼（Frank Swiaczny）供职于威斯巴登（Wiesbaden）一家名为联邦人口研究所（Federal Institute for Population Research）的智库。他说，“上世纪90年代出生锐减的一代人，到2010年代同样少生孩子。这是个恶性循环。”根据政府的统计数字，到2060年，东德的人口将从2016年的1250万缩减到870万。比特费尔德-沃尔芬所在的萨克森-安哈尔特州（Saxony-Anhalt）目前引领这条下降曲线。

柏林过去并不重视该地区。然而区域性的衰落已经产生了政治影响。2016

年3月举行的一次州选举中，民粹主义政党另类选择党（AfD）在比特费尔德得票第一，在沃尔芬位居第二。预计9月份的联邦大选会很胶着，届时这些地方就很关键。从1989年到今天，比特费尔德-沃尔芬的人口已从7.5万骤降至4.05万。即使管理部门已拆除了一些公寓楼及其他建筑，仍有断壁残垣在等待落锤。将近五分之一的建筑都是空的。一栋斯大林时代的宏伟建筑曾是这个小城的文化中心，如今也已废弃。1990年以来，三分之二的幼儿园以及一半以上的学校都已关闭。完成中等学业的学生人数下降了一半。雇主苦苦寻觅能填补岗位空缺的人。

学徒工很难招到，尤其是在服务业。新兴的护理行业迫切需要更多的老年病学家、护士和见习生。为了帮助填补这一缺口，当地一个培训机构“欧洲学校”（Euro-Schulen）将目光投向了越南。4月有16名已在河内学习过德语的年轻学徒上岗，很快还会再有20名。附近的城市德绍（Dessau）也正同中国订立类似的合作协议。

德国一直都靠移民来弥补生育率低下。像近年这样大批涌入的移民在抵消本土出生人口缩水之后通常还会有富余，但过去一直提供移民的欧盟国家本身也在老龄化，例如波兰。移民的流动将放缓，争夺劳动力的竞争将会加剧。德国联邦统计局的奥尔加·波茨什（Olga Pötzsch）表示，德国人口预计会在2020年后加速减少，要遏制人口下跌，所需的移民数量要远超现在的数字。

当地一位高级官员乌维·舒尔策（Uwe Schulze）说，难民并不足以弥补劳动力的短缺。2015年至2016年间来到该地区寻求庇护的2600多人中，如今只有不到三分之一的人登记为“有工作能力”，只有40个人找到了全职工作。比特费尔德-沃尔芬市长阿尔明·申克（Armin Schenk）在他那间木板墙面的办公室（这幢新古典主义风格的建筑曾是欧洲数一数二的彩色胶片生产商的办公室）里表示，问题主要有语言障碍、工作资质欠缺以及不确定难民们是否能获得庇护。当被问及阿富汗和叙利亚人是否也可以加入像越南人那种项目，欧洲学校的利亚妮·米歇埃丽丝（Liane Michaelis）用力地摇了摇头。她指出，教育、宗教以及道德伦理方面的隔阂令他们难以从事护理工作。此外，“那些确实有许可的人又都会很快离开。”经合组

织（OECD）表示，之前，先在德国东部落脚的避难者一旦拿到了居留许可，便会搬到汉堡等地。

虽然看起来赢面不大，但比特费尔德-沃尔芬起码仍在想办法。申克带领来访者快速在城内转了一圈，并展示了一个从废弃的煤矿改造而来的湖泊，湖边还新建了一个小码头和一条漫步大道。他反复搬出这座城市的口号：“只为提供优质的生活和休闲。”一本小册子上印着孩子们的笑脸，还有游艇和网球。上面还写着比特费尔德-沃尔芬是“德国最年轻的城市之一”。但即便这样的营销确实阻止了人口外流（2015年流入人口的数量首次略微超过流出人口），该地的人口仍在萎缩，因为每年死亡的人口超过新出生人口的两倍。

在欧洲很多乡村，市长们在为类似的问题苦恼，琢磨着什么时候把本地的学校改成护理院。据联合国预测，以年龄中位数计，到2050年希腊、意大利、波兰、葡萄牙和西班牙的老龄化程度将超过德国，人口也将大幅缩减（而且这些国家与德国不同，均遭受人才的净外流）。国际货币基金组织指出，老龄化和人口外流很可能会进一步抑制欧洲中部和南部国家的经济增长。据其估算，到2030年某些国家的人均GDP要比假设没有人口外流的情形低3%到4%。

| 比特费尔德-沃尔芬何去何从

不过，这些问题的后果在德国尤为严重。由于经济强盛，劳动力市场供不应求，一些雇主已经很难找到人来填补岗位空缺。波士顿咨询公司（BCG）预测，到2030年，德国的劳动力市场将出现500到700万人的缺口。莱比锡经济研究院的奥利弗·霍尔特莫勒（Oliver Holtemöller）预言，劳动力规模减小、社会支出增加，以及劳动力老龄化抑制创新和生产率这三重冲击未来会拖累经济的增长。他还指出，这些影响在东德要更为深重。东德的生产率比西德低20%；人口日益老化以及持续向西部迁移会让东西部经济平衡更加难以实现。■



End-of-life care

How to have a better death

Death is inevitable. A bad death is not

IN 1662 a London haberdasher with an eye for numbers published the first quantitative account of death. John Graunt tallied causes such as “the King’s Evil”, a tubercular disease believed to be cured by the monarch’s touch. Others seem uncanny, even poetic. In 1632, 15 Londoners “made away themselves”, 11 died of “grief” and a pair fell to “lethargy”.

Graunt’s book is a glimpse of the suddenness and terror of death before modern medicine. It came early, too: until the 20th century the average human lived about as long as a chimpanzee. Today science and economic growth mean that no land mammal lives longer. Yet an unintended consequence has been to turn dying into a medical experience.

How, when and where death happens has changed over the past century. As late as 1990 half of deaths worldwide were caused by chronic diseases; in 2015 the share was two-thirds. Most deaths in rich countries follow years of uneven deterioration. Roughly two-thirds happen in a hospital or nursing home. They often come after a crescendo of desperate treatment. Nearly a third of Americans who die after 65 will have spent time in an intensive-care unit in their final three months of life. Almost a fifth undergo surgery in their last month.

Such zealous intervention can be agonising for all concerned. Cancer patients who die in hospital typically experience more pain, stress and depression than similar patients who die in a hospice or at home. Their families are more likely to argue with doctors and each other, to suffer from post-traumatic stress disorder and to feel prolonged grief.

| *What matters*

Most important, these medicalised deaths do not seem to be what people want. Polls, including one carried out in four large countries by the Kaiser Family Foundation, an American think-tank, and *The Economist*, find that most people in good health hope that, when the time comes, they will die at home. And few, when asked about their hopes for their final days, say that their priority is to live as long as possible. Rather, they want to die free from pain, at peace, and surrounded by loved ones for whom they are not a burden.

Some deaths are unavoidably miserable. Not everyone will be in a condition to toast death's imminence with champagne, as Anton Chekhov did. What people say they will want while they are well may change as the end nears (one reason why doctors are sceptical about the instructions set out in "living wills"). Dying at home is less appealing if all the medical kit is at the hospital. A treatment that is unbearable in the imagination can seem like the lesser of two evils when the alternative is death. Some patients will want to fight until all hope is lost.

But too often patients receive drastic treatment in spite of their dying wishes—by default, when doctors do "everything possible", as they have been trained to, without talking through people's preferences or ensuring that the prognosis is clearly understood. Just a third of American patients with terminal cancer are asked about their goals at the end of life, for example whether they wish to attend a special event, such as a grandchild's wedding, even if that means leaving hospital and risking an earlier death. In many other countries, the share is even lower. Most oncologists, who see a lot of dying patients, say that they have never been taught how to talk to them.

This newspaper has called for the legalisation of doctor-assisted dying, so that mentally fit, terminally ill patients can be helped to end their lives if

that is their wish. But the right to die is just one part of better care at the end of life. The evidence suggests that most people want this option, but that few would, in the end, choose to exercise it. To give people the death they say they want, medicine should take some simple steps.

More palliative care is needed. This neglected branch of medicine deals with the relief of pain and other symptoms, such as breathlessness, as well as counselling for the terminally ill. Until recently it was often dismissed as barely medicine at all: mere tea and sympathy when all hope has gone. Even in Britain, where the hospice movement began, access to palliative care is patchy. Recent studies have shown how wrongheaded that is. Providing it earlier in the course of advanced cancer alongside the usual treatments turns out not only to reduce suffering, but to prolong life, too.

Most doctors enter medicine to help people delay death, not to talk about its inevitability. But talk they must. A good start would be the wider use of the “Serious Illness Conversation Guide” drawn up by Atul Gawande, a surgeon and author. It is a short questionnaire designed to find out what terminally ill patients know about their condition and to understand what their goals are as the end nears. Early research suggests it encourages more, earlier conversations and reduces suffering.

These changes should be part of a broad shift in the way health-care systems deal with serious illness. Much care for the chronically ill needs to move out of hospitals altogether. That would mean some health-care funding being diverted to social support. The financial incentives for doctors and hospitals need to change, too. They are typically paid by insurers and governments to do things to patients, not to try to prevent disease or to make patients comfortable. Medicare, America’s public health scheme for the over-65s, has recently started paying doctors for in-depth conversations with terminally ill patients; other national health-care systems, and insurers, should follow. Cost is not an obstacle, since

informed, engaged patients will be less likely to want pointless procedures. Fewer doctors may be sued, as poor communication is a common theme in malpractice claims.

| *One last thing before I go*

Most people feel dread when they contemplate their mortality. As death has been hidden away in hospitals and nursing homes, it has become less familiar and harder to talk about. Politicians are scared to bring up end-of-life care in case they are accused of setting up “death panels”. But honest and open conversations with the dying should be as much a part of modern medicine as prescribing drugs or fixing broken bones. A better death means a better life, right until the end. ■



临终关怀

怎样才能拥有更好的死亡

死亡无可避免，但糟糕的死亡却可以避免

1662年，伦敦一位擅长数字的男装店店主发表了第一份死亡量化记录。约翰·格朗特（John Graunt）记录了种种死因，比如一种被称为“国王的恶虐”的结核病，人们相信这种疾病经过君主触碰便可治愈。其他的死因看起来很离奇，甚至颇有诗意。1632年，15位伦敦人“自寻短见”，11人死于“忧伤”，两人死于“昏睡”。

通过格朗特的著作，我们可以瞥见现代医学诞生之前死亡的突然与恐怖。而且死神到得也很早：20世纪前，人类的平均寿命和黑猩猩差不多。如今科技和经济的发展让人类的寿命长过任何陆生哺乳动物。然而意想不到的后果是，死亡变成了医疗体验。

在过去一个世纪里，去世的原因过程、时间和地点都发生了变化。就在1990年，全球还有一半的死亡是由慢性病导致，到了2015年，这一比例已经上升到三分之二。发达国家的死者大多都经历了多年忽快忽慢的衰竭过程。大约三分之二的人是在医院或养老院离世，而且通常在离世前接受了不惜一切的治疗，一次强过一次。65岁以后去世的美国人中，近三分之一在生命中的最后三个月里曾住进特护病房，近五分之一在最后一个里做过手术。

如此积极的干预可能让所有相关之人都痛苦不堪。相比在临终关怀医院或家中过世的同类病人，死于医院的癌症患者往往会经历更多的痛苦、紧张和沮丧。他们的家人则更可能与医生发生争执或彼此争吵、患上创伤后压力综合症以及感受挥之不去的哀恸。

| 要紧之事

最重要的是，这些医疗化的死亡似乎并非人们所愿。包括由美国智库凯撒家庭基金会（Kaiser Family Foundation）和本刊共同在四个大国进行的一

次民调在内，各类民意调查均发现，大多数健康人都希望能在大限来临之际于家中过世。少有人在被问及自己对人生最后一段时日的希望时会说首要之事是尽可能多活一会儿。他们宁可在亲友的陪伴下无痛苦地安详离世，不给身边的人造成负担。

有些死亡无可避免地要遭受痛苦。不是人人都能像契诃夫那样端着香槟为死亡的临近干杯。当最后一刻来临之时，人们可能会改变他们在身体尚健康时所做的打算，这也是为什么医生会置疑“生前遗嘱”中的安排的一个原因。如果所有的医疗设备都在医院，在家中去世是不那么有吸引力的。当在死亡和治疗两者间抉择时，想象中难以忍受的治疗似乎还不那么可怕。一些患者愿意坚持到希望完全破灭。

但是大多数时候，由于职业训练使然，医生往往不充分与病人讨论他们的倾向或确保他们清楚理解预后情况，而是不顾其临终意愿，“尽一切可能”对患者施以高强度的治疗。在美国，只有三分之一的晚期癌症患者会在生命的最后时刻被问及有什么愿望，例如是否想参加孙辈的婚礼等特殊活动，即便这需要离开医院，有可能导致提早离世。在很多其他国家，这一比例甚至更低。面对众多濒危患者的肿瘤科医师大多表示，从未学习过如何与这些病人谈话。

本刊曾呼吁让“医生协助死亡”合法化，让神智清楚的晚期患者可以在医生的帮助下结束生命——如果这是他们自己的意愿的话。但是，死亡的权利只是更好的临终关怀的一部分。证据表明，大多数人想要保留这一选择权，但很少有人会最终行使这一权利。要给予人们他们声言想要的死亡，医学应该采取一些简单的步骤。

需要更多的姑息治疗。这一被忽视的医学分支侧重于减轻痛苦和其他症状，比如呼吸困难，以及为晚期病人提供咨询。直到最近，它还常常被贬为根本不算医学，仅仅是所有希望破灭后的一点安慰与同情。即使在临终关怀运动的发源地英国，姑息治疗的应用也是零零散散。近期的研究表明这真是大错特错。事实证明，在晚期癌症的治疗中，在常规疗法的同时及早提供姑息治疗，不仅可以减轻痛苦，还能延长生命。

大多数医生从医是为了帮助人们延缓死亡，而不是谈论死亡的不可避免。但是他们必须要谈论。一个好的开始可能是《重病谈话指南》（*Serious Illness Conversation Guide*）的更广泛使用，外科医生、作家阿图·葛文德（*Atul Gawande*）起草了这本指南。这是一个简短的问卷，用来弄清晚期病人对自己病情的了解程度，以及他们在大限临近时的愿望。早期研究表明，它鼓励了更多更早的沟通，并减轻了痛苦。

除了这些变化，医疗系统对严重疾病的处理方式还应该有更广泛的转变。很多慢性疾病的护理需要完全脱离医院。这需要让部分医疗资金流向社会支援领域。对医生和医院的金钱激励也需要改变。这些资金通常由保险公司和政府提供，用于对患者进行治疗，而不是预防疾病或者让病人更舒服一些。美国针对65岁以上人士的公共医疗系统联邦医疗保险（*Medicare*）最近已开始报销医生与晚期病人进行深入沟通的费用，其他的国家医保制度和保险公司也应跟进。费用并不是问题，因为那些对病情了解更多、更主动参与治疗的病人更不会想要无意义的治疗。沟通不当是医疗纠纷中的常见问题，所以这也能让医生少吃官司。

| 我走之前的最后一件事

大多数人在深思自己的死亡时都会感到恐惧。由于死亡被隐藏于医院和养老院，人们对它不再那么熟悉，也更难谈论它。政客们不敢倡议临终关怀，担心被指斥为设立“死亡委员会”。但是与垂危病人开诚布公的交谈应该和开药与接骨一样成为现代医学的一部分。更好的死亡意味着更好的人生，直到最后一刻。■



Economic policy

Friction lovers

It is time to impose a tax on efficiency

EFFICIENCY is at the heart of progress. Yet just as too much of a good thing (travel, say) can yield a bad (congestion), so excessive ease in transactions can generate costs, known in the jargon as a “facile externality”, such that less efficiency would actually be more efficient. In academic circles, especially Scandinavian ones, the notion is well established that innovations which eliminate too much hassle could do society harm.

True to their cause, the high-minded theorists of facile externality go out of their way to make their ideas hard to understand. The effort required to master them has the happy effect of increasing their value, as intended. But it has also held them back from broad application. The good news is that this may at last be about to change.

In the past year facile externality has started to gain traction (a term that, in itself, demonstrates the centrality of friction to progress). This is in part thanks to some well-placed disciples, such as Danilov P. Rossi of the UN’s “Don’t Nudge—Tell” office (DoNuT). But it is also because technology is prompting an exponential loss of friction. Some experts fear a slippery slope.

Firms want to erase the sources of inconvenience and delay that irritate consumers. Technology has made this easy for them. Ride-hailing services allow passengers to walk off without fumbling for money. Streaming video brings the next episode to viewers just before the previous one ends. As Jerry Seinfeld once observed: “I love Amazon 1-click ordering. Because if it takes two clicks, I don’t even want it any more.”

In all this indulgence, the forgone benefits of hassle (*slygge* in Danish) go largely unrecognised. Frictionlessness encourages bad habits. For those who resent the time suck of 1-click ordering, Domino's has pioneered "zero-click" pizza-buying. Simply open the app and, after ten seconds, it automatically places a pre-set order. Domino's competitors are working on a "direct-to-mouth" drone-delivery service that will send individual slices of pizza into your home via an electronic flap. Pizza experts are seeking ways around the "chewing bottleneck".

Payments are also subject to facile externality. Three in five Britons say they spend more with a wave of the plastic than they would with cash. Ordering goods using Alexa, a voice-activated assistant, is as easy as saying its name. Tech firms are working on gesture-controlled devices that could enable payments with just a furtive glance of desire.

But the great curse of facile externality is value-erosion. Persistent need is the world's great motivator. With instant gratification, consumers end up alienated and economies worse off.

| *Take back control*

A few companies have recognised the benefits of restoring friction. Research into "the Ikea effect", named in honour of those happy hours spent with an Allen key, a Billy bookcase and a rising hatred of Sweden, shows that people put extra value on things when they devote their own labour to them.

But the market cannot solve this problem on its own. As Mr Rossi says, only government can properly defend the cause of inefficiency. DoNuT is calling for ideas. Since time-wasting is of the essence, it has imposed a deadline of April 1st next year.

We at *The Economist* plan to lead by example. From next week, readers will

need an extra tool: a paper knife with which to separate the pages of their copy. Henceforth, you will have to slit apart the folded pages of our folios to enjoy the words within. And you will, we are sure, thank us for it. ■



经济政策

摩擦爱好者

是时候对效率征税了

效率是进步的核心。但正如好事情太多可能会带来某个坏结果（比如太多人出门旅行而导致拥堵）那样，交易太过容易也可能产生成本——用行话说就是“便利的外部性”，这时效率低些反而会让结果更高效。在学术界，特别是在斯堪的纳维亚国家，一个普遍的观点是创新若消除了太多麻烦可能会对社会造成危害。

高尚的“便利外部性”理论家们尽忠职守，竭力让自己的观点不易理解。掌握这些理论所要付出的努力会产生一个乐见的效果——增加其价值。这正是他们的意图。但这也阻碍了这些理论被广泛应用。好消息是，这种局面可能终于要改变了。

过去一年里，便利外部性已经开始获得了前行的“抓地力”（而这个词本身就表明摩擦是前行的要义）。这在某种程度上要归功于某些有一定身份的追随者，比如联合国“别推，要说”办公室（Don't Nudge—Tell, “DoNuT”）的丹尼洛夫·罗西（Danilov P. Rossi）。但另一个原因是技术正使摩擦呈指数级减少。一些专家担心情况会迅速恶化。

企业希望能从根源上消除那些令消费者不悦的不便与延迟。技术让它们很容易就做到这一点。有了网约车服务后，乘客不用翻口袋掏钱就能施施然下车了。流视频在观众快看完某一集时就奉上下一集。杰瑞·宋飞（Jerry Seinfeld）曾经说过：“我爱亚马逊的一键下单。因为如果需要点两次，我就不想买了。”

在这一切的放纵之下，人们大多没有意识到，“麻烦”（丹麦语是slygge）所具有的一些好处也被损失掉了。缺少摩擦会助长恶习。为迎合那些觉得连一键下单都很浪费时间的人，达美乐（Domino's）开创了“零点击”购买比萨。只需打开应用，十秒后，它就会自动下一个预设好的订单。达美乐

的竞争对手正在开发一种“直接送到嘴边”的送餐服务，通过无人机把一片比萨送到顾客家中。比萨专家正在寻找解决“咀嚼瓶颈”的方法。

付款也会受便利外部性的影响。五个英国人中有三个表示，相比使用现金，他们在刷卡时花钱更多。用语音助手Alexa来订购商品就像叫出它的名字一样简单。科技公司正在研制用手势操控的设备，只要用希冀的眼神偷偷瞄上一眼就能成功支付了。

但便利外部性的巨大诅咒是价值侵蚀。持久的需求是世界的巨大动力。需求被即刻满足后，消费者最终会变得疏远，各个经济体的境况变得更糟。

| 收回控制权

少数几家公司已经意识到恢复摩擦的好处。对“宜家效应”（the Ikea effect）的研究表明，当人们在一些事物上倾注了自己的劳动时，他们就会赋予这些事物额外的价值。用宜家来给这一效应命名便是为了纪念那些花在内六角扳手、毕利书架上的快乐时光，以及瑞典正在招致的与日俱增的怨憎。

但市场靠自身并不能解决这个问题。正如罗西所言，只有政府才有可能为追求低效做出正当辩护。DoNuT办公室正在征集意见。由于浪费时间至关重要，该办公室规定最后限期为明年4月1日。

我们《经济学人》计划以身作则。从下周起，读者将需要一件额外的工具——一把裁纸刀，用它来分离杂志的页面。从今以后，你得要裁开我们折叠起来的页面才能看到里头的文字。而且我们相信，你会因此而感谢我们。■



Bottled water

Liquid gold

Companies are racing to add value to bottled water

PRESENTED in an unusually-shaped heavy glass bottle with outsized black lettering, it could be a fine vodka. On sale for £80 (\$99) in Harrods, an upmarket department store in London, it has a price tag to match. In fact, it is a bottle of water. Harvested directly from Norwegian icebergs that are up to 4,000 years old, Svalbardi is one of hundreds of water brands that are sourced from exotic places and marketed as luxury products.

From the basic to the expensive, the market for bottled water is an attractive place to be. According to Zenith Global, a consulting firm, the global market has grown by 9% annually in recent years and is worth \$147bn. The main reason is changing lifestyles. People are spending more time, and eating more of their meals, away from home. They are also switching from soft drinks and alcohol to healthier fare. Data from Beverage Marketing Corporation (BMC), another consultancy, show that consumption of bottled water overtook that of sugary soft drinks in America in 2016 (see chart).

Basic brands, such as Aquafina from PepsiCo, compete on price and have slim margins. (The cost of the raw material, which comes from either natural or municipal sources, is next to nothing; the main costs are packaging, distribution and marketing.) At the other end of the scale, convincing customers to pay a lot should be hard when your product doesn't have a distinctive taste and an alternative is freely available from the tap in most rich countries. But "premiumisation" is working. Though still a small part of the American market, really high-cost bottled water (selling for more than \$1.30 a litre) has been one of its fastest-growing areas, says BMC.

Premium water is hardly a new idea. The Perrier brand, which is owned by Nestlé, a Swiss consumer-goods giant, and Evian, owned by Danone, a French one, have long emphasised the uniqueness of their natural sources to sell water. But the newest offerings are promoting a lifestyle. Coca-Cola's premium water brand, which is advertised by Jennifer Aniston, is marketed as "inspirational" water for successful people. That is also the buzzword for PepsiCo's LIFEWTR, launched in America with a 30-second ad during Super Bowl in February. For the fashion crowd, one range of Evian bottles features artwork from Christian Lacroix.

Adding flavour is another way to dress up water. Grocery stores stock fruit-flavoured waters and "plant" waters, such as coconut, maple or birch. Water that has been fortified with vitamins and minerals is a hit with exercise junkies. The market is small but lucrative: sales of flavoured water amount to only 4% of the volume of plain water sold, according to Zenith, but bring in 15% of the total revenue.

At the luxury end of the market, water has become more like wine, argues Michael Mascha, the author of a guide to fine water. In expensive restaurants the precise origin of water is what matters; many eateries offer water lists along with the wine selection. For power-lunchers in health-conscious Los Angeles, says Mr Mascha, buying an expensive bottle of water is a way to signal status.

High prices can be controversial, given that many people in poor countries have limited access to drinking water and environmental worries dog the industry. Transporting water from exotic places is costly; most plastic bottles languish in landfill sites; and some firms, such as Nestlé, have been accused by environmental groups of monopolising water sources at the expense of local communities, for instance during periods of drought in California. (Nestlé says it monitors environmental conditions around its source springs and that it adheres to sustainable practices.) Many brands

address such concerns head-on. Svalbardi water is certified as carbon-neutral, for example; Coca-Cola funds drinking-water projects in Africa.

The thirst for posh water will only deepen, predicts Euromonitor, a market-research firm, as middle-class consumption in poorer countries catches up and as Westerners continue shunning unhealthy soft drinks. If so, the ingenuity seen so far in the bottled-water industry may be just a drip from the iceberg. ■



瓶装水

液体黄金

各公司争相为瓶装水增值

一个形状别致的厚重玻璃瓶，瓶身印着大号的黑色字体标识，看起来像是一瓶高档伏特加。伦敦哈罗德百货（Harrods）有售，80英镑（99美元）的售价很符合这家高档百货公司的档次。但这其实是一瓶水——斯瓦尔巴迪（Svalbardi）冰山水，直接取自挪威近4000年前形成的冰山。像这样产地非同寻常的水有数百个品牌，都作为奢侈品来营销。

普通也好，高端也罢，瓶装水市场吸引力巨大。据咨询公司Zenith Global的数据显示，近年来全球瓶装水市场每年增长9%，价值1470亿美元。增长的主要原因是生活方式不断改变。如今人们会花更多的时间外出，在外就餐的次数也更多，还减少了软饮和酒精的消费，转而选择更健康的饮食。另一家咨询公司饮料营销公司（BMC）的数据显示，2016年美国瓶装水的消费量超过了含糖软饮（见图表）。

像百事公司的Aquafina这样的普通品牌打的是价格战，利润空间很小。它们的原材料来自自然或市政水源，成本几乎可以忽略，主要的成本来自包装、分销和营销。而在高端品牌方面，当产品并没什么特别的味道，且在大多数富裕国家水龙头随时供应直饮水的情况下，要说服客户高价买水应该很难。但是“高端定位”的策略却正在见效。BMC的数据表明，真正高成本的瓶装水（每公升售价超过1.30美元）尽管只占美国市场的一小部分，但已成为增长最快的部分之一。

高端水算不上什么新概念。瑞士消费品巨头雀巢的巴黎水（Perrier）品牌及法国达能的依云（Evian）长久以来一直强调其独特天然水源的卖点。但最新的产品推销的是一种生活方式。可口可乐的高端水品牌由珍妮弗·安妮斯顿（Jennifer Aniston）代言，营销的定位是成功人士的“灵感”之水。这也是百事可乐的瓶装水LIFEWTR（生命之水）的营销关键词（LIFEWTR在2月份的超级碗比赛中通过30秒的广告在美国推出）。依云

的一个瓶装水系列面向时尚一族，瓶身带有克里斯汀·拉克鲁瓦（Christian Lacroix）的艺术设计。

添加味道是为水升级的另一种方式。杂货店摆满了大量水果味和“植物系列”瓶装水，如椰子、枫树或桦树汁；添加了维生素和矿物质的水则是运动狂的最爱。有添加的瓶装水市场规模虽小，但利润丰厚：Zenith Global的数据显示，加味水的销量只有普通水的4%，但却贡献了总收入的15%。

曾经为高端瓶装水撰写品鉴指南的迈克尔·马沙（Michael Mascha）认为，在高端奢侈水市场，水已经变得更像葡萄酒了。在高级餐厅，水的确切来源至关重要；许多餐馆除了葡萄酒单还提供饮用水单。马沙说，在推崇健康生活的洛杉矶，在商务午餐中选购一瓶昂贵的水是彰显地位的一种方式。

由于在贫穷国家还有很多人难以喝到饮用水，对环境的担忧又一直困扰着瓶装水行业，所以高价水可能引发争议。从偏远水源地运水的成本很高；大多数塑料瓶用完后在垃圾填埋场无法降解；而包括雀巢在内的一些公司已被环保组织谴责垄断水源，不惜牺牲当地社群的利益，比如雀巢在加利福尼亚州旱灾期间的做法。（雀巢表示一直在监控水源地周围的环境状况，并坚持可持续发展的做法）。许多品牌在积极解决这些问题，例如，Svalbardi极地冰山水获得了碳中和的认证；可口可乐为非洲的饮用水项目提供资助。

市场研究公司欧睿信息咨询公司（Euromonitor）预测，随着较不富裕国家中产阶级的消费能力不断上升，以及西方人继续减少饮用不健康的软饮，对高端水的需求只会加深。果真如此的话，目前瓶装水行业所有的独出心裁可能只是“冰山一滴”。■



Buttonwood

Not barking yet

Why gold has not responded to geopolitical risk or reflation talk

AMERICA has bombed Syria, and its relations with Russia have deteriorated. North Korea is developing a long-range nuclear missile, a development which Donald Trump has vowed to stop, unilaterally if necessary. There is talk of a “reflation trade”, with tax cuts in America pepping up global growth.

All this ought to be good news for gold, the precious metal that usually gains at times of political uncertainty or rising inflation expectations. But as the chart shows, gold took a hit when Mr Trump was elected in November and is still well below its level of last July. As a watchdog, gold has failed to bark.

Bullion enjoyed a ten-year bull market from 2001 to 2011, when it peaked at \$1,898 an ounce. This long upward run was bolstered in its later stages by two developments: first, the use of quantitative easing (QE) by central banks, which gold bugs argued would inevitably lead to high inflation; and second by the euro crisis, which caused nervousness about the potential for a break-up of the single currency and about the safety of European banks. By 2013, however, euro-zone worries were fading and, despite QE, no inflation had been seen. The gold price fell sharply and has stayed in a narrow range since.

Last year was a disappointing one for jewellery demand, with an annual survey by Thomson Reuters finding that jewellery fabrication fell by 38% in India (where it was hit by a new excise duty) and by 17% in China. The Chinese central bank was also a less enthusiastic gold-purchaser than before: net central-bank buying dropped to a seven-year low.

The big change in the gold market since the turn of the millennium has been the rise of exchange-traded funds (ETFs), which have made it easy for investors to get exposure to the metal without worrying about storing it or insuring it. At the peak, gold ETFs held around 2,500 tonnes of gold, according to Citigroup, worth around \$100bn at today's prices.

Gold ETFs were bought as a classic "momentum trade" by investors who try to make money by following trends. Once the price trend changed in 2013, such investors scrambled to get out of the metal. At the moment ETFs hold just 1,800 tonnes.

The problem with gold is that there is no obvious valuation measure. The metal pays no real "earnings". Although gold is seen as a hedge against inflation, it cannot be relied on to fulfil this function over the medium term; between 1980 and 2001, its price fell by more than 80% in real terms.

The general rule is that gold is seen as an alternative currency to the dollar, so when the greenback does well, bullion does badly. But this also means that gold's performance can look rather better in other, weaker currencies. Since the Brexit referendum, for example, bullion is up by 19% in sterling terms. Another factor is real interest rates. When they are high, the opportunity cost of holding gold is also high. Conversely, very low interest rates mean that there seems little to lose by holding gold.

Those two factors explain why the "Trump trade" was initially not very good for gold. In the immediate aftermath of the election, investors hoped that tax cuts would revive the American economy; this would force the Federal Reserve to push up interest rates and that rate boost would drive the dollar higher. Neither prospect would be good for gold.

But the Trump trade has lost momentum. The president's failure to repeal Obamacare has raised doubts about the prospect of a tax-reform

programme being passed by Congress. Gold has duly perked up a bit since the start of the year, and the price rose by 1.6% on April 11th. But, although inflation may be a bit higher, nothing suggests a return to the kind of double-digit rates seen in the 1970s, when gold enjoyed a spectacular price rise.

Even so, the metal has not performed as well as it might have done, given the geopolitical headlines. Perhaps this is because Mr Trump has backed away from some of his pre-election threats—on trade with China, for example. The bombing in Syria may turn out to be a one-off, and his statements on North Korea could be “full of sound and fury, signifying nothing”. With the help of advisers such as Rex Tillerson, the secretary of state, and James Mattis, the defence secretary, Mr Trump may turn out to be a more conventional foreign-policy president than expected.

So buying bullion is really a bet that things will go spectacularly wrong: that events escalate in the Middle East and North Korea or that central banks lose control of monetary policy. It could happen, of course, but it helps explain why gold bugs tend to be folks with a rather gloomy attitude towards life. ■



梧桐

还没叫

为何黄金对地缘政治风险或通货再膨胀言论尚无反应

美国轰炸了叙利亚，它和俄罗斯的关系也已恶化。朝鲜正在研发远程核导弹，特朗普曾发誓要加以阻挠，称如有必要将采取单边行动。随着美国减税刺激全球增长，“通货再膨胀贸易”的说法已经出现。

这些对于黄金来说应该都是好消息——这种贵金属在政治不确定期或通胀预期上升时通常都会升值。但如图表所示，去年11月特朗普当选时金价曾受打击，目前仍远低于去年7月的水平。作为看门狗，黄金没有叫。

从2001年起，黄金享受了十年的牛市，在2011年达到每盎司1898美元的最高位。在后期支撑这一长期上行走势的是两大因素。其一是各央行实行量化宽松。黄金信徒认为此举将不可避免地导致高通胀；二是欧元危机令人们担心该单一货币可能崩盘以及欧洲银行是否安全。不过到2013年，欧元区的担忧消退；而且，尽管采取了量化宽松，通胀并未出现。金价大幅下跌，之后也一直窄幅波动。

去年的珠宝需求令人失望。汤森路透的年度调研显示，在印度，珠宝加工受新消费税的影响而下跌了38%，在中国则下跌了17%。中国央行也不再像以前那样热衷于购入黄金，其黄金净买入跌至七年最低。

迈入新千年以来，黄金市场最大的变化是交易所交易基金（ETF）的兴起。它们让投资黄金变得更容易，还令投资者无需担心储存或投保问题。根据花旗集团的数据，在鼎盛期，黄金ETF持有约2500吨黄金，按照今天的价格约值1000亿美元。

购买黄金ETF是一种典型的“动量交易”，投资者想通过跟随趋势来赚钱。2013年价格趋势突变，这类投资者便争相脱手黄金。当时ETF仅持有1800吨黄金。

黄金的问题在于没有明显的估价标准。黄金并不产生真正的“收益”。尽管黄金被视作一种防范通货膨胀的手段，但却无法依靠它在中期实现这一功能；从1980年到2001年，金价按实值计算下跌超过80%。

一般的规则是将黄金看作美元的替代货币，因此当美元走高时，黄金走低。不过这也意味着以其他较弱货币来计算，黄金的表现可能就相当好。例如，英国脱欧公投以来，黄金以英镑计价上涨了19%。另一个因素是实际利率。当实际利率高时，持有黄金的机会成本也高。反之，很低的利率意味着持有黄金也许不会有什么损失。

这两个因素解释了为什么“特朗普交易”最初对黄金并不是很有利。就在选举之后，投资者希望减税会让美国经济复苏；这会迫使美联储加息，而利率提升会把美元推得更高。无论哪方面的预期都对黄金不利。

但是特朗普交易已经失去了动力。他没能废除奥巴马医改，这让人不禁怀疑国会正审核的税改方案的前景。自今年年初以来，黄金如预期般活跃起来；4月11日，金价上涨1.6%。然而，尽管通胀可能会略微升高，但并没有迹象显示会上涨到上世纪70年代的两位数水平——当时金价上涨惊人。

即便如此，考虑到地缘政治形势动荡，黄金的表现也没能达到应有的水平。可能是因为特朗普从选战时威胁的政策立场上退让了，对华贸易就是一例。轰炸叙利亚最终可能是一击而止，而他在朝鲜问题上的声明也可能“充满喧嚷与狂怒，却毫无意义”。在国务卿雷克斯·蒂勒森（Rex Tillerson）和国防部长詹姆斯·马蒂斯（James Mattis）等幕僚的辅佐下，特朗普有可能成为一名在外交政策上比预期更保守的总统。

因此，购买黄金其实是在赌事态的走向会坏得惊人：中东和朝鲜局势升级，或是央行对货币政策失控。这些当然有可能发生，但这也可以解释为什么黄金信徒往往是对生活态度比较悲观的人。■



Car mergers

Wheels in motion

Carmakers will need to get bigger to compete for the future of mobility

CARS are getting bigger. Motorists worldwide have for years been abandoning four-door saloons in favour of bulkier SUVs. Carmakers have become bigger, too. Four car firms now make around 10m vehicles a year in order to reap economies of scale, particularly in the mass-market bit of the business where profit margins can be painfully thin.

Many executives also believe that size is the only protection against the technological upheaval sweeping the industry. But bulking up fast is easier said than done. Lots of different constituents have to be won over. And most car bosses are still reticent about taking the plunge on mergers because many have been catastrophes. Daimler's acquisition of Chrysler in 1998, for example, was a notable disaster. The list of past crashes is lengthy. Indeed, one recent deal—General Motors' sale of Opel, its European arm, to France's PSA Group for €1.3bn (\$1.4bn)—seems to go directly against the imperative to bulk up.

In fact, that deal has had the effect of spurring more talk of consolidation. Speculation centred at first on a possible mega-merger between GM and Fiat Chrysler Automobiles (FCA), itself the result of a deal in 2014 (FCA's chairman, John Elkann, sits on the board of *The Economist's* parent company). The Italian-owned firm, which makes just under 5m vehicles a year, is run by Sergio Marchionne, who has been eyeing a merger with GM for years. With the American firm now discarding a loss-making European business, the theory goes, it could replace it with a profitable one—Fiat—and crunch together the two firms' successful operations in America.

Mary Barra, GM's boss, has repeatedly rejected Mr Marchionne's overtures; selling Opel is unlikely to have changed her mind. Some observers unkindly suggest that GM is in any case unable to handle three tasks at once, and that its aim in ridding itself of Opel was to concentrate on improving its operations in America and in China. Moreover, a lot of the synergies from a deal depended on combining Fiat and Opel in Europe.

The rumour mill has since moved to Volkswagen. The German firm has long cast a covetous eye over bits of FCA. At an annual industry shindig in Geneva in March that coincided with the final sale of Opel, Mr Marchionne said he had "no doubt that at the relevant time Volkswagen may show up and have a chat". He also suggested that PSA Group's acquisition of the GM unit, which puts the French firm in second place in Europe, adds to the pressure on VW, the market leader, to bulk up further. VW's campaign to conquer America, where its diesel-emissions scandal has undermined its weak position, would be strengthened with FCA in tow. FCA's Ram trucks are hugely profitable in America and the Jeep brand is resurgent worldwide. The unrealised potential of Maserati and Alfa Romeo, alluring bywords for Italian style, is also attractive.

A deal would, however, bring little benefit in Europe, where VW already has a big slice of the market and plenty of small cars on offer. With Seat, a Spanish division, struggling and its own brand said to be loss-making in the region, VW could well do without the trouble of integrating Fiat. FCA is also the only big car company that is lumbered with lots of debt (of just under €5bn), making it a less tempting target.

Matthias Müller, VW's chief executive, has not ruled out talks with FCA, and has indicated that the German group is more open to a merger than it used to be. But FCA is not the only option. An acquisition of Ford (which just suffered the humiliation of being overtaken in market capitalisation by Tesla, an electric-car firm founded in 2003) might also fit VW's plans. Still,

if VW is intent on leading the next round of industry consolidation, it will need to put “dieselgate” behind it. Though the German firm has paid \$22bn in fines and compensation, the issue of who knew what and when is still unresolved.

Whatever combination of firms might bring it about, the goal of creating a group that produces nearly 15m vehicles a year makes sense. Mr Marchionne’s oft-stated view is that the industry’s duplicated investment in kit such as near-identical engines and gear boxes is a waste of resources, and that much of the money would be better returned to shareholders. Other car bosses reckon the money should go on the technologies that will transform the industry: mobility services such as ride-sharing, electrification of the drivetrain and autonomous vehicles. Scale would allow car firms to spread the cost over more vehicles.

One argument against full-scale mergers has been that loose alliances, such as that between Renault, a French car manufacturer, and Japan’s Nissan, can do the job by helping to pool development costs. The Renault-Nissan alliance has succeeded. After taking a controlling stake in Mitsubishi, a smaller Japanese carmaker, last year, the firm makes nearly 10m cars a year.

An alliance works well for components and for individual platforms, the basic structure underpinning a car, where the aim is clear and specifications can be agreed on. An engine that might cost \$1bn to develop, for example, can be easily split two or more ways. Yet alliances work far less well for broader technologies such as connectivity and autonomous vehicles. It is harder to specify a common goal for a product that could find its way into every vehicle the companies make. And it makes less sense to share futuristic technologies that may prove to be the differentiating factor for buyers of cars in the future.

The arrival of new competitors such as Tesla, and deep-pocketed tech

giants intent on disrupting the transport industry such as Google, Apple and Uber, make dealmaking an even more pressing need. “Everyone agrees on the rationale for big mergers, even if execution of deals has been extremely difficult up to now,” says an adviser to the industry.

If car mega-mergers are to go ahead, however, and stand a better chance of success than past attempts, two conditions apply. First, the big stakeholders—governments, families and unions—will need to be convinced. Many carmakers, such as BMW, Fiat, Ford, Toyota, VW and others, have ties to families, which in some cases have blocking shareholdings. VW’s unions or France’s government, which has stakes in Renault and PSA, would oppose deals that could result in big domestic job losses.

Second, transactions will need to do more than simply chase volume. A welcome new trend in the industry is to put greater emphasis on profitability. One of GM’s reasons for getting rid of Opel was to concentrate on profits rather than solely on how many cars it turns out, a decision that Tim Urquhart of IHS Markit, a research firm, calls “groundbreaking and brave”.

A mega-merger would take similar courage, and car bosses tend to be conservative and risk-averse. But after over 100 years of selling cars powered by internal-combustion engines, the industry faces the huge wrench of adapting to a future of electrification and self-driving cars. Software and electronics are displacing mechanical parts as the most important components of a car. A business focused on selling objects will have to start offering ever more transport services. If carmakers do not take the plunge, an alternative is that one of the technology giants with big ambitions in mobility could try to buy, say, Ford, Tesla or PSA Group. For cash-rich firms like Apple or Google, the cost of such an acquisition would be pocket change. ■



车企合并

车轮转动

为争夺出行行业的未来，汽车制造商需要扩大规模

汽车的尺寸越来越大。多年来，世界各地的驾驶者纷纷舍弃四门轿车而选择体型更大的SUV。汽车制造商也变得越来越庞大。目前四家车企年产约一千万辆汽车以取得规模经济效益，尤其是在利润空间小得可怜的大众市场。

许多高管也相信规模是抵挡科技革新力量横扫行业的唯一屏障。但要快速壮大说着容易，做起来却很难，且需争取多方的支持。而大多数车企老板仍不愿冒险合并，毕竟许多合并最终都以灾难收场。例如，1998年戴姆勒收购克莱斯勒就是个明显的失败案例。过往的溃败案例可以列出一长串。最近通用汽车更是以13亿欧元（14亿美元）的价格向法国标致雪铁龙集团（PSA Group）出售了其欧洲子公司欧宝（Opel），似乎与扩大规模这一当务之急完全背道而驰。

实际上，这宗交易引发了更多有关整合的议论。猜测先是集中在通用汽车和菲亚特克莱斯勒（FCA）身上，猜想两者可能会合并。后者本身就是2014年一宗并购交易的产物（菲亚特克莱斯勒汽车的董事长约翰·埃尔坎为《经济学人》母公司董事）。这家意大利公司每年生产近500万辆汽车，其首席执行官塞尔吉奥·马尔乔内（Sergio Marchionne）多年来一直紧盯机会，希望能与通用汽车合并。如今这家美国公司舍弃了亏损的欧洲业务，按道理应该会购入另一家盈利的汽车公司如菲亚特作为顶替，然后融合两家公司在美国的成功业务。

通用汽车的老板玛丽·博拉（Mary Barra）一再拒绝马尔乔内的示好；出售欧宝的行动也不大可能让她改变主意。一些观察家不客气地指出，通用汽车无论如何也无法同时处理三个任务，而出售欧宝的目的是集中精力改善在美国和中国的业务。此外，并购交易的许多协同效应原本有赖于菲亚特和欧宝在欧洲的整合。

传言转而集中到大众身上。这家德国公司长期觊觎菲亚特克莱斯勒汽车的部分业务。欧宝最终在今年3月被出售，适逢汽车行业年度盛会在日内瓦举行。会议期间马尔乔内说自己“深信在适当时间大众汽车可能现身并进行会谈”。他还表示，标致雪铁龙集团收购通用汽车的部分业务后，成为了欧洲第二大车企，这令市场霸主大众扩大规模的压力增大。大众的柴油车排放丑闻使它在美国市场的弱势地位雪上加霜，而联合菲亚特克莱斯勒可能有助于大众征服美国。菲亚特克莱斯勒的公羊（Ram）皮卡在美国极为赚钱，它的Jeep品牌也在全球各地重振声威。作为意大利风尚的诱人代名词，玛莎拉蒂和阿尔法罗密欧的发展潜力也很有吸引力。

然而，并购在欧洲带来的好处并不大，大众汽车在那里已经占据相当的市场份额并供应了大量小型车。大众的西班牙子公司西雅特目前业绩不佳，大众品牌本身据说在该地区内也处于亏损。因此，大众大可不必费神整合菲亚特。菲亚特克莱斯勒也是唯一一家负债累累（近50亿欧元）的大型车企，这使它成了一个不那么诱人的收购目标。

大众汽车的首席执行官马蒂亚斯·穆勒（Matthias Müller）并未排除与菲亚特克莱斯勒商谈合并的可能，并表示大众对并购的态度要比以前开放。但菲亚特克莱斯勒不是唯一的选择。福特（刚因市值被2003年成立的电动汽车公司特斯拉超越而蒙羞）也可能适合大众的收购计划。不过，假如大众集团意欲引领行业的下一轮整合，则需要摆脱“柴油门”的阴影。虽然这家德国公司已支付220亿美元的罚金和赔偿金，事件还有哪些内幕以及涉事人责任等问题尚未解决。

无论企业如何组合，创建年产近1500万辆汽车的集团都是个合理的目标。马尔乔内多次表示，业内对发动机和变速箱等近乎相同技术的重复投资是浪费资源，还不如将这些资金的大部分归还给股东们。其他车企老板们则认为，应该把这些资金用在将彻底改变行业的技术上，如拼车等出行服务、传动系统电动化和自动驾驶车辆。规模经营能令车企把成本分摊到更多的车辆上。

反对全面合并的论据之一是，像法国车企雷诺与日本日产那样的松散联盟

也能通过共担开发成本达成上述目标。雷诺-日产联盟成功做到了。去年，公司控股了较小的日本车企三菱汽车，如今年产近一千万辆汽车。

零部件及各个车型开发平台用于打造车辆的基本结构，在这方面组成车企联盟效果不错，因为目标清晰，也能就规格达成一致。例如，开发一款引擎可能需要十亿美元，而这项成本轻易地就可由两方或更多方分担。但对于联网汽车和自动驾驶等更广泛的技术而言，车企联盟的作用则小得多。为各家公司的每款车型都有可能用到的某个产品制定共同的目标更为困难。而分享未来尖端科技也更不明智，毕竟那可能是在未来吸引买家的差异化因素。

特斯拉等新对手，以及谷歌、苹果、优步等财力雄厚而意欲颠覆运输业的科技巨头加入竞争，令并购之计更是迫在眉睫。“所有人都认同进行大型合并的道理，虽然直到现在执行起来也还是极为困难。”一位行业顾问说道。

然而，大型车企如果要推进合并、想要比以往有更大的把握获得成功，需要满足两个先决条件。首先要说服政府、家族和工会这些主要利益方。许多汽车制造商都与家族有关联，如宝马、菲亚特、福特、丰田、大众等，部分家族拥有可否决并购的股权。大众集团的工会和持有雷诺和标致雪铁龙股份的法国政府都会反对导致国内工人大量失业的并购。

第二，并购还要着眼更多目标，而不是仅仅追逐规模。行业内令人欣喜的一个新趋势是大家越来越强调盈利能力。通用汽车出售欧宝的原因之一就是要关注利润而非仅在乎汽车产量，市场研究公司IHS Markit的蒂姆·厄克特（Tim Urquhart）称这个决定“勇于开拓”。

大型合并将需要类似的勇气。车企老板们往往因循守旧，不愿冒险。但销售了100多年内燃机汽车后，汽车业需经历巨大的痛楚去适应由电动和自动驾驶汽车构建的未来。软件和电子设备正取代机械部件成为汽车中最重要的组件。一个专注销售实物的行业不得不开始提供越来越多的运输服务。假如汽车厂商不冒险一试，某个对出行服务怀有远大抱负的科技巨头

也可能会收购大型车企如福特、特斯拉或者标致雪铁龙。对于苹果或谷歌这类资金充裕的公司来说，这种收购的成本微不足道。■



Open science

Time's up

Scientific journals were once a great idea. Now, though, they are slowing progress. But that is about to change

ON JANUARY 1st the Bill & Melinda Gates Foundation did something that may help to change the practice of science. It brought into force a policy, foreshadowed two years earlier, that research it supports (it is the world's biggest source of charitable money for scientific endeavours, to the tune of some \$4bn a year) must, when published, be freely available to all. On March 23rd it followed this up by announcing that it will pay the cost of putting such research in one particular repository of freely available papers.

To a layman, this may sound neither controversial nor ground-breaking. But the crucial word is "freely". It means papers reporting Gates-sponsored research cannot be charged for. No pay walls. No journal subscriptions. That is not a new idea, but the foundation's announcement gives it teeth. It means recipients of Gates' largesse can no longer offer their wares to journals such as *Nature*, the *New England Journal of Medicine* or the *Proceedings of the National Academy of Sciences*, since reading the contents of these publications costs money.

That will hurt. Publication in such Premier-league journals is the stuff careers are built on. But it will also hurt the journals themselves. Their prestige is based on their ability to pick and publish only the best. If some work is out of bounds to them, no matter how good it is, that will diminish their quality. And if other patrons of science follow suit, those journals' businesses could begin to crumble. Moreover, by actively directing the beneficiaries of its patronage towards the repository in question, set up last year by the Wellcome Trust (after Gates, the world's second-largest medical-research charity), the foundation is pointing to a specific type of

alternative—and to a future for scientific publication that, if not completely journal-free, is likely to be at least, “journal-lite”.

| *Wellcome to the 21st century*

Periodical journals have been the principle means of disseminating science since the 17th century. The oldest still around, the *Philosophical Transactions of the Royal Society* (pictured), appeared first in 1665. Over the intervening three and a half centuries journals have established conventions for publication—such as insisting on independent (and usually anonymous) peer review of submissions—that are intended to preserve the integrity of the scientific process. They have, though, come under increasing attack in recent years.

One criticism, in a world where most non-commercial scientific research is sponsored by governments, is that there should be no further charge for reading the results of taxpayer-funded work. Journals, in other words, should have no cover or subscription price. A second is that the process of getting a paper published takes too long. Months—sometimes years—can pass while a hopeful researcher first finds a journal willing to publish, and then waits for peer review and the negotiation of amendments. That keeps others in the field in the dark about new results for longer than is really necessary, and thus slows down the progress of science. Third, though this is less easy to prove, many researchers suspect that anonymous peer review is sometimes exploited by rivals to delay the publication of competitors’ papers, or, conversely, that cabals of mates scratch each others’ backs, review-wise.

To these criticisms, another may be added, which is not the fault of journals, but still needs addressing. This is the unwillingness of many researchers to publish the data on which their conclusions are based. Some journals do insist on full disclosure of data, but not all are so particular. And, even then, the data in question will not see the light until publication

day.

Partial solutions to some of these problems have been tried. The Gates foundation is experimenting with carrots, as well as sticks. It has offered the publishers of one top-flight journal, *Science*, \$100,000 to make papers published this year about Gates-sponsored research free to read from the beginning. If this goes well, the experiment may be extended to other publications. Similarly, there is a movement among some publishers to make papers free to the reader by charging the authors (and therefore, ultimately, their patrons) for the costs of publication—usually in the range of \$2,000-\$3,000 per paper. But many now think these are half-measures, and that a real revolution in the idea of scientific publishing is needed.

Part of science has already undergone such a revolution. Since 1991 physicists have been able to deposit early versions of their papers, known as preprints, in an online repository called *arXiv* (the “X” represents a Greek “chi” rather than a Latin “ex”). *ArXiv* is paid for by Cornell University Library, the Simons Foundation, a charity, and through fees from around 200 members (mostly universities). Over the years the number using it has increased, to the point where around 300 preprints are deposited every day.

This sort of “pre-publication” is rapidly becoming physics’s method of choice. Depositing a paper in *arXiv* both establishes that a researcher has been the first to arrive at a discovery and makes that discovery available immediately to others. It does not provide formal peer review, but physicists are not shy of criticising the work of others, so a lot of informal (and un-anonymous) feedback can accumulate rapidly. This potential flak is a deterrent to publishing half-baked work. Nor does appearing in *arXiv* preclude later publication in a journal. The editors of periodicals were once sniffy about accepting material previously available elsewhere. In physics, they can no longer afford this luxury.

The Gates foundation's announcement is part of an attempt to extend this idea to the rest of science, particularly biomedical research. Biomedical equivalents of *arXiv* exist, but they are not much used. One of the largest, *bioRxiv*, received around 600 submissions in February. That is but a fifteenth as many as *arXiv*, even though many more biomedical papers are published per year than physics papers.

Why biologists have failed to follow physicists' lead is unclear. It may simply be a historical accident. *ArXiv* was started before most journals went online, so was initially more distinct from such journals than online databases are now. By the time biologists, less computer-literate as a clan than physicists, caught up with the idea, the online-offline distinction had blurred, and the journals saw online repositories as rivals. But whatever the cause, the result was clear: an unwillingness by non-physicists to embrace preprints.

The time, however, seems ripe to change that. Though its absolute numbers are still low, the use of *bioRxiv* is growing fast (see chart). And it is not just outside nudges that are bringing this sort of thing about. In February, for example, ASAPbio, a group of biologists who are trying to promote the use of preprints, began looking for bidders to create a website which will index all life-science preprints published in public repositories.

Outside nudges do help, though. It will not harm ASAPbio's chances of success that its plan has the backing of America's National Institutes of Health, the country's main source of taxpayer finance for medical research. And other philanthropic organisations besides the Gates foundation are also pushing in the same direction. The Wellcome Trust's creation of the repository Gates has just joined is one example. Another is the Chan Zuckerberg Biohub in San Francisco, brainchild of Mark Zuckerberg, a founder of Facebook, and his wife, Priscilla Chan. In February the Biohub announced it would disburse \$50m to 47 local scientists on condition they

made their work available as preprints.

There is even room for commerce in this brave, new world. The Wellcome-Gates repository is actually run by a firm called F1000, that also has its own preprint repository, F1000Research. This operates in a slightly different way from *arXiv* and its imitators in that it does include a formal process of peer review. F1000's review process involves named rather than anonymous reviewers, which many regard as a strength. But who those reviewers should be is suggested by a submitted paper's authors, which carries obvious risks of partiality. Revenue comes from a fee of up to \$1,000 that authors pay on submission.

The wider use of preprints might also help reduce the problem of pre-publication data-hoarding. Once a preprint is published, its authors need not fear that others will take credit for their work. And it is becoming easier to make data available in a way that lets the originator retain control and garner credit. Sites such as Figshare let researchers assign a unique alphanumeric code (called a Digital Object Identifier) to data sets, figures, video and so on, meaning their origins are clear.

None of this necessarily means that non-physicists will eschew journals and rush to publish their work in open repositories. Over time, though, more may come to see the advantages of doing so. As more researchers submit preprints and make their data available to others, they may find the comments they receive regarding their work helpful. Even the kudos of publication in the premier journals may slowly fade in the face of data about a piece of work's actual, rather than potential, impact. Having survived three and a half centuries, scientific journals will no doubt be around for a long time yet. With luck, though, they will return to being science's servants, rather than its ringmasters. ■



开放科学

时间到了

科学期刊曾是一项伟大的创举，如今却令科技进步放缓。不过这种状况很快将改变

1月1日，比尔及梅琳达·盖茨基金会的举动也许会帮助改变科学实践。两年前提出的一项政策现在正式生效：基金会支持的研究一旦发表成果，必须要让所有人都能自由获取。（该基金会是世界最大的科研工作赞助方，每年的捐款约达40亿美元。）3月23日基金会继而宣布会承担费用，将上述研究成果汇集至一个特定的文献库中，库中的论文可供人自由取用。

对外行来说，这听起来也许既没什么可争议的，也不具什么开拓性。但关键的字眼是“自由”。如果某项研究是由盖茨基金会赞助的，报告其成果的论文就不得收费。没有收费墙。无需订阅期刊。这并不是一个新想法，但盖茨基金会公布的决定赋予了它效力。这意味着接受盖茨夫妇慷慨赠与的研究者再也不能将文章提供给《自然》、《新英格兰医学杂志》或《美国国家科学院院刊》这类期刊，因为这些刊物的内容要花钱才能阅读。

这就有麻烦了。在上述顶级刊物上发表文章是科研人员奠定事业的基石。而这些刊物本身也会遭受损害——它们的声望就在于有能力只挑选并发表最优秀的文章。如果某项成果极为优秀，这些刊物却没有资格染指，刊物的品质便会被削弱。而且，一旦其他科学赞助人也纷纷效仿，这些刊物的业务便岌岌可危。此外，基金会积极地将赞助受益人引导至上文提及的文献库中（由惠康基金会[Wellcome Trust]于去年建立。此基金会是盖茨基金会之外世界第二大支持医学研究的慈善机构），此举为科研论文发表指出了一种明确的替代方案，也指明了这样一个未来：即使不能完全抛弃期刊，至少也有可能实现“不再是期刊至上”。

| 欢迎来到21世纪

自17世纪起，科学期刊便是传播科学的主要手段。始创于1665年的《自然科学会报》（Philosophical Transactions of the Royal Society）是世界上最

古老的期刊（见图），如今仍在持续出版。在这中间的三个半世纪里，众科学期刊已确立了一系列的出版惯例，例如坚持对所提交论文进行独立（且通常是匿名）的同行评审。此举是为了维护科研过程的可信度，不过近年来却遭到越来越多的攻击。

一种批评是：在大多数非商业性科研工作都是由政府支持的情况下，要阅读获纳税人资金支持的研究成果就不应该再付钱。换句话说，阅读和订阅期刊就不应该花钱。第二种批评是论文发表过程耗时太久。一位怀揣希望的研究者从找到一家愿意发表自己论文的期刊，到等待同行评审并就文章修改进行商讨，会耗费数月甚至数年的时间。这无谓地增加了该领域其他人获知新成果的时间，从而延缓了科学进步。第三个问题虽然并不那么容易证实，但很多研究者都怀疑竞争者有时会利用同行匿名评审来拖延对手论文的发表，或者反过来，结成小团体的研究者们会在评审这一环节上彼此行方便。

除上述问题外，也许还有一种批评声音。问题虽然并不出在期刊本身，但仍需处理。这个问题便是许多研究者不愿公布支撑自己研究结论的数据。有些期刊确实会要求作者披露完整的数据，但并非所有的期刊都会特别要求这一点。即便有这样的要求，也要等到论文发表那一天才看得到这些数据。

已有人尝试了一些方法，部分解决了这其中的某些问题。除了大棒，盖茨基金会也正在试验奉上胡萝卜：它向顶尖期刊《科学》的出版者拨付10万美元，以使受基金会赞助、发表于2017年的论文自刊出起便可免费获取。如果该协议进展顺利，这样的尝试也许还会扩展到其他出版物。同样，一些出版商也已有所行动，它们通过向作者收取出版费用（因此最终还是要他们的赞助者来掏腰包）来向读者提供免费论文。每篇论文的出版费用通常在2000到3000美元之间。不过眼下有很多人认为这些都只是权宜之计，科学出版这一理念需要的是一场真正的革命。

在某些科学领域中，这样的革命已经发生。自1991年后，物理学家便可将自己未定稿的论文（即所谓的预印本）存放在一个名为arXiv（“X”按希腊

语发“chi”音，而不是发拉丁语中的“ex”）的在线文献库中。arXiv的经费来自康奈尔大学图书馆、慈善机构西蒙斯基金会（Simons Foundation），以及大约200个会员机构（多数都是大学）缴纳的费用。多年来，arXiv的用户逐步增加，每天提交的预印本多达300篇左右。

这种“预发表”的形式正迅速成为物理学界的首选方法。将一篇论文提交至arXiv既能证实某位研究者是第一个获得某项新发现的人，也会让其他人立刻知晓这一发现。arXiv并不提供正式的同行评审，但物理学家们向来都对他人的劳动成果不吝指正，因此可迅速积累起大量非正式（且非匿名）的反馈。因为有可能遭到严厉批评，研究者们便会有所忌惮，不会贸然提交半吊子水平的成果。文章出现在arXiv上也并不会妨碍它之后在正式期刊上发表。期刊的编辑们曾对接收已在别处出现过的内容嗤之以鼻，而在物理学界，他们却再也没摆谱的资本了。

盖茨基金会的公告便是将这一想法延伸至其他科学领域的一种尝试，尤其是生物医学研究。生物医学领域也有与arXiv相对应的文献库，但研究人员并不怎么用它们。BioRxiv是其中规模最大的一个，在2月份收到约600份投稿。这个数字仅相当于arXiv投稿量的十五分之一，然而每年发表于期刊上的生物医学论文却要比物理学论文多得多。

至于生物学家们为什么没有效仿物理学家，原因并不清楚。也许仅仅是因为历史的偶然。早在大多数期刊提供在线内容之前，arXiv便已开始运作，因此与现在的在线数据库相比，最一开始的它与这些期刊的区别要更大。生物学家这个群体对电脑的熟悉程度不及物理学家，等到他们赶上这股潮流时，线上线下的区别已然模糊，而且期刊也视在线文献库为竞争对手。但不管原因为何，结果是明确的：物理学家之外的研究者并不愿积极拥抱预印本。

然而，改变这一状况的时机似乎已成熟。虽然bioRxiv使用量的绝对数字仍很低，但正在快速增长（见图表）。这种局面的实现并不只是缘于外部的助推。例如，2月，试图推广使用预印本的生物学家组织ASAPbio开始寻觅竞标者来创建一个网站。该网站将为发表在公开文献库中的所有生命科

学领域预印本编制索引。

不过，外部的推动确实有效。ASAPbio的计划得到了美国国家卫生研究院（America's National Institutes of Health，美国用于医学研究的纳税人资金主要都来自该机构）的支持，这一点并不会妨碍它取得成功。除盖茨基金会外，其他慈善组织也正在向同一方向迈进。盖茨基金会刚刚加入的由惠康基金会创立的文献库便是一个例子。另一个例子则是成立于旧金山的陈·扎克伯格生物中心（Chan Zuckerberg Biohub），由Facebook创始人马克·扎克伯格及其妻子普莉希拉·陈发起。2月，该中心宣布将向当地47位科学家捐赠5000万美元，前提是他们将研究成果以预印本形式向他人开放。

在这样一个美丽新世界里，就连商业也有一席之地。惠康-盖茨文献库实际上是由一家叫做F1000的公司在运营，这家公司本身也有自己的预印本文库：F1000Research。该文献库的运作方式与arXiv及其模仿者略有不同，区别在于它包含一个正式的同行评审程序。参与F1000评审程序的审稿人为实名而非匿名，很多人认为这是该文献库的一项优势。但该由谁担当审稿人则是由投稿人提议，这显然存在有失公正的风险。该文献库的营收来自作者投稿时缴纳的费用，最高为1000美元。

预印本的使用愈加广泛，这也许还会帮助减少文章发表前藏匿数据的问题。一旦一个预印本发布，其作者便无需担心其他人会将自己的功劳占为己有。在开放数据的同时也令原创者保持对自己成果的把控以及获得应有的认可，这一点也正变得更加容易。一些网站例如Figshare允许研究者给数据集、数字、视频等分配一个独一无二的、数字字母混合的编码（称作数字对象标识码），这样便可清楚知道它们的来源。

这一切并不一定就意味着物理学家之外的研究者会绕过期刊，并急于将自己的成果发布在公开文献库中。不过，久而久之，也许会有更多人认识到这样做的好处。随着更多的研究者提交预印本并将自己的数据向他人开放，他们也许会发现其他人对自己研究的评论很有帮助。随着有关一项研究成果实际而非潜在影响的数据显现，即便在顶级期刊上发表的荣光也会

慢慢褪色。科学期刊已存在了三百五十余年，无疑还会继续存在很长的时间。不过，如果够幸运，它们将重新成为科学的仆人，而不是对它发号施令的人。■



Human Development Index

Rwanda made great strides in human development

Between 1990 and 2015 Rwanda made the greatest strides in human development, according to the UN's annual Human Development Index (HDI), which looks at life expectancy, income and education. Rwandans can expect to live 31 years longer than they did in 1990 and now spend twice as much time at school. Syria and Swaziland have both seen their scores deteriorate. One estimate suggests that during the first two years of its war, Syria lost the equivalent of 35 years of progress in human development. The UN also calculates an adjusted development index that takes inequality into account. On average, this reduces countries' 2015 scores by 22%; Rwanda's falls by over 30%. ■



人类发展指数

卢旺达在人类发展方面大步前进

根据联合国每年发布的人类发展指数（Human Development Index，综合衡量预期寿命、收入以及教育状况），1990至2015年间，卢旺达在人类发展方面取得了最大的进步。卢旺达人目前的预期寿命较1990年多出31年，受教育的时间则增加了一倍。叙利亚及斯威士兰的得分均有下滑。一项估算显示，叙利亚内战爆发后的头两年，该国相当于失去了35年的人类发展进程。联合国还将不平等也考虑进去，计算出一项经调整后的指数。平均来看，调整后的指数令各国在2015年的得分降低了22%，卢旺达的分数则跌去超过30%。 ■



Free exchange

Self-inflicted wounds

The political recklessness behind Venezuela's economic catastrophe

IT IS hard to convey the severity of Venezuela's unfolding crisis. Its extent is astounding: the economy shrank by 10% last year, and will be 23% smaller than in 2013 by the end of this year, according to IMF forecasts. Inflation may exceed 1,600% this year. The human details are more poignant: over the past year around three-quarters of Venezuelans have lost weight, averaging 8.7kg per person, because of a scarcity of food. No war, foreign or civil, is to blame for this catastrophe. Venezuela did this to itself. And its woes are deepening, as the regime of President Nicolás Maduro lurches towards dictatorship. Fifty years ago, Venezuela was an example to the rest of Latin America, a relatively stable democracy and not much poorer than Britain. How did this tragedy occur?

Venezuela's economy is built on oil—its leaders boast it has the world's largest proven reserves—and it is tempting to blame fickle crude prices for its woes. Oil accounts for more than 90% of Venezuelan exports. It helps to fund the government budget and provides the foreign exchange that the country needs to import consumer goods. Nearly everything of consequence in the economy, from toilet paper to trousers, is imported from abroad.

As oil prices soared in the 2000s, Venezuela found itself awash in cash. In 2014 the boom ended. The volume of dollars flowing into the country tumbled, presenting the new government of Nicolás Maduro, who had taken over after Hugo Chávez's death, with an unappetising menu of options. He could have allowed the currency, the bolívar, to tumble in value. Yet prices for imported goods would have soared as a result, the market's way of curtailing Venezuelan demand for products it no longer

had the dollars to afford. Soaring prices would have violated the egalitarian spirit of Venezuela's Bolivarian government.

More important, it would have made the new president unpopular. Instead, Mr Maduro kept the wildly overvalued official exchange rate and rationed imports by tightening the government's control over access to hard currency. From early in the Chávez era, the government controlled the flow of dollars earned by the oil industry; importers had to prove they were trying to bring in something of value before being allowed to swap bolívars for greenbacks. Mr Maduro tightened the screws.

The effect was not as intended. As the flow of imports dried up, prices rose. Mr Maduro tried price controls; supply either evaporated or moved to the black market in response. The government's fiscal troubles added to the mess. With oil revenues slashed by half and the government deficit soaring, Mr Maduro might have opted to cut spending and broaden the tax base. But such measures must have looked like political poison to a freshly anointed president. Instead, Venezuela turned to the printing press to cover its bills. Devastatingly high inflation is further undermining the workings of the economy.

So oil is merely a scapegoat in Venezuela's tragedy. Economic dependence on oil is always fraught. Soaring oil prices place upward pressure on the exchange rate, leaving other, non-oil industries at a competitive disadvantage. That deepens an oil-exporting economy's dependence on crude, worsening the pain when prices eventually fall. Governments of oil-exporting countries know this, and often try to mitigate the risk. When times are good, some use inflows of hard currency to build up foreign-exchange reserves, which can be drawn down later to cover foreign-currency obligations and import bills; Saudi Arabia holds reserves worth more than \$500bn, for example. Others use oil profits to fill sovereign-wealth funds, which invest in a diversified portfolio in order to reduce the

economy's long-run exposure to petroleum. Norway's fund, which is intended to help pay for state pensions, is worth nearly \$900bn.

Chávez had the good fortune to take office at the tail end of a two-decade swoon in oil prices, and to preside over a price surge. The money that came to Chávez, he spent. From 2000 to 2013, spending as a share of GDP rose from 28% to 40%: a much bigger rise than in Latin America's other large economies. Spending crowded out growth in foreign-exchange reserves. In 2000 Venezuela had enough reserves to cover more than seven months of imports; that dropped to under three months by 2013 (over the same period Russia's reserves grew from five months of import cover to ten, and Saudi Arabia's from four months to 37).

Why did Chávez not leave Venezuela better prepared for the inevitable crash? In his version of events, Venezuelans fared poorly during the long oil bust from 1979 to his ascent in 1999 not because crude was cheap but because capitalists robbed the people of their due. During his rule, Chávez increased public spending on social programmes and expanded subsidies for food and energy. Venezuelans felt the results, in higher incomes and improved standards of living. Chávez delivered, for a time.

Yet this narrative was always false. Those in power always have a greater incentive to buy off political threats than to invest in projects that will only bear fruit over time, possibly after they have gone. In oil-rich economies, they also have the means. Chávez expropriated and redistributed wealth to weaken enemies and woo allies. In his careless economic management, he undercut the oil wealth that funded Venezuelan socialism. His assaults on private firms left the country short of the expertise and capital needed to develop its resources. In recent years it has produced less oil than China and a quarter of the output of Saudi Arabia. Venezuela ate its seed corn despite record harvests.

| *Darkness drops again*

Venezuela was once the envy of Latin America, until a long stagnation in living standards brought a populist strongman to power. But popularity is hard to maintain. The greater the desperation of the populist, the greater the willingness to accept long-run risks in exchange for short-run pay-offs. Whether or not the populist survives to see it, the day of reckoning eventually arrives. And it is always the people that suffer most. ■



自由交流

自我戕害

委内瑞拉经济灾难的背后是政治上的轻率

委内瑞拉正在蔓延的危机之深已经难以言表。其程度可谓骇人听闻：去年该国经济收缩了10%，而据国际货币基金组织的预测，到今年年底，其经济将比2013年时缩减23%。今年的通胀率可能超过1600%。当地居民的境况更是令人心酸：去年，约有四分之三的委内瑞拉人体重下降，平均每人轻了8.7公斤，原因是食物匮乏。如此灾祸并非由什么内外部的战乱引起，完全是该国自作自受。而随着总统尼古拉斯·马杜罗（Nicolás Maduro）的统治日渐倾向独裁，委内瑞拉的苦难还在加深。50年前，委内瑞拉曾是令拉美其他国家仰视的典范，是相对稳定的民主国家，经济状况和英国相差不多。如今这场悲剧是怎么发生的呢？

石油是委内瑞拉的经济支柱，其领导人宣称国内的石油探明储量为全球最高。当前的困境很容易被归咎于原油价格的变幻莫测。石油占委内瑞拉出口收入的90%，为政府提供预算资金及进口消费品所需的外汇。从卫生纸到裤子，委内瑞拉经济中几乎所有重要的商品都要从海外进口。

21世纪头十年油价飙升，委内瑞拉赚得盆满钵满。但在2014年，石油牛市终结。流向委内瑞拉的美元骤减，使得在乌戈·查韦斯（Hugo Chávez）离世后继任的尼古拉斯·马杜罗及其新政府面临一系列棘手的选择。他本可令委内瑞拉货币玻利瓦尔大幅贬值，但这样会使进口商品的价格暴涨，这样的市场机制会抑制委内瑞拉对进口产品的需求，因为没有足够的美元。价格飞涨将有违委内瑞拉玻利瓦尔派政府的平等主义精神。

更重要的是，这会使新总统不受欢迎。于是相反，马杜罗让官方汇率保持在极度虚高的水平，并收紧政府对硬货币的管制来定量供应进口商品。从查韦斯时代起，政府就控制着石油工业所赚取的美金的流动；进口商必须证明自己进口的商品是有价值的，才能获准把玻利瓦尔兑换成美元。马杜罗则进一步收紧了这种控制。

结果却出乎所料。进口萎缩后，价格随之上涨。马杜罗试图控制价格，导致供应不是化为乌有就是转移至黑市。政府的财政困难加剧了混乱。石油收入腰斩，政府赤字飙升，马杜罗本可选择削减支出并拓宽税基。但这类措施在一位新任总统看来肯定无异于政治毒药。所以委内瑞拉转而通过大量印钞来支付账单。破坏性的高通胀进一步损害了经济运行。

因此，石油只是委内瑞拉这场悲剧的替罪羔羊。经济上依赖石油总是会令人忧心忡忡。油价飙升对汇率造成上行压力，令其他非石油工业在竞争中处于劣势，并加深石油出口经济体对原油的依赖，在油价最终下滑时会令痛楚加剧。各石油出口国政府都明白这一点，往往会努力减轻这一风险。在好的年景，有的国家会利用流入的硬通货建立外汇储备，供偿付日后的外汇债务及进口账单，例如，沙特阿拉伯就拥有价值超过5000亿美元的储备。也有些国家会把石油利润注入主权财富基金；为降低经济体依赖石油业的长期风险，主权财富基金会进行多样化的投资。挪威拥有价值近9000亿美元的基金，用于支持发放国家养老金。

查韦斯有幸在油价持续低迷20年的尾声上台，而在他任内油价大涨。他赚进多少就花掉多少。从2000年到2013年，支出占GDP的比例从28%上升到40%，比拉美其他大型经济体的增幅高得多。支出吞噬了外汇储备的增长。在2000年，委内瑞拉拥有的储备足够支付七个多月的进口，到2013年降至不足三个月（同一时期，俄罗斯的储备从只够支付五个月的进口上升至十个月，沙特阿拉伯从四个月升至37个月）。

查韦斯为何没替国家未雨绸缪以应对无可避免的崩溃？按他的说法，从1979年到他上台的1999年这段石油萧条期内，委内瑞拉人之所以生活窘迫并非由于原油价格低廉，而是因为资本家抢夺了人民应得的成果。在任内，查韦斯增加公共开支用于社会福利项目，并扩大粮食和能源补贴。委内瑞拉人感受到的结果是收入提高，生活水平改善。查韦斯的施政一度带来了成效。

然而，这种论调永远是错的。掌权者总是更有动机花钱来消除政治威胁，而非投资于经年累月、可能在自己离任后才能见效的项目。在石油蕴藏丰

富的经济体中，他们也拥有可以达到这种目的手段。查韦斯征用并重新分配财富来削弱敌人，拉拢盟友。在他漫不经心的经济管理之下，为委内瑞拉社会主义提供资金的石油财富受到削弱。他打击私人企业，导致国家缺乏开发资源所需的专业人才和资本。近年来，其石油产量低于中国，还不到沙特阿拉伯产量的四分之一。委内瑞拉虽然有过丰收的年景，但却也吃掉了谷种。

| 黑暗再次降临

委内瑞拉曾经是拉美国家艳羡的对象，直到后来人们生活水平长期停滞，促使一位民粹主义强权上台。但人气是难以维持的。这位民粹主义统治者越是铤而走险，便越甘愿承受长期风险以换取短期回报。不管他本人是否能活到那一天，清算之日终将来临。而受苦最深的始终都是黎民百姓。■



The lessons

A China that works

The delta shows what the country could achieve by setting entrepreneurs free

“THE PRD WAS always the first mover in China,” explains William Fung of Li & Fung. Hong Kong’s success, he reckons, owes much to its tendency to ignore Beijing’s diktats. And Shenzhen’s special economic zone did well because it operated as a freewheeling hub. By embracing globalisation and eschewing central planning, the cities of the PRD led the way for the country’s economic opening.

As this special report has argued, the next economic revolution is now under way. New infrastructure, including high-speed rail links and the world’s longest sea bridge, is helping to stitch the region ever more closely together. Whereas some parts of China are dominated by state-owned enterprises, this region’s economy is made up almost entirely of private-sector firms. Slowing growth in world trade threatens all of China Inc, but the PRD’s nimble private firms tend to be more resilient than protected state-owned enterprises elsewhere on the mainland.

Since these firms operate in competitive global markets, they are currently undergoing the unnerving process of Schumpeterian creative destruction. Some are moving away or closing down, but those that remain are growing stronger. They are scrambling to upgrade, investing in automation, robotics and advanced manufacturing techniques. A region once infamous for its copycats is producing some world-class innovators.

The PRD is more open to the world and to the private sector than any other place on the mainland. Zhejiang, the province that is home to globally minded Alibaba, has about 33,000 foreign-invested firms, and Shanghai about 75,000, but Guangdong has over 110,000. In Liaoning, an industrial

province in the north-east, SOEs account for about 31% of total industrial revenues, and in Shanghai for more than 36%, but in Guangdong the share is less than 14%. And the delta alone generates nearly half of the mainland's high-quality international patent filings, leading China on innovation.

| *Dragon, unshackled*

To catch a glimpse of the future of the PRD, head to the Lok Ma Chau Loop. This valuable parcel of land, at the border between Shenzhen and Hong Kong, was left undeveloped for years because the two cities were fighting over its ownership. In January they agreed to develop it jointly as an innovation and technology park.

The best chance for the PRD's economy of upgrading for the future lies in co-operation between the governments of the region. Xu Qin, Shenzhen's former Communist Party secretary, sees the Loop deal as part of his city's effort to strengthen co-operation with Hong Kong so it can become an international hub. Nicholas Yang, Hong Kong's innovation secretary, reckons that since both cities have advanced economies based on services, they must work together "to get value from knowledge".

The Global Entrepreneurship Monitor, a respected annual report, pointed out in its latest issue in February that both cities have seen explosive growth in entrepreneurship in recent years even as it is declining elsewhere in China. The report argued that the two cities should build on their complementary strengths. Shenzhen has many swashbuckling startups and plenty of risk capital to back them, but they often lack global sophistication and management skills. Hong Kong is more conservative, but its cosmopolitan entrepreneurs are better at scaling, branding and going global.

With more such collaboration between the two cities, they might form the nucleus of a new regional technology cluster, as recently proposed by Ma

Huateng, Tencent's influential boss (an idea subsequently endorsed by Li Keqiang, China's prime minister). The creation of such a hub, said Mr Ma, would help China "preside over the global tech revolution of the future".

The delta can weather today's storms if its pragmatic officials work more closely together across the board and continue to respect market forces. Earlier reforms in the region demonstrated the benefits of capitalism to the rest of China and exposed the folly of central planning. The remarkable entrepreneurs who built the delta's economy can propel it forward. All that governments have to do is stay out of the way. ■



教训

一个成功的中国

珠三角展示了给企业家松绑能为中国带来什么

“珠三角一直是中国的先行者。”利丰的冯国纶说。他认为，香港的成功在很大程度上要归功于它无视北京指令的倾向。深圳经济特区发展得很好，是因为它是一个不受拘束的枢纽。通过拥抱全球化、避开中央规划，珠三角的城市引领着中国的经济开放。

正如本特别报道已指出的，新一轮经济革命正在发生。包括高速铁路和世界上最长的跨海大桥在内的新基础设施正在把这一区域更加紧密地缝合在一起。虽然在中国的某些地区，国有企业占据主导地位，但这一区域的经济几乎完全由私营企业构成。全球贸易增长放缓威胁着所有的中国公司，但珠三角敏捷的私营企业往往比内地其他地方那些受保护的国有企业更有韧性。

由于这些公司在竞争激烈的全球市场上运作，它们目前正在经历令人不适的熊彼特式“创造性破坏”过程。有些公司搬走或倒闭了，但留下来的那些正在变得更强。它们争先恐后地升级，投资于自动化、机器人技术和先进制造技术。这个一度因山寨货而臭名昭著的地区正在产生一些世界级的创新者。

珠三角对于世界和私营部门的开放程度比中国内地其他任何地方都要高。浙江是拥有全球视野的阿里巴巴的所在地，这里设有约3.3万家外商投资企业，上海约有7.5万家，但广东有超过11万家。国有企业在东北工业大省辽宁贡献了工业总收入的约31%，在上海贡献了超过36%，但在广东不到14%。中国内地高质量的国际专利申请中，单是珠三角就占了近一半，在创新方面领先全中国。

| 挣脱枷锁的巨龙

要想一窥珠三角的前景，去落马洲河套区看看吧。这片位于深圳和香港边

界的宝贵土地因为两座城市争夺所有权而闲置多年。今年1月，两市同意共同将这里开发成一个创新科技园区。

珠三角经济为未来升级的最佳机会在该地区各级政府之间的合作。深圳前市委书记许勤将河套区协议看作是深圳强化与香港合作以发展成国际枢纽的其中一步。香港创新及科技局局长杨伟雄认为，既然两市都有基于服务业的先进经济，它们必须共同努力“用知识创造价值”。

权威的《全球创业观察》年度报告在今年2月份的最新一期中指出，最近几年，这两个城市都有爆炸性的创业增长，尽管中国其他地区的创业在减少。该报告认为，两个城市应该充分利用其互补优势。深圳有很多声势凌厉的初创公司和大量的风险资本来支持它们，但它们往往缺乏全球历练和管理技能。香港比较保守，但其国际化的企业家在扩大规模、品牌打造和走向全球方面更为擅长。

随着两个城市之间此类合作的增多，它们可能会成为一个新的区域技术集群的核心，就像腾讯公司呼风唤雨的老板马化腾最近提出的那样（这个想法之后得到了中国总理李克强的背书）。马化腾表示，建立这样的枢纽将帮助中国“主导未来的全球技术革命”。

如果务实的官员能更紧密地全盘合作，并继续尊重市场的力量，珠三角将能够度过今天的风暴。该地区此前的改革向中国其他地区证明了资本主义的好处，也暴露出中央计划的愚蠢。打造了珠三角经济的卓越企业家们有能力继续推动它前行。政府要做的仅仅是别挡道。 ■



Innovation

Welcome to Silicon Delta

Copycats are out, innovators are in

ON A RECENT weekend several hundred academics and lawyers gathered in a hotel ballroom in Shenzhen for a discussion on “Innovation, inclusion and order”, an event jointly organised by the law schools at Peking, Oxford and Stanford universities. Legal conferences can be soporific, especially in China, and a scholar from Beijing duly set the tone by asserting that “order is important in the market.” But one of the local speakers livened things up by delivering a surprisingly stout defence of disruptive innovation. Xu Youjun, vice-chairman of the Shenzhen division of the Chinese People’s Political Consultative Conference, a government advisory body, said Shenzhen owed its success not to the government or the Communist Party but to its policy of allowing people to go “beyond the planned economy”.

The city imposes few limits on freedom of movement (though only a minority of its population has an official *hukou*, or household-registration certificate), is relaxed about employment contracts and does not discriminate against outsiders. “People are the greatest source of our growth,” Mr Xu concluded. The contrasting views of the boffin from Beijing and the local apparatchik help explain how disruptive entrepreneurs turned Shenzhen into one of the world’s most innovative cities.

Between 1980 and 2016 Shenzhen’s GDP in real terms grew at an average annual rate of 22% and today stands at 2trn yuan. The city’s Nanshan district, home to about 125 listed firms with a combined market value of nearly \$400bn, has a higher income per person than Hong Kong. Unlike Beijing, which has many top-flight universities, Shenzhen has only a handful of lacklustre institutions of higher learning; but so many graduates from all over China flock to the city that they make up a greater share of its

population than do graduates in Beijing.

Shenzhen spends over 4% of its GDP on research and development (R&D), double the mainland average; in Nanshan the share is over 6%. Most of the money comes from private firms. Companies in Shenzhen file more international patents (which are mostly high quality, unlike many of the domestic Chinese ones) than those in France or Britain (see chart).

The official story attributes Shenzhen's success to brave party leaders and far-sighted policies. Deng Xiaoping is lauded for liberalising the region's economy. Later political leaders receive praise for investments in infrastructure that enabled rapid growth. That is an incomplete version of history.

An incisive new book, "Learning from Shenzhen", edited by Mary Ann O'Donnell, Winnie Wong and Jonathan Bach, reveals that many of the advances seen since the city was opened up in 1980 came disruptively from below. For example, early reformers pushed ahead with unauthorised investment deals with non-mainland companies and retroactively developed the legal framework needed to protect foreign firms. Time and again, grassroots innovators hit on better ways of doing things, even though strictly speaking they were not permitted. When their risk-taking proved successful, communist leaders typically took the credit. So the best way to study innovation in Shenzhen is to examine it through the eyes of its entrepreneurial firms.

The common perception that China is incapable of innovation needs re-examining. According to a widely quoted study published earlier this decade, the value added on the mainland to Apple's iPods (nearly all of which are assembled there) represents less than 5% of the total, reinforcing the stereotype of Chinese factories as low-end sweatshops. However, a more recent study by Britain's University of Sussex and others for the

European Commission concludes that the iPod example “is far from representative”. These researchers calculate that the average value China adds to its exports is 76% (the EU’s is 87%). The World Bank reaches similar conclusions.

The PRD’s companies, which account for a huge chunk of China’s innovation, have been moving up the value chain. Local firms that used to rely entirely on imported know-how and parts have started to work on their own inventions and methods. Foreign firms that used to come to the delta to harness its brawn are now tapping into its brains as well. Today, Shenzhen is attracting many entrepreneurs keen to develop new ways of making things. The innovators are transforming the entire delta into an advanced manufacturing cluster. Many multinationals have a listening post in the city to stay close to the latest trends.

| *Making it, better*

Foxconn, a Taiwanese contract manufacturer which employs over 1m workers on the mainland, is sometimes represented as a low-tech sweatshop; in fact, it holds international patents in areas ranging from electrical machinery to computing to audio-video technology. It is expanding its Shenzhen facility to support rapid prototyping by Apple’s new R&D centre in the city. Its joint venture with Japan’s Sharp is investing \$8.8bn in Guangzhou to make advanced liquid-crystal displays. It is also developing industrial robotics in Shenzhen.

BGI, formerly known as the Beijing Genomics Institute, moved to Shenzhen to get away from northern bureaucrats. Seven years ago it was declared a “DNA superpower” by *Nature*, a science journal, after it bought so many genome-sequencing machines that it ended up owning more than half the world’s total. It is due to go public shortly.

Mindray, a devices firm with \$1bn in global sales, is developing new

technologies for ventilators, digital operating rooms and surgical robots. The firm's experience of managing both American and Chinese researchers is revealing. Its researchers in Silicon Valley are not just tutoring their counterparts in Shenzhen, it turns out, but also learning from them. Cheng Minghe, the firm's president, observes that Westerners produce high-quality research but take a long time over it, whereas the locals are better at speedy development of new kit.

Huawei spends more on R&D than Apple does. The privately held Shenzhen firm made its name as a telecoms-equipment vendor, but is now a big force in smartphones and cloud computing too. Its revenues for 2016 are estimated at 520bn yuan, a 32% increase on a year earlier. It devotes an impressive 15% of its revenues and 82,000 of its 180,000 employees to R&D.

Huawei is innovating as it is globalising. Dieter Ernst of the East-West Centre, an American think-tank, praises the company for creating a "global innovation network" of the sort that only Western multinational companies used to have, with more than two dozen R&D centres the world over and a number of collaborative hubs run with leading multinationals and universities.

This has paid dividends. Huawei is one of the world's most prolific generators of high-quality international patents. Along with Sweden's Ericsson it is at the forefront of 5G, which will replace the current 4G networks for mobile telephony. Its narrow-band internet-of-things protocol, a cheap and low-energy way to connect machines to the cloud, was recently approved as a global standard.

Another way Shenzhen is rewriting the rules is by embracing open innovation. In the West, corporate innovation has generally been a secretive, top-down affair. Many factories in the city started by making

clever imitations of Western goods, which led foreigners to dismiss the locals as mere copycats. That was a mistake. David Li of Shenzhen's Open Innovation Lab argues that the copycats have since morphed into a powerful ecosystem of collaborative, fast-learning suppliers and factories. "Anybody can come to Shenzhen with an idea and get it prototyped, tested, made and put on the market at a decent price," he says. Silicon Valley is obsessed with rich-world problems, he thinks, but China's open innovators work on affordable solutions for the masses on everything from health care to pollution to banking.

Mr Li says the already frenetic pace of Chinese innovation is speeding up further. Dealmaking used to involve long banquets and vast quantities of *baijiu*, a local firewater. Now introductions are made at the flick of a finger on WeChat, a remarkable messaging and payments app with more than 800m users. As soon as a WeChat group is formed, there is little need for phone calls or meetings. Tencent, the internet and online-gaming giant that invented WeChat, is also based in Shenzhen. Worth some \$250bn, it is one of Asia's most valuable firms. Its snazzy and green new headquarters in Nanshan towers over a modern neighbourhood of startups, incubators and funky coffee shops.

One of Shenzhen's most daring startups, Royole, is expanding its output of an extraordinary product: the world's thinnest foldable full-colour touchscreen display. Liu Zihong, a mainlander, earned his doctorate in electrical engineering at Stanford University, where he dreamt of radical new ways for machines and humans to interact. When he started Royole, he says, he knew it had to be based in Shenzhen. Getting from early-stage research to manufactured product would require a massive amount of what he calls integrated innovation: "Materials, process, device design, circuit design—all needed to be innovated...if you changed one material, you had to change the process." His team had to develop entirely new materials and factory tools, including custom-built robots, to make his screens,

accumulating over 600 patents along the way. He insists this could not have been done even in Silicon Valley, because California cannot match Shenzhen's ecosystem of "makers".

With \$280m in venture-capital investment, Royole is valued at \$3bn. It is investing \$1.8bn to build a heavily automated factory and integrated R&D complex which should propel sales past \$3bn. But Mr Liu has even grander ambitions. He thinks his screens could be deployed more widely, in places such as cups, clothes, desks, even walls. "Last year the display industry was worth \$150bn," he says, "but flexible displays will double that."

| *Hacking the future*

Shenzhen has become the world capital for hardware entrepreneurs. Navi Cohen is the co-founder of Revols, a Canadian startup developing affordable, custom-fitted headphones. His firm raised a fortune on Kickstarter, a crowdfunding site. When it tried to develop its product in Montreal, it found things slow and expensive, so it moved to Shenzhen, where supplies were cheap and factories made prototypes quickly. It is now in production.

Another promising startup that moved to Shenzhen is Wazer, an American firm. A conventional metal-cutting machine on a factory floor costs \$100,000 or more. Shenzhen's know-how helped Wazer perfect a way to cut any material precisely with pressurised water. Its desktop cutter costs about \$5,000 and will disrupt the industry when it comes to market later this year.

Revol and Wazer are among dozens of startups that have gone through a manufacturing boot camp run by Hax, a hardware "accelerator" based in Shenzhen's Huaqiangbei, the world's largest electronics-supplies market. Benjamin Joffe, a partner at Hax, reckons that Silicon Valley's experience of hardware is "six to seven years out of date". Big firms ranging from Johnson

& Johnson, an American health-care firm, to Michelin, a French tyre maker, have entered into partnerships with Hax to get closer to these bright sparks.

The most successful of Shenzhen's recent startups is Da-Jiang Innovations (DJI), reportedly worth over \$8bn, which makes affordable commercial drones. Frank Wang, the founder, and his 1,500-strong R&D team had to invent vital bits of the technology needed for its flying robotic cameras. The privately held firm commands over half of the global market for small civilian drones, and is purportedly planning to go public soon. It is now diversifying its offerings. Paul Xu, the head of DJI Enterprise Solutions, says it is aiming for business clients in fields ranging from agriculture and energy to public security. It is also considering a services-business model where users can rent airtime.

Shenzhen has done more than any place on the mainland to debunk the outdated myth of "copycat China", becoming the global hub of innovation in hardware and manufacturing. Its entrepreneurs are coming up with entirely new industries. It has been the driving force behind the upgrading that should help the PRD withstand competition. But what does its rise mean for Hong Kong, which has been the catalyst of investment and growth in the delta for decades? ■



创新

欢迎来到硅三角

山寨商走了，创新者来了

最近的一个周末，数百位学者和律师齐聚深圳一家酒店的宴会厅，参加由北京大学、牛津大学和斯坦福大学的法学院联合举办的“创新、包容与秩序”讨论。法律会议，特别是中国的法律会议，往往让人昏昏欲睡。不出所料，一位来自北京的学者声称“在市场中秩序很重要”，为会议定下了基调。不过，深圳当地的一位发言人为颠覆式创新做出了非常强有力的辩护，令现场气氛活跃了起来。深圳市政协副主席徐友军表示，深圳的成功不是因为政府或共产党，而是它的政策让人们得以“超越计划经济”。

深圳市对于自由流动的限制很少（虽然只有少数人具有正式户口），对就业合同较为宽松，也不歧视外地人。“人是我们增长的最大源泉。”徐友军总结道。来自北京的学究和当地官员的观点大相径庭，这有助于解释颠覆性创业者如何让深圳跻身世界上最具创新力的城市之列。

从1980年到2016年间，深圳的实际GDP以年均22%的速度增长，如今已达2万亿元人民币。该市南山区有约125家上市公司，合计市值约4000亿美元，该区人均收入超过香港。和拥有很多顶级学府的北京不同，深圳只有几家乏善可陈的高等院校，但来自全国各地的大量高校毕业生蜂拥而至，占人口的比例甚至比北京更高。

深圳花费在研发上的开支超过GDP的4%，是内地平均水平的两倍；而在南山区这一比例超过了6%。大部分资金来自私人公司。深圳公司提交的国际专利数量（与很多中国国内专利不同，这些大多是高质量专利）比法国和英国都要多（见图表）。

官方说法将深圳的成功归功于勇敢的党的领导人和有远见的政策。邓小平因解放了该地区的经济而备受称赞。后来的政治领导人则因投资于基础设施，促成高速增长而受到好评。而这一版本的历史并不完整。

由玛丽·安·奥多奈尔（Mary Ann O'Donnel）、黄韵然（Winnie Wong）和乔纳森·巴赫（Jonathan Bach）合编的新书《向深圳学习》（Learning from Shenzhen）一针见血地揭示了这座城市自1980年设立特区以来的诸多发展都是从底层颠覆性地发生。例如，非内地企业的投资协议尚未获批，早期的改革者就推进项目，之后才开发出保护外国公司所需的法律框架。草根创新者一次又一次发现了更好的做事方法，即便严格来说它们是不被允许的。当他们的冒险取得成功之后，共产党领导人通常会归功于自己。因此，要研究深圳创新的最好办法，就是以创业企业的视角去观察它。

认为中国没有创新能力的普遍看法需要重新审视。根据几年前发表的一份被广泛引用的研究，中国内地为苹果公司的iPod播放器（几乎全部在内地组装）增加的价值不到其总价值的5%，这强化了中国厂家是低端血汗工厂的刻板印象。然而，英国萨塞克斯大学和欧盟其他大学最近做的一项研究称iPod的例子“远不具有代表性”。这些研究人员计算出，中国对其出口品的平均附加值达到了76%（欧盟为87%）。世界银行也得出了类似的结论。

为中国创新贡献巨大的珠三角企业已经在向价值链的上游迈进。本地企业以前完全依赖进口专业知识和零件，但现在已开始研究自己的发明和方法。外企来到珠三角一度是冲着这里的体力，如今也开始利用其脑力。今天，深圳吸引了许多热衷于开发新生产方法的创业者。创新者们正将整个珠三角变成一个先进制造集群。许多跨国公司都在深圳设有“情报站”以跟上最新的趋势。

| 制造，做更好

台湾合同制造商富士康在内地雇用了超过100万名工人，它有时会被描绘成低技术含量的血汗工厂。事实上，它拥有的国际专利涵盖了从电气机械到计算再到音频视频技术等领域。它正在扩建位于深圳的工厂，用以支持苹果公司新的深圳研发中心进行快速原型设计。它与日本夏普的合资企业正在广州投资88亿美元制造先进的液晶显示器。它还在深圳开发工业机器人。

原名北京华大基因研究中心的华大基因迁至深圳以摆脱北方的官僚。七年前，它购买了大量基因测序机器，最终拥有的机器数量占全世界总数的一半以上，被科学杂志《自然》称为“DNA超级强权”。该公司将于近期上市。

拥有10亿美元全球销售额的设备厂商迈瑞（Mindray）正在开发用于呼吸机、数字化手术室和外科手术机器人的新技术。该公司管理美国和中国研究人员的经验引人深思。它在硅谷的研究人员不只是在指导深圳的同行，事实证明，他们也在向深圳学习。公司总裁程明和发现，西方人能够做出高质量的研究但需要的时间更长，而本地人则更善于迅速开发新的组件。

华为在研发上的投入比苹果还多。这家私人所有的深圳公司过去作为电信设备供应商而扬名，但如今在智能手机和云计算方面也实力雄厚。其2016年收入估计达5200亿元，较去年同期增长32%。它将营收的15%以及18万员工中的8.2万人投入研发，这一点令人印象深刻。

华为在全球化过程中不断创新。美国智库东西方中心（East-West Centre）的迪特·埃恩斯特（Dieter Ernst）称赞该公司建立了只有西方跨国公司曾经有过的“全球创新网络”，在全球拥有20多家研发中心，并和领先的跨国公司和大学建立了若干合作枢纽。

这已经带来了回报。华为是世界上最多产的优质国际专利来源之一。它与瑞典的爱立信一起站在5G的最前沿，而这即将取代目前移动电话的4G网络。其窄带物联网协议——一种廉价而低能耗地将机器连接到云端的方式——最近被批准为国际标准。

深圳改变规则的另一种方式是拥抱开放式创新。在西方，企业创新一般都是遮遮掩掩、自上而下的活动。深圳的许多工厂靠巧妙地模仿西方商品起家，这导致外国人将当地人仅仅视为山寨商。这是一个错误。深圳开放创新实验室的李大维认为，山寨商已经演变成了由善于合作、快速学习的供应商和工厂构成的强大生态系统。他说，“任何人都可以带着一个想法来到深圳，制作原型、进行测试、制造产品，并以合理的价格投放市场。”

他认为，硅谷痴迷于解决富裕世界的问题，但中国的开放创新者致力于为大众提供他们负担得起的解决方案，涵盖从医疗保健到污染治理再到银行业务的方方面面。

李大维说，中国已然狂热的创新步伐还在进一步加快。谈生意以前要吃很久的宴席并灌下大量白酒，现在只要在微信（一个拥有八亿用户的杰出的讯息和支付应用）上划划手指就可以引荐某人。一旦形成微信群，就不再需要电话或会议了。发明了微信的互联网和在线游戏巨头腾讯也把总部设在深圳。它市值约2500亿美元，是亚洲市值最高的公司之一。它位于南山区的时髦绿色新总部俯视着附近由初创企业、孵化器和时尚咖啡馆构成的现代社区。

深圳最大胆的创业公司之一柔宇（Royole）正在扩大生产一款卓越的产品——全球最薄的折叠式全彩触摸屏。刘自鸿是中国内地人，在斯坦福大学获电气工程博士学位，在那里他梦想着机器和人类互动的颠覆性新途径。他说，创办柔宇时，他知道必须立足于深圳。从早期研究到制成品，这需要大量他称之为“集成创新”的东西。“材料、工艺、设备设计、电路设计，一切都需要创新……如果你改了一个材料，你就得改工艺。”为了生产屏幕，他的团队必须开发全新的材料和包括定制机器人在内的工厂工具，并在此过程中积累了600多项专利。他坚持认为，这即使在硅谷也不可能完成，因为深圳的“制造者”生态系统是加州无法比拟的。

柔宇手握2.8亿美元的风险资本投资，估值达30亿美元。它正在投资18亿美元来建设一个高度自动化的工厂和集成研发园区，这预计会推动销售额超越30亿美元。但刘自鸿的雄心还不止于此。他认为他的屏幕可以应用在更广泛的地方，比如杯子、衣服、桌子甚至墙壁。“去年，显示行业价值1500亿美元，”他说，“但柔性屏会让它再翻一番。”

| 破解未来

深圳已成为硬件创业者的全球中心。内维·科恩（Navi Cohen）是开发经济型定制耳机的加拿大创业公司Revolvs的联合创始人。他的公司在众筹网站Kickstarter上募集了一笔钱，但在蒙特利尔尝试开发产品时，他发现那

里又慢又贵。于是他把他公司搬到了深圳，这里原料便宜，工厂也能迅速做出原型。目前产品已经投产。

另一家搬到深圳的创业公司——美国公司Wazer也很有前途。工厂中的传统金属切削机售价在10万美元或更高。深圳的技术帮助Wazer完善了一种用高压水来精确切割任何材料的方式。其台式切割机售价约5000美元，今年晚些时候推出市场时将颠覆整个行业。

在几十家通过了Hax设立的制造业训练营的创业公司中，Revolis和Wazer只是其中的两家。Hax是一家硬件“加速器”，总部设在深圳的华强北——世界上最大的电子和耗材市场。Hax的合伙人本杰明·乔夫（Benjamin Joffe）估计硅谷的硬件经验已经“过时了六七年”。从美国医疗保健公司强生到法国轮胎制造商米其林，大企业也与Hax建立合作关系以接近这些耀眼的火花。

深圳近期最成功的创业公司是制造经济型商用无人机的大疆创新，据报道其价值超过80亿美元。创始人汪滔和他多达1500人的研发团队必须发明飞行机器人摄像机的关键技术。这家私营企业牢牢抓住了全球超过一半的小型民用无人机市场，且据称正在计划于近期上市。现在它提供的产品愈发多元化。大疆企业解决方案负责人徐华滨说，公司正在瞄准从农业和能源到公共安全领域的企业客户。它也在考虑让用户租借飞行时间的服务业务模式。

为了破除已经过时的“山寨中国”的论调，深圳做得比中国内地任何地方都多，并成为了硬件和制造的全球创新中心。其创业者正在打造全新的产业。这里一直推动着是产业升级，应该能帮助珠三角抵抗竞争。但对于香港这个几十年来珠三角投资和增长的催化剂而言，深圳的崛起又意味着什么呢？ ■



Automation

Robots in the rustbelt

Factories are upgrading, but still lag far behind the rich world

WONG CHAP WING, a native of Hong Kong, runs a factory in Dongguan, an industrial city north of Shenzhen. Hip Fai, his privately held firm, stamps metal parts for things like printers and copiers. The energetic septuagenarian started die- and mould-making in 1966, and recalls a time when migrants were grateful for a job. “There are not enough technical workers now,” he complains. Young people turn up their noses at factory work. He used to pay 600 yuan a month, but now they demand 5,000.

The future is not bright for workshops that cannot upgrade. Mr Wong looked into shifting to a cheaper location inland but decided that the savings were too small. He says that many low-end subcontractors in his area are closing down. Looking at the antiquated equipment and the throngs of workers in his factory, it seems this greasy and noisy place, too, may face extinction.

Turn a corner, though, and you spot the future: a hybrid assembly line where shiny Japanese robots are mingling with human workers. Peter Guarraia of Bain, a consultancy, explains that the big global trend in factory automation is “co-bots”: robots designed to collaborate safely with workers. They will look out for people and can be programmed by line workers.

Mr Wong spent 200,000 yuan on each robot but expects to get his money back within three years because his reconfigured assembly line is much more productive. Looking back, “I could not imagine my factory full of robots,” he reflects. “I came here for the cheap labour.”

Dongguan has an official policy of encouraging automation, and has set

aside 200m yuan a year to help its factories eliminate jobs. This is part of a national strategy to upgrade manufacturing through automation. The governments of the PRD are leading the charge. Guangdong has pledged to spend 943bn yuan to boost the manufacture and adoption of robotics in the province. Guangzhou optimistically hopes to automate the jobs of four-fifths of the city's industrial workforce by 2020.

| *The productivity imperative*

The sprawling headquarters of Midea in Foshan, a city near Guangzhou, look as though that day has already come. The firm was started in 1968 with 5,000 yuan, operating from a workshop measuring just 20 square metres. He Xiangjian, the founder, and his team scrounged what they could from Mao's tattered economy to make plastic bottle caps, glass bottles and rubber balls. Today Midea is a *Fortune* 500 company and one of the world's biggest white-goods manufacturers, selling everything from internet-controlled kitchen appliances to smart washing machines. Mr He, who retains a controlling stake in the firm, is a multi-billionaire. Last year Midea gobbled up Kuka, a German robotics firm, in a deal worth nearly \$5bn. It also has a joint venture with Yaskawa, a Japanese robotics outfit. It is spending 10bn yuan to develop robots, both to use in its own factories and to sell to others.

There are two main reasons to think the delta's factories need to upgrade. First, the level of automation in China remains low compared with some of its competitors. In 2015 the average for the country as a whole was fewer than 50 robots per 10,000 factory workers, compared with about 300 in Germany and Japan and more than 500 in South Korea (see chart).

Second, China's supply of cheap labour is running out, which is pushing up wages steeply. China's low birth rate, exacerbated by its one-child policy (now revoked), has meant that the working-age population has already peaked and is set to shrink significantly in the next few decades. The mass migration of poor rural dwellers from interior provinces to the PRD is

slowing, and without that influx of labour, growth targets will be harder to hit.

As a consequence, China urgently needs to beef up its productivity. Over the two decades to 2016, labour productivity has risen by an average of 8.5% a year, but in the past three years this growth has slowed to less than 7% a year, and the absolute level remains low, at only 15-30% of that in OECD countries.

Yet automation should be market-driven, not subsidy-induced, and there are signs of a bubble. Thanks to the official push for “indigenous innovation”, Chinese automation firms are often subsidised even if their technology is not up to scratch.

In an era of rapid growth and cheap labour, Chinese bosses set up factories without much concern for efficiency or quality of tooling. If a problem arose, they would throw more men at the job rather than invest even in simple automation. Now many of them are uncritically replacing humans with hardware. AlixPartners, a consultancy, warns that China risks being “left behind as a failed low-cost-country-model economy”.

Karel Eloot of McKinsey, a consultancy, reckons that most Chinese firms are not even bothering to adopt such global best practices as Six Sigma, which uses statistical methods to ensure quality, and lean manufacturing, which emphasises efficiency and waste reduction. By one estimate, such tools could boost productivity by 15-30%. Instead, many firms are deploying robots to automate their current inefficient ways of working. Mr Eloot would like to see more data, measurement and analysis on the shop floor, with the lessons integrated into work routines.

That may sound too sophisticated, but the PRD's firms are already showing the rest of China how to leapfrog on smart automation. Consider Ash

Cloud's factory in Shenzhen. This private company makes cheap plastic cases for mobile phones, each costing a few yuan. It sells about 35m of them a year, earning it about \$35m in revenues. Although this is a brutally competitive niche, the firm's profit margin is 10%.

Fred Chen, its general manager, reveals his secret: "Most Chinese firms suffer from production losses, mistakes, scrap, communications and production errors, warehouse mismanagement and so on...our success is due to very good controls." The firm's genius is in its manufacturing management system. Every employee has access to it from scores of iPads found all over the factory. There are cameras and sensors everywhere. The iPads display in large type how much net revenue has been earned from each product during a given shift.

A manager explains the advantages: "We have no information islands...radical transparency means no secrets, no turf battles." Since everybody sees the data in real time, all can change plans on the fly. For Mr Chen the conclusion is obvious: "It is time for Chinese factories to change their management habits." ■



自动化

衰落厂房里的机器人

工厂正在升级，但仍远远落后于富裕国家

香港人黄集荣在深圳以北的工业城市东莞拥有一家工厂。他的这家名叫协挥精密五金厂（Hip Fai）的私营企业为打印机和复印机等设备冲压五金配件。这位精力充沛的七旬老人自1966年起从事染料和模具制造，他回忆起移民为获得一份工作而感激不尽的年代。“现在技术工人不够了。”他抱怨道。年轻人瞧不上工厂的活计。过去他向工人支付600元的月薪，现在他们要价5000元。

对于那些无法升级的工厂，未来并不光明。黄集荣琢磨过搬到中国内陆更为廉价的地方，但发现能节省的钱太少。他说，自己这个行当里的许多低端分包商正在把厂子关掉。看看他工厂里陈旧的设备 and 大批的工人，这个油腻又嘈杂的地方似乎也可能消亡。

然而，走过一个拐角，你却看到了未来：这里有一条混合装配线，外壳锃亮的日产机器人正和工人一起忙碌着。咨询公司贝恩的彼特·瓜拉亚（Peter Guarraia）解释说，工厂自动化的全球大趋势是“协作机器人”——被设计成和工人安全协作的机器人。它们会照顾工人，可以由流水线工人人为其编程。

黄集荣为每台机器人花费了20万元，但预期三年内就可以收回投资，因为改造后的装配线生产力已经大为提高。回想过去，“我没法想象我的工厂里都是机器人，”他沉思道，“我是为了廉价工人来这里的。”

东莞有鼓励自动化的官方政策，每年划拨两亿元帮助本地工厂减少工作岗位。这是通过自动化来升级制造业的国家战略的一部分。珠三角地区的各级政府率先发力。广东已承诺投入9430亿元来推动该省生产和使用机器人。广州市乐观地希望在2020年前将该市八成工业工作岗位都自动化。

| 提升生产率迫在眉睫

在毗邻广州的佛山市，美的集团庞大的总部里，这一天似乎已经到来。这家公司创办于1968年，启动资金5000元，最初只是一个20平米的作坊。创办人何享健带着一帮人从毛时代的经济废墟中筹措资金，生产塑料瓶盖、玻璃瓶盖和皮球等。今天，美的已是财富五百强企业，也是全球最大的家电制造商，出售从互联网控制的厨房用具到智能洗衣机等林林总总的产品。何享健目前仍是美的的控股股东，身家百亿。去年美的以近50亿美元的价格收购德国机器人公司库卡（Kuka）。它还和机器人制造商日本安川电机（Yaskawa）成立了合资公司。它正投入100亿元人民币研发机器人，将在自家工厂里使用，也会对外出售。

之所以认为珠三角的工厂需要升级，主要有两个原因。首先，和一些竞争者相比，中国自动化的水平仍然低下。2015年，全国平均水平为每一万个工厂工人拥有不到50台机器人，而德国和日本约为300台，韩国为500多台（见图表）。

其次，中国廉价劳动力的供给正在枯竭，这推动了工资急剧上涨。中国因独生子女政策（现已废除）而加剧的低出生率意味着劳动年龄人口已经见顶，且势必会在未来几十年里显著缩减。内陆省份的贫困农民往珠三角的大规模迁移也已放缓，而缺少了这一劳动力输入，增长目标将更难达到。

因此，中国亟需提高生产力水平。1996到2016年的20年间，劳动生产率平均每年提高8.5%，但在过去三年已放缓至不到7%，而绝对值仍处于低水平，仅为经合组织国家的15%到30%。

但自动化应当由市场而非补助驱动，而现在已经出现了泡沫的迹象。由于官方推动“自主创新”，中国的自动化企业常常在技术水平并不达标的情况下就获得补助。

在快速增长和廉价劳动力的年代，中国的老板们在开设工厂时无需多担心加工工具的效率和品质。一旦出现问题，他们就增配人手，而不会去投资哪怕是很简单的自动化。如今他们中的许多人都在不假思索地用硬件取代

人工。咨询公司AlixPartners警告说，中国有可能“因低成本国家经济模式失败而落后”。

咨询公司麦肯锡的卡雷尔·艾鲁特（Karel Eloot）认为，大部分中国公司甚至不愿费心去采用全球最佳做法，比如使用统计法来确保质量的六西格玛，或者强调效率和减少浪费的精益制造。有估计称，这类工具可以将生产率提升15%到30%。倒是有许多企业正在部署机器人来让目前的低效率作业变得自动化。艾鲁特期望在工厂车间看到更多数据、测量和分析，并能将所得的经验融入工作规程中。

这听起来可能太过复杂，但珠三角的企业已经在向中国其他地区展示如何在智能自动化上实现飞跃。看看黑云信息技术公司在深圳的工厂。这家私营企业生产廉价的塑料手机壳，每个手机壳的成本为几元人民币。它每年卖出约3500万个手机壳，带来约3500万美元的收入。虽然这是一个竞争惨烈的小市场，该公司的利润达10%。

总经理陈冠义透露了自己的秘诀：“大部分中国企业都要承受生产损失、失误、废品、沟通和生产故障、仓库管理不当等问题.....我们的成功源于非常好的控制。”该公司的特色在于其制造管理系统。每个员工都能在工厂里随处可见的大批iPad上查看这个系统。摄像头和传感器无处不在。iPad以大号字体显示在某个班次里每件商品赚到了多少净收益。

一位主管解释了优势所在：“我们这儿没有信息孤岛.....彻底透明化意味着没有秘密也没有争权夺利。”因为每个人都能实时看到数据，所有人都能即时调整计划。对陈冠义来说，结论是显而易见的：“中国工厂该改变管理习惯了。”■



Diversification

Asia makes, China takes

The delta's factories are doing a U-turn

“THE GREAT CONVERGENCE”, a recent book by Richard Baldwin, argues that throughout most of the industrial era the know-how and culture essential for high-end manufacturing remained cloistered in the factories of the rich world. That led to a divergence between the fortunes of the West and the rest. But once the cost of communications started plunging, after 1990, such knowledge flowed more freely. Western multinationals built world-class factories in remote places, unpacking and outsourcing their manufacturing operations and supply chains.

China was one great beneficiary of this process. The developed world's industrial knowledge and the PRD's low wages created an unbeatable combination. Vast quantities of well-made but affordable goods were shipped from the delta's factories to meet the seemingly insatiable appetites of the rich world. So the other great beneficiary of this axis of efficiency was the consumer in the West.

Now the axis is looking wonky at both ends. Labour shortages and increases in minimum wages have pushed up manufacturing salaries by a factor of four in the past ten years (see chart). They are now considerably higher in China than in South-East Asia or India. At the same time the rich world's appetite for imports from China has been kept in check by years of stagnation, and there are now fears that its enthusiasm for free trade may be waning.

This problem faces industrial exporters across the mainland, but it is most acute in the delta. Hourly wages in Guangzhou are about a third higher than the national average. In response, the PRD's resilient manufacturers are

performing a neat pivot. They are shifting some of their manufacturing to cheaper regions nearby, and they are redirecting exports to the huge and growing mainland market. “China 2.0 has emerged,” declares Marshall Fisher of the Wharton Business School. Until about 2010, the region’s labour-intensive factories (which he dubs China 1.0) operated on labour-cost arbitrage. When wages shot up, many pundits predicted a bleak future for the delta, with factories decamping en masse to cheaper places in Asia. Instead, says Mr Fisher, the PRD’s companies diversified and adapted.

It is worth noting that despite the recent difficulties, China Inc remains king of global manufacturing. Deloitte, a consultancy, quizzes over 500 chief executives round the globe every three years to rank countries on their manufacturing prowess. In the latest report, published last year, China came top, beating America, Germany and Japan, just as it had done in 2013 and 2010.

Moreover, the delta has not been hollowed out, as some had predicted. Many firms have considered leaving, and those in highly labour-intensive industries (such as low-end textiles or shoes) have indeed left. But most firms have stayed, keeping the bulk of their operations in the delta but hedging their bets by investing in cheaper regions. Some have set up factories in cities in China’s interior, others in South-East Asia.

Such investments typically form the spokes of a wheel still radiating from the PRD. George Yeo has his finger on the region’s pulse. He runs Hong Kong’s Kerry Logistics, a warehousing and transport firm with a big presence in the region. There is no evidence of a wholesale exodus, he says. His clients are adding factories in places like northern Vietnam from which goods can reach the delta within about a day.

The PRD’s pragmatic diversification has created a resilient regional network of production, known as Factory Asia, which reinforces rather than

undermines the region's importance. The delta contains many industrial clusters, ranging from cars to lighting to electronics. The complex webs of suppliers, middlemen and skilled workers on which these ecosystems rely are unlikely to disappear from it in the foreseeable future.

Tommi Laine-Ylijoki, who manages the supply chain for the consumer business at Huawei, a Chinese multinational based in Shenzhen, emphatically rejects the idea that rising costs might force him to shift manufacturing out of the PRD. He says he did look into moving inland, but found that the cost differential was only 20-30%—and his entire supplier base is in the delta. He also wants his factories and suppliers to be close to his R&D team because he believes that “collaborative manufacturing” promotes innovation. Huawei outsources the production of most smartphones, but keeps about a tenth in-house to maintain the “touch and feel” of mass manufacturing. Given the PRD's outstanding logistics, manufacturing and supply chain, he says, “I can't think of a better place to be in the world to do this.”

| *A treasure at home*

The grand pedestrian promenade at the heart of Guangzhou feels like a modern homage to Barcelona's Rambla. On one side rises a beautiful opera house designed by Zaha Hadid, on the other is a fine museum set in a building resembling a Chinese treasure box. A rainbow of lights on the elegant Canton Tower casts a shimmering reflection on the Pearl river nearby.

It does not look like a grubby industrial city. Decades of growth have made this region wealthy. The delta owes its dynamism to legions of private companies, so this wealth has been widely spread. Guangdong has a huge middle class of avid consumers. Annual total retail sales in Guangzhou and Shenzhen are far bigger than in Hong Kong. The world's highest-grossing outlet of Sam's Club, an American retailer, is in Shenzhen.

Alibaba, China's biggest e-commerce firm, holds a giant online-shopping extravaganza, known as Singles' Day, on November 11th every year. Last year customers spent a whopping 120bn yuan (\$17bn) on its shopping sites during those 24 hours, more than Americans spend on their Black Friday and Cyber Monday shopping sprees combined. Usually Alibaba hosts the event in its home town of Hangzhou, but last year it moved the Singles' Day gala (featuring Kobe Bryant, a basketball star, and lingerie supermodels from Victoria's Secret) to Shenzhen.

Guangdong spends more than any other province on Singles' Day, but there was another reason to hold the event in the province, says Chris Tung, Alibaba's chief marketing officer: his firm embraces globalisation and innovation, and Shenzhen "has always been at the forefront of China's opening up to the world and represents the spirit of forward-looking innovation".

The pivot to domestic consumption may seem an obvious move for the delta's factories, but foreign firms operating in the PRD, long fixated on export markets, were slow to respond to the rise of China's middle classes. Now they are cottoning on. Factories in the delta with owners in Hong Kong are also switching from exports to the mainland market.

Edwin Keh, an academic who previously worked as a senior procurement manager at America's Walmart, offers an explanation: "We've created this global supply chain that is very efficient at making stuff in the East and consuming in the West...but now it's pointed in the wrong direction." The PRD's shipping, transport and logistics are designed for the speedy delivery of manufactured goods from Shenzhen to Los Angeles, not Shenzhen to Xi'an. Fortunately, that is changing fast. ■



多样化

亚洲制造，中国消费

珠三角工厂180度大转弯

理查德·鲍德温（Richard Baldwin）在其新近出版的著作《大融合》（The Great Convergence）中提出，在工业时代的大部分时间里，对高端制造业至关重要的专门知识和文化一直停留在富裕世界的工厂里，这导致了西方和世界其他地区之间财富的差异。但是，1990年后通讯成本开始大跌，这类知识随即更自由地流动起来。西方跨国公司在偏远之地建造了世界级工厂，将自身的生产运营和供应链拆分并外包。

中国是这一过程的重大受益者之一。发达国家的工业知识和珠三角的低工资形成了一个无可匹敌的组合。大量制作精良而大众仍买得起的商品从珠三角的工厂输出，去满足富裕世界看似永无止境的需求。这一效率坐标轴上的另一大受益者是西方的消费者。

如今这一坐标轴的两端似乎都在摇摆。过去十年里，劳动力短缺和最低工资上涨将制造业工资推高了四倍（见图表）。如今中国的工资水平要显著高于东南亚和印度。与此同时，富裕世界经济发展停滞多年，这遏制了它们对中国商品需求的增长。现在，人们还担心它们对自由贸易的热情也在减退。

这一问题摆在中国大陆各地的工业出口商面前，但在珠三角最为尖锐。广州的时薪比全国平均水平高出约三分之一。对此，有强大适应能力的珠三角制造商们做了一个灵巧优雅的转身。它们正将生产部分转移到附近劳动力更廉价的地区，同时将出口转向中国广大且成长中的内陆市场。“中国2.0已经形成。”沃顿商学院的马歇尔·费希尔（Marshall Fisher）宣称。直至2010年左右，该地区劳动力密集型工厂（费希尔称之为中国1.0）的盈利模式一直都是劳动力成本套利。工资大幅上升后，许多专家预测珠三角前景黯淡，工厂将集体搬迁至亚洲劳动力更廉价的地区。然而，费希尔说，该地区的企业却与时俱进，将经营变得更加多样化。

值得注意的是，尽管近年困难重重，中国仍是全球制造业之王。咨询公司德勤每三年对全球各地的500多名首席执行官开展一次问卷调查，对各国的制造业实力做出排名。在去年发布的最新排名中，中国打败美国、德国和日本，位列榜首，和2013年及2010年的结果并无二致。

而且，珠三角并未像一些人预测的那样被掏空。许多公司考虑过离开这里，那些劳动力高度密集产业（比如低端纺织或制鞋）中的公司确实离开了。但大部分留了下来，将运营主体留在珠三角，但同时投资于更廉价的地区来对冲风险。一些公司已经在中国内陆城市开设了工厂，另一些则在东南亚设点。

这类投资往往仍以珠三角为轴心，并向四周辐射开来。杨荣文（George Yeo）对该地区的最新动向了如指掌。他主管的香港仓储和运输公司嘉里物流（Kerry Logistics）在该地区拥有强大的业务。他说并无证据显示发生了大规模撤离。他的客户正在越南北部等地增设工厂，在那里制造的产品大概一天内就能运抵珠三角。

珠三角务实的多元化策略已经创造出一个充满弹性的地区性生产网络，即人们口中的“亚洲工厂”，它强化而非损害了该地区的重要性。珠三角包含许多产业集群，从汽车到照明再到电子产品，不一而足。这些生态系统依赖由供应商、中间商和熟练工人组成的复杂网络。在可预见的未来，这一网络不大可能从珠三角消失。

在总部位于深圳的中国跨国公司华为，主管消费者业务供应链的汤米·莱恩-于利约基（Tommi Laine-Iijoki）断然否定了成本上升会迫使他将生产移出珠三角的可能性。他说自己确实研究过转移到中国内陆地区，但发现成本差异仅为20%到30%，而他的整个供应商基地都在珠三角。他也想让工厂和供应商靠近研发团队，因为他相信“协作制造”会推动创新。华为将大部分的手机生产外包，但保留了约一成在公司内部完成，以保持对批量生产的“直观感受”。他说，珠三角有杰出的物流、制造业和供应链，“我想不出世界上还有更好的地方来做这件事”。

| 家中的宝藏

位于广州市中心的大型步行广场仿佛像巴塞罗那兰布拉大道（Rambla）的现代致敬版。它的一边是扎哈·哈迪德（Zaha Hadid）设计的美丽的大剧院，另一边有一座高水准的博物馆，镶嵌在一个中国聚宝盒般的建筑中。五彩灯束投射到精美的广东塔上，在毗邻的珠江上洒下粼粼微光。

这看起来并不像个脏乱的工业城市。几十年的发展让这个地区变得富裕。珠三角的活力源自大批私营企业，因而这里的财富也分布广泛。广东拥有一个庞大的积极消费的中产阶级群体。广州和深圳的年零售额总和远高于香港。美国零售商山姆会员店（Sam's Club）全球销量最高的门店就在深圳。

每年11月11日，中国最大的电子商务公司阿里巴巴都会举行“双十一”（光棍节）大型网上促销狂欢。去年，顾客在那24小时内在该公司的网站上消费高达1200亿元人民币，超过美国人在黑色星期五和网购星期一消费季的总和。阿里巴巴通常都在其总部所在地杭州举办双十一狂欢夜，但去年它把这项活动放在了深圳（出席者包括篮球明星科比和维秘超模）。

广东在双十一这天的消费超过其他任何省份，但把狂欢夜放在该省另有原因，阿里巴巴的营销总监董本洪（Chris Tung）说。公司拥抱全球化和创新，而深圳“一直都处于中国对外开放的第一线，代表了前瞻创新精神”。

对珠三角的工厂而言，向国内消费转向看起来似乎是个显而易见的选择。但在这里运营的外国企业长久以来固守出口市场，对于中国中产阶级的崛起反应迟缓。如今它们加快了步伐。香港人在此拥有的工厂也开始由出口海外转向内地市场。

曾在美国沃尔玛任资深采购经理的学者埃德温·凯（Edwin Keh）给出了一种解释：“我们已经创造了一个全球供应链，它在东方非常高效地制造，在西方非常高效地消费.....但现在它的方向颠倒了。”珠三角发货、运输及物流的设计都是为了制成品从深圳快速发往洛杉矶而不是西安。幸好，这正在迅速转变。 ■



World GDP

China's economy accounts for over two-fifths of global growth

The world economy grew by 2.8% in the last quarter of 2016 compared with a year earlier, according to our estimates. The contributors to global growth have shifted over the past two decades. China's economy may be slowing—it expanded by less than 7% in the fourth quarter of 2016—but it still accounts for over two-fifths of global growth. America was the main propellor of the world economy 20 years ago, accounting for 30% of the total. It is now behind China and India in third place, contributing a mere 11%. Hong Kong was a bright spot in the fourth quarter of last year: growth in service exports helped the economy expand by 3.1% year on year, up from 2% in the previous quarter. ■



全球GDP

中国经济对全球增长的贡献超过五分之二

根据本刊估算，2016年最后一个季度，世界经济较去年同期增长了2.8%。过去20年来为全球增长做出贡献的国家已发生了改变。中国经济也许正在放缓（2016年第四季度的增长率不到7%），但它对全球增长的贡献仍超过了五分之二。20年前美国曾是世界经济的主要推动力量，占世界经济总量的30%。如今它位列中国和印度之后排在第三，仅贡献了11%的全球增长。香港在去年第四季度表现亮眼：服务的出口有所增长，推动其经济同比增长了3.1%，而第三季度的同比增长率为2%。 ■



Brains and computers

We can remember it for you wholesale

Elon Musk enters the world of brain-computer interfaces

EVER since ENIAC, the first computer that could be operated by a single person, began flashing its ring counters in 1946, human beings and calculating machines have been on a steady march towards tighter integration. Computers entered homes in the 1980s, then migrated onto laps, into pockets and around wrists. In the laboratory, computation has found its way onto molars and into eyeballs. The logical conclusion of all this is that computers will, one day, enter the brain.

This, at least, is the bet behind a company called Neuralink, just started by Elon Musk, a serial technological entrepreneur. Information about Neuralink is sparse, but trademark filings state that it will make invasive devices for treating or diagnosing neurological ailments. Mr Musk clearly has bigger plans, though. He has often tweeted cryptic messages referring to “neural lace”, a science-fictional concept invented by Iain M. Banks, a novelist, that is, in essence, a machine interface woven into the brain.

Although devices that can read and write data to and from the brain as easily as they would to and from a computer remain firmly in the realm of imagination, that has not stopped neuroscientists (and, of course, Mr Musk) from indulging in some speculation. Theodore Berger of the University of Southern California, in Los Angeles, has proposed that brain implants might be used to store and retrieve memories. Dr Berger’s prosthesis would be intended to help those whose brains cannot form long-term memories because they are damaged. But if the idea worked, there seems little reason why those without damage should not and would not want something similar. Mr Musk himself, more ambitiously still, imagines an implant that would let the wearer tap directly into the

internet, and all of the computational power available there.

| *Of minds and melding*

Behind this suggestion lies Mr Musk's argument, made repeatedly, that human beings need to embrace brain implants to stay relevant in a world which, he believes, will soon be dominated by artificial intelligence.

Proposing the artificial augmentation of human intelligence as a response to a boom in artificial intelligence may seem a bit much. But Mr Musk's new company is not alone. A firm called Kernel is following a similar path.

To start with, Kernel's engineers hope to build devices for the treatment of neurological conditions such as strokes and Alzheimer's disease.

Ultimately, however, they want to create cognition-enhancing implants that anyone might care to buy. Kernel was founded in October 2016 by Bryan Johnson, an entrepreneur who, like Mr Musk, got rich by processing payments online (PayPal, which Mr Musk helped found, bought Braintree, Mr Johnson's company, in 2013). Mr Johnson put \$100m of his own money into Kernel, stating that "unlocking our brain is the most significant and consequential opportunity in history."

In some ways, Mr Johnson and Mr Musk are merely the new boys in what is quite an old field. The first brain implants, carried out in the 1970s, were prosthetic visual systems, though they did not work well. Cochlear implants, to restore hearing, have done much better. Hundreds of thousands of people now have them—though, strictly speaking, they talk to auditory nerves rather than to the brain directly, which simplifies the task. For some people, the symptoms of Parkinson's disease can be kept in check by electrodes the diameter of a strand of spaghetti inserted deep into the brain. And one of the latest ideas in the field is to read and interpret brain activity, in order to restore movement to the limbs of the paralysed.

In one important way, however, Kernel and Neuralink are different from

previous efforts. Though aimed initially at medical applications, they also explicitly nod to the possible non-medical uses of this kind of implant technology. In February Mr Musk said that he thought “meaningful” interfaces between the brain and computation were five years away. The creation of Neuralink suggests that he, like Mr Johnson, is putting his money where his mouth is.

Most neuroscientists would, it must be acknowledged, regard all this as heroically optimistic. In a review of the field, published in January in *Nature Reviews Materials*, Polina Anikeeva and her colleagues at the Massachusetts Institute of Technology (MIT) wrote that, although Moore’s Law and the miniaturisation of electronics have brought devices down to a size where their insertion into the brain can be considered, big challenges lie ahead.

The brain’s complexity, and researchers’ present lack of understanding of how that organ’s component cells work together to do what they do, makes designing interfaces between brain and machine hard. But, even were it simple in principle, the rigid, silicon-based tools of modern computing do not mesh easily with the squishy soft-tissue of biology. Implants often generate scars around themselves. And the surgery needed to put them in place carries risks of its own.

There may, though, be alternative approaches. One such is being tested by a group at Florida International University, in Miami, led by Sakhrat Khizroev. Dr Khizroev and his team use magnetoelectric particles so tiny that they can interact with the electric field generated by an individual nerve cell. The team inject these particles, tens of billions at a time, into a vein in a rat’s tail, then drag them into the animal’s brain using magnets. Each particle produces an electric field when stimulated by an external magnetic field. This may, in principle, permit a researcher to use such a particle to influence the electrical states of nearby nerve cells—and thus, in

essence, reprogram them. How that would be done in practice, though, is obscure.

Another approach, being pioneered by Jose Carmena of the University of California, Berkeley, and his colleagues, uses devices the size of a grain of rice to convert ultrasonic energy beamed towards them into electricity that can stimulate nerve or muscle cells. Ultrasound travels through the body, so can power and control such devices without wires.

Both Dr Khizroev's technique and Dr Carmena's are less invasive than the current standard brain interface, a patch of needlelike electrodes known as a Utah array that is plugged into the brain's surface. This is far too blunt an instrument to send any but the crudest signals into a brain. But, regardless of the precise approach taken to hardware, another problem the field faces is that no one understands the mechanism behind the natural equivalent of software—the way the brain encodes information. Such interfaces as do exist have to be trained, rather than instructed what to do. Instruction would be possible only if brain signals were properly understood.

It is not yet clear which technological routes Mr Musk's and Mr Johnson's commercial efforts will take, though Kernel recently bought Kendall Research Systems, a spin-off from MIT that builds devices which use light, rather than electricity, to stimulate the brain. But the two firms' shared underlying premise—that medical purposes might lead to more consumer-orientated applications—does seem a sensible way to do things.

People understand that medical procedures can be risky. As long as it is done in good faith, they will tolerate experimentation on people that would be intolerable in non-medical circumstances. That will let Neuralink, Kernel and those that come along afterwards build up expertise that might be turned to more general effect in the future.

As for Mr Musk himself, Neuralink brings to five the number of ambitious technology companies in which he is involved. The others are Tesla (electric cars, batteries and solar power), which in late March attracted an investment from Tencent, a Chinese tech giant; SpaceX (rocketry); the Boring Company (tunnelling); and Hyperloop (vacuum trains). It is hard to discern the connections between these ideas. But, in Mr Musk's mind, they are presumably already laced together. ■



人脑与计算机

我们能为你保存大把的记忆

伊隆·马斯克步入脑机连接的世界

1946年，第一台可由单人操作的计算机埃尼阿克（ENIAC）开始展示自己的环形计数器。自那时起，人类和“计算的机器”便一直向更紧密的结合稳步前进着。计算机在上世纪80年代走入千家万户，之后又移步至人们的膝上、口袋里以及腕间。在实验室里，计算在白齿上及眼球中派上了用场。由此得出的一个合理结论便是：总有一天，计算机会进入人类的大脑。

起码一家名叫Neuralink的公司押下了这一赌注。这家公司刚由开创了一系列科技业务的企业家伊隆·马斯克（Elon Musk）设立。关于该公司的信息寥寥，但其商标申请文件称公司将打造用于治疗及诊断神经系统疾病的侵入性装置。不过，马斯克无疑还有更宏伟的计划。他经常在推特上发些令人捉摸不透、谈及“神经织网”（neural lace）的消息。这一科幻概念是由小说家伊恩·M·班克斯（Iain M. Banks）所构想，从本质上说，就是将机器界面植入人脑。

虽然能够自如地在人脑内读写数据（就像在计算机上读写数据那样）的设备仍然只停留在想象的世界中，但神经科学家们（当然，还有马斯克）并没有就此停止去探究某些猜测。洛杉矶南加州大学的西奥多·伯格

（Theodore Berger）提出，人脑植入物也许可用来存储和提取记忆。伯格所说的这种大脑假体将被用于帮助那些脑部因受损而无法形成长期记忆的人。不过，如果这一想法奏效，那些大脑并没受损的人似乎也并没有什么理由不应该要、也没理由不想要和这种假体类似的东西。马斯克本人的想象更为大胆。他觉得可以有这样一种植入物，让植入者直接就能使用互联网，以及互联网提供的所有计算能力。

| 人脑与融合

马斯克反复提及、用以支撑这一想法的论据是：他认为人工智能很快将主导这个世界，人类需要欣然接纳脑植入物才不至于变得无足轻重。利用人

为手段来增强人类智能，以此来应对人工智能的蓬勃发展，这似乎有点过火。不过马斯克的新公司并不是独一份。一家名叫Kernel的公司也走上了类似的道路。

Kernel的工程师希望首先能打造出用于治疗中风及阿尔茨海默症等神经系统疾病的设备。不过，他们最终想创造的是能够强化认知能力、任何人也许都想买的植入物。Kernel由企业家布莱恩·约翰逊（Bryan Johnson）于2016年10月创立。和马斯克一样，他也是因提供在线支付的处理服务而致富（马斯克参与创办的Paypal在2013年收购了约翰逊的公司Braintree）。约翰逊自掏腰包向Kernel投入一亿美元，并称“解开我们大脑的秘密是有史以来最为重要、意义最为重大的一个机会。”

从某些方面来看，约翰逊和马斯克仅仅是新步入一片久经耕耘的领域的毛头小伙。最早的脑植入物是人工视觉系统，于上世纪70年代植入人脑，不过效果并不太好。用于恢复听力的人工耳蜗表现则要好得多。如今已有几十万人植入了人工耳蜗——不过严格说来，它们并不是直接同大脑对话，而是连接听觉神经，这使任务得以简化。在有些人那里，将数根意面粗细的电极植入其大脑深处，便可抑制帕金森氏症的某些症状。该领域最新的想法之一是读取并解读大脑的活动，以使瘫痪之人的四肢恢复活动能力。

不过，Kernel和Neuralink在一个重要的方面有别于前人的工作。虽然它们最初的计划是将这类植入技术应用于医疗，但也明确表示可能将它们应用于医疗之外的目的。马斯克在2月称，他认为要实现人脑和计算机之间“有意义”的连接需要五年的时间。Neuralink的创立表明他和约翰逊一样，是个会为自己倡导的东西投资的人。

必须得承认，多数神经科学家都会认为这些计划乐观中却也透着逞强。在发表于1月《自然综述：材料》（*Nature Reviews Materials*）上的一篇对该领域的综述中，麻省理工学院的波琳娜·安尼基娃（Polina Anikeeva）及其同事写道，虽然摩尔定律及电子元件的微型化已使各种装置缩小到可以考虑将之置入大脑的程度，但未来仍存在着重大挑战。

由于人脑的复杂性，以及研究人员目前对组成人脑的细胞协同工作的原理解得并不充分，要设计人机接口并不容易。不过，就算这在理论上变得简单易行，要让硬质的现代化计算硅片跟生物学中黏湿的软组织相融合也不会很容易。植入物经常会对周围的组织造成创伤，将它们放入相应位置的手术本身也存在风险。

不过，或许还有其他的办法。迈阿密佛罗里达国际大学（Florida International University）的萨克拉特·齐兹洛夫博士（Sakhrat Khizroev）所领导的团队便在测试其中的一种。他们使用的磁电粒子十分微小，能够与单个神经细胞产生的电场相互作用。该团队将数百亿这种粒子一次性注射进小鼠尾部的血管中，然后用磁铁将它们引至小鼠的大脑。每个粒子都会在外部磁场的刺激下产生电场。这在理论上或许可令研究人员利用这种粒子来影响附近神经细胞的电位状态——实质上就是重新编排这些细胞。但这在实践中能如何实现就不得而知了。

加州大学伯克利分校的何塞·卡梅纳（Jose Carmena）及其同事正在开创另外一种替代办法。他们所使用的装置有一粒米那么大，可将射向它们的超声波能量转化为电能来刺激神经或肌肉细胞。超声波能穿透身体，因而无需电线就可驱动和控制这种装置。

齐兹洛夫和卡梅纳所采用技术的创伤都小于目前常见的那种脑界面，即一个布满针状电极的小块，名为犹他电极阵列（Utah array），使用时插入大脑表层。它只能向大脑发送最粗糙的信号，远不是一个有效的方法。不过，不管硬件采取的是何种方法，该领域都还面临着另外一个问题：没有人了解软件的天然对等物的工作机制，即大脑是如何进行信息编码的。现有的这种接口只能接受训练，而不能遵循指令行事。只有在大脑信号能被正确理解的情况下才能有效地发布指令。

目前尚不清楚马斯克和约翰逊的商业运作会采用何种技术路线，不过Kernel最近收购了从麻省理工学院剥离出来的Kendall Research Systems。该公司制造的装置利用光而不是电来刺激大脑。但这两家公司共同的假设——医疗上的用途也许会指向以消费者为导向的应用——似乎确实是一个

明智的行事方法。

人们明白医疗手术会有风险。不过只要态度真诚，人们或许会容忍在非医疗目的的情况下对人体进行实验，而这种实验通常在非医疗目的的情况下是不被允许的。这样的话，Neuralink、Kernel以及随后出现的公司就能增强自身的专门技能，在将来也许可将这些技能转化成更为广泛的应用。

对马斯克本人而言，有了Neuralink，与他有关的雄心勃勃的科技公司数量就变成了五个。其他四个分别是：生产电动汽车、电池及太阳能的特斯拉，3月底刚吸引了中国科技巨头腾讯的投资；从事火箭研究的SpaceX；专事挖掘隧道的Boring Company；采用悬浮真空列车的超回路列车（Hyperloop）。要识别这些创意之间的关联很难，不过，在马斯克的脑袋里，它们想必已经交织在一起了。■



Optics

The bug-eyed view

An insect's eye inspires a new camera for smartphones

MALES of a species called *Xenos peckii* have an unusual eye for the ladies. *X. peckii* is a member of the Strepsiptera, a group of insects that parasitise other insects. Its victim of choice is the paper wasp, inside the abdomen of which it develops from larva to adult by eating its host from the inside. Females of the species are blind—there is, after all, little to see in their abode. But males have a pair of eyes (see picture below) that are unique to the Strepsiptera, and vital for one brief and important task. When he matures, a male *X. peckii* must leave his host and find a mate quickly, because he will die within a few hours. A group of researchers working for the Fraunhofer Society, a German government research organisation, have now copied the way male *X. peckii* eyes work, and used the method as the basis of a new miniature camera for smartphones.

Many animals (human beings and octopuses are good examples), have eyes that use a single lens to focus light onto a sheet of receptor cells at the back of the eye, called a retina, to form an image. This is similar to the way that a digital camera's lens focuses such an image onto a retina-like light-sensor made up of millions of individual detectors. Other creatures, though—insects among them—have compound eyes. These are composed of units called ommatidia. Each ommatidium consists of a tiny lens, called a facet, and a few receptor cells. The eye itself is a bulbous structure composed of many of these ommatidia arrayed together. Individual ommatidia detect points of light, which act as the pixels from which the creature's brain weaves a complete image. Compound eyes generally have worse resolutions than single-lens eyes, but their shape provides a wider field of view, which is useful for spotting food and predators.

The eyes of *X. peckii*, however, are a compromise between these two extremes. They have a few, large facets and instead of detecting points of light the ommatidia each create an actual image of part of the eye's field of view. The resulting mosaic of slightly overlapping images is then stitched together by the insect's brain. This unusual arrangement results in both high resolution and a broad view of the world, using a pair of eyes that do not take up much space.

| *Compound interest*

That is great for finding a mate. It is also exactly what makers of smartphones want for their cameras. At the moment, smartphones often have what is known as a "camera bump"—a bulge in the case to house the optics. Build a camera that mimics *X. peckii*'s eye and you could remove that bump. Which is what the Fraunhofer team hope to do.

Fraunhofer is an organisation with institutes all over Germany. In this case the lead is being taken by the Institute for Applied Optics and Precision Engineering, in Jena, though other sites are involved as well. So far, the project's researchers have succeeded in making a camera with 135 facets that is only 2mm thick but has a resolution of one megapixel.

True, that resolution is dwarfed by the 12 megapixels available on the latest iPhone 7, but the iPhone's camera still requires a bump even to fit into the generous dimensions of the phone's 7.1mm-thick case. And one megapixel is only a start. The group believe that their facetVISION camera, as they call it, can be boosted to four megapixels. At that resolution it would be good not only for leisure use, but also for a number of industrial and medical applications. Besides phones, it might be fitted to probes, to small sensors and even to robots, to give them vision.

The initial facetVISION camera was made using a vapour-deposition process similar to the one employed to make computer chips. This has

limitations, and is expensive for mass-production. For high-volume applications, such as smartphones, the researchers are therefore trying to adapt the process to the way cameras for phones are made at the moment. This employs injection moulding to form the lenses; those lenses are then placed over the light-sensors in a separate operation. Using this production technology the group think it will be possible to build a facetVISION camera that has several small lenses placed next to each other. The result would be around 3.5mm thick, so would fit easily inside the case of the thinnest smartphone—and, by being able to use more powerful sensors, would boast a resolution greater than ten megapixels.

A smartphone using this camera would have to run special software to combine the images—much as *X. peckii*'s brain does. But elaborate image-processing already happens in such phones, so that should not be hard. Moreover, since the multiple lenses each capture slightly different aspects of the image being snapped, lots of other tricks might be possible, too. Watch out, then, for a bug's eye view on Facebook, Snapchat or Instagram. ■



光学

大开眼界

一种新型智能手机摄像头面世，灵感来自于某种昆虫的眼睛

有一种名为Xenos peckii的物种，雄虫有一双特殊的眼睛，善于寻觅雌虫的芳踪。它所属的捻翅目（Strepsiptera）昆虫都会寄生于其他昆虫体内。最常被X. peckii选中的可怜虫是胡蜂，它在胡蜂的腹腔内蚕食宿主，从幼虫成长为成虫。雌虫没有视觉——毕竟它们的住所里也没什么可看的。然而雄虫却有一对捻翅目昆虫特有的眼睛（见下图），在进行一项短暂但重要的任务时不可或缺。雄虫一旦成熟，就必须离开宿主并迅速找到交配对象，因为它在几个小时内便会死亡。目前，德国政府研究机构弗劳恩霍夫应用研究促进协会（Fraunhofer Society）的研究人员效仿这种雄虫眼睛的工作原理，以此为基础来研发智能手机上的新型微型摄像头。

许多动物（人类和章鱼就是很好的例子）的眼睛都是利用单个“镜头”（即晶状体）将光线聚焦到眼睛后部的一层薄膜上成像，这层由感光细胞组成的膜就叫做视网膜。这与数码相机镜头将图像聚焦在类似视网膜的感光元件上相似，感光元件则是由数百万个独立探测器构成。不过，其他种类的生物（包括昆虫在内）则拥有复眼。复眼是由名为小眼的单元组成，每个小眼都有一个叫做小眼面的微小晶状体，以及一些感光细胞。复眼本身则是一个球形结构，由很多这样的小眼排列组合而成。每个小眼感应到的光点便是生物大脑所拼合的完整图像的像素。复眼成像的分辨率通常比单眼的要差，但它们的形状为生物提供了更宽的视野，这在寻找食物和躲避捕食者时都很有用处。

不过X. peckii的眼睛则是宽广视野和高分辨率二者的折衷。它们的小眼晶状体很大，但数量少，并且每个小眼都会生成视野局部的实际图像，而不是去感知光点。由此产生的一系列略微重合的图像再由昆虫的大脑拼合起来。有了这种不同寻常的构造，即便它的眼睛并不算太大，也能做到既拥有高分辨率，又有广阔的视野。

| 复眼的妙处

这在寻找交配对象时十分有利。而智能手机生产者也希望自家摄像头拥有这类特点。目前，智能手机通常都存在着所谓的“摄像头凸起”（camera bump），即为了容纳光学元件，摄像头会凸起于手机之外。仿照X. peckii的眼睛来制造摄像头就可消除这个凸起。弗劳恩霍夫团队期望做到的便是这一点。

弗劳恩霍夫协会下设的研究机构遍布德国，领导这个项目的则是耶拿（Jena）的应用光学和精密机械研究所（Institute for Applied Optics and Precision Engineering），不过其他地方的机构也参与了进来。到目前为止，该项目的研究人员已成功研制出包含135个微小平面的摄像头，仅有两毫米厚，但分辨率达到了100万像素。

当然，这样的像素和最新的iPhone 7高达1200万的像素相比是小巫见大巫。不过即使是安装在7.1毫米厚的大尺寸机身中，iPhone的摄像头仍需凸出于机身。而且，100万像素仅仅是个开始。该团队相信，他们所谓的“小眼视觉”（facetVISION）摄像头可提高至400万像素。这种水平的分辨率不仅可满足闲暇时的消遣，在工业和医疗领域里也会有多种应用。除了手机，这种摄像头还可安装于探测仪、小型传感器甚至机器人之中，给它们以“视觉”。

最初制造小眼视觉摄像头采用的是气相沉积工艺，与制造电脑芯片的工艺类似。但这种方法有局限性，进行大批量生产的成本也很高昂。因此，为了智能手机这样的大量应用，研究人员正尝试改进这项工艺，使之适用于当下手机摄像头的制造方法。这种方法采用注塑成型的工艺来生产镜头，之后再在另外一道工序中将镜头置于感光元件之上。该团队认为，运用这种生产技术将可以制造出由若干小镜头排放在一起形成的小眼视觉摄像头。最终生产出的摄像头厚度约为3.5毫米，最为纤薄的智能手机也能轻松装入。再者，一旦使用了更为强大的传感器，这种摄像头还能实现超过1000万像素的分辨率。

使用这种摄像头的智能手机将需要运行特殊的软件来拼合图像，这与X.

peckii大脑的功能大致相仿。不过智能手机已经具备复杂的图像处理功能，所以这应该不会是个难题。此外，面对拍摄对象时，众多镜头中的每一个所捕捉到的部分都与其他镜头略有不同，利用这一点或许还可以玩出很多别的花样。期待Facebook、Snapchat和Instagram上的照片让你大开眼界吧。 ■



The construction business

Profiting from the wall

Construction firms eye up the wall planned for America's border with Mexico

FEW slogans were chanted with as much passion by Donald Trump's supporters in the presidential campaign as "Build that wall!". The construction industry is almost as enthusiastic. In mid-March America's Customs and Border Protection agency (CBP) issued two invitations for companies to bid to build the wall on the border with Mexico, which is expected to cost anywhere between \$12bn and \$25bn. The deadline for designs falls on March 29th. One request is for a solid concrete border wall, and the other for a wall using "alternatives" to reinforced solid concrete, suggesting the government has yet to decide what the barrier should be made of.

More than 700 companies, from big general contractors to firms selling materials to niche providers of lighting and surveillance systems, have registered to try to become suppliers. To the surprise of some, about one in ten of the firms bidding are local ones with Hispanic owners, drawn by the scale of the earnings on offer. Cemex, a Mexican cement giant that has plants on both sides of the border, said it would not sell cement for the project, though it had earlier expressed interest in joining the bidding. Another, tiny, Mexican firm has offered lighting.

Other foreign firms muscling in include SA Fence & Gate from South Africa and Quickfence from Spain, although they may not get far: the government's tender mentions a "Buy American" preference. Skanska, a Swedish firm that is one of the construction industry's largest, publicly snubbed the project. "We believe in openness and equality," declared its chief executive, Johan Karlstrom.

The big American bidders try to downplay the politics. Howard Nye, the boss of Martin Marietta, a materials giant based in North Carolina, says simply that his company has “a general interest in large infrastructure projects”. Its shares and that of other construction firms have risen as a result of Mr Trump’s pledge to lavish \$1trn on infrastructure across the country. Those plans may be delayed, but not, it seems, the wall. For some smaller bidders, business and personal views are aligned. Michael McLaughlin of Greenfield Fence, a contractor based near San Diego, says the barrier is needed to keep “dangerous drug dealers” out of the country.

The general requirement is for a wall that is at least 5.5 metres high, preferably 9 metres, with anti-climb and anti-tunnelling features, and which—on the American side, at least—is “aesthetically pleasing”. The few dozen firms that make it to the second round will later present detailed drawings and technical specifications as well as their best price. At the end of the process a still unknown number of winners will each be awarded a contract with a maximum value of \$300m.

The rules of the game clearly favour large engineering and construction firms such as KBR, which helped build the detention camp at Guantánamo Bay and which will probably bid, or Kiewit, from Nebraska. These companies have the best design expertise, top-notch construction-management teams and the ability to strong-arm materials suppliers. But smallish players could still turn a profit by signing up to be subcontractors to bigger, prime contractors. Andrew Dorfschmidt of McDirt Excavation, a family-owned business in South Dakota, hopes to sell digging services to whichever companies are awarded the government contract.

Other firms are not interested in building the wall itself but are looking to sell border-wall accessories that are known as “tactical infrastructure and technology”. These include lighting, standing platforms and remote video-surveillance systems. One such firm, 2020 Surveillance, assumes there will

be cameras placed every 60 metres along the wall. At a licensing fee of a few hundred dollars per camera per year it would expect to make \$10m in revenue every year the wall is in place, if it supplied surveillance for the whole length required, or about 1,000 miles (1,610km).

Despite the strong expression of interest from potential bidders, the construction schedule could be unpredictable. For one thing, company bosses note that the wall will run through many parcels of private land. Although eminent-domain laws, which force the transfer of private property into public hands, may be invoked by the government, agreeing on adequate compensation for evicted landowners often becomes a legal headache.

Receiving payment could also take time. Only a small fraction of the estimated total cost of building the wall has been ring-fenced under Mr Trump's "skinny" budget proposal. Mexico has disobligingly ruled out paying for it. Delay may not matter to everyone, however. Working on Mr Trump's pet project is probably a good way to get a slice of a broader infrastructure splurge, if and when it comes. ■



建筑业

筑墙获利

建筑公司都盯上了美国与墨西哥之间拟建的边境隔离墙

特朗普的支持者在总统竞选中喊过许多口号，“建墙！”是喊得最激昂的一个。建筑行业对此几乎也同样热情洋溢。美国海关和边境保护局（CBP）在3月中旬发布了两份美墨边境隔离墙的项目招标书，预计建设成本在120亿到250亿美元之间，有意向的承包商需要在3月29日前递交设计方案。两份招标书里一份要求建造坚实的混凝土墙，另一份则要求使用钢筋混凝土的“替代品”，这表明政府尚未决定用什么材料来建这道墙。

从大型总承包商到建筑材料公司，再到照明和监控系统的配套供应商，已有700多家公司注册想要成为供应商。让一些人惊讶的是，受到盈利规模的吸引，投标公司中约有十分之一是拉美裔业主所有的本地企业。在边界两边都有工厂的墨西哥水泥巨头西麦斯（Cemex）早些时候表示有兴趣参加投标，现在又称不会向该项目出售水泥。另一家很小的墨西哥公司已投标照明工程。

其他想要挤入围的外国企业包括南非的SA Fence & Gate和西班牙的Quickfence，不过它们中标的希望都不大，因为政府的招标提到了优先“从美国公司采购”。建筑行业最大的公司之一瑞典斯堪斯卡（Skanska）公开对该项目表示不屑，公司首席执行官约翰·卡尔斯特隆（Johan Karlstrom）宣称：“我们相信开放和平等。”

参与投标的美国大公司试图淡化其中的政治元素。建筑材料巨头马丁·玛丽埃塔（Martin Marietta）位于北卡罗来纳州，该公司老板霍华德·奈（Howard Nye）轻描淡写地说，他的公司“对大型基础设施项目都有兴趣”。由于特朗普承诺在全国各地的基础设施建设上投资一万亿美元，马丁·玛丽埃塔和其他建筑公司的股价均已上涨。其他基建计划可能会推迟，但边境墙似乎不会。对于一些较小的投标公司，公司观点和个人观点是一致的。圣地亚哥附近的承包商Greenfield Fence的迈克尔·麦克劳克林

（Michael McLaughlin）说，有必要修建边境墙将“危险的毒贩”拒于国门之外。

招标书的基本要求是边境墙要防攀爬、防打地道穿越，至少5.5米高，最好9米，还要兼顾“美观”（至少在美国这边）。进入第二轮投标的几十家公司之后将提供详细的图纸和技术规格，以及最优惠的价格。在招标工作的最后，数量不定的中标公司将各自签下最高可达3亿美元的合同。

此次的游戏规则明显有利于KBR集团（参与修建了关塔那摩湾监狱，有可能会参与投标）或内布拉斯加州的Kiewit公司这样的大型工程和建筑公司。这些公司拥有顶尖的设计专长、一流的施工管理团队以及对材料供应商强硬的议价能力。不过小公司仍可通过签约成为大型主承包商的分包商来获利。McDirt挖掘公司（McDirt Excavation）是南达科他州的一家家族企业，该公司的安德鲁·多夫施密特（Andrew Dorfschmidt）希望能向任何获得政府合同的公司出售挖掘服务。

其他一些公司对修建边境墙本身并不感兴趣，但期望能够出售被称为“战术基础设施和技术”的配套设施和服务，包括照明、岗哨平台和远程视频监控系統。其中就包括提供监控设备的2020 Surveillance公司，它假设边境墙每隔60米就要安装一个摄像头，每个摄像头每年的许可使用费为几百美元。如果能为整个边境墙提供监控设备（全长大约1610公里），预计每年将有1000万美元的收入。

尽管潜在的投标公司兴趣很大，但施工进度却可能无法预测。一方面，很多公司老板都指出，这堵隔离墙将经过许多私人地块。虽然政府可以诉诸土地征用权法，强制将私有土地转入政府手中，但要与被征用土地的所有者就适当的赔偿水平达成一致通常都会成为棘手的法律难题。

拿到工程款也可能需要较长时间。隔离墙的预计总成本中只有一小部分被纳入特朗普业已“瘦身”的预算草案。墨西哥已经毫不客气地拒绝买单。然而并非所有人都会在乎付款延迟，因为参与特朗普钟爱的项目或许是从更广泛的庞大基建计划中分得一杯羹的好方法，如果该计划有朝一日成为现

实的话。■



Aarusha Homes

Room to grow

The road to Indian prosperity is paved with cheap and cheerful hostels

IF SEVERAL hundred million Indians do migrate from the countryside to cities between now and 2050, as the UN expects, it will be a fiendishly busy few decades for Vivek Aher, who runs a low-cost hostel, one of five, on the outskirts of Pune, a well-off city three hours' drive from Mumbai. A fair few of the new arrivals will have their first experience of urban living bunking in one of the hostels' 1,350 beds. Should recent experience be anything to go by, most of the new arrivals will test Mr Aher's patience by tacking posters on his hostel's walls, or endlessly complaining about the Wi-Fi.

India has two main drags on economic growth. One is the difficulty of finding a job, especially in the places people live. The other is a chronic shortage of cheap housing. Aarusha Homes, Mr Aher's employer, started in 2007 to help people seize economic opportunities far from home. Its rooms are basic and cheap. They include up to six beds, a bathroom for every three or four residents, some common areas and little else. Rent ranges between 3,500 and 10,000 rupees (\$52-\$149) a month including food.

Most of Aarusha's tenants are young, many of them taking first steps into the middle-class as IT or business-processing outsourcing professionals. Paying up to six months' deposit for a city flat is beyond their means, as is the down payment for a motorbike that would allow them to live far from their employer. Aarusha's successful pitch is that its hostels are safer than slums or informal "guest houses", especially for women. It now has 4,300 beds in 1,300 rooms spread out over 20 hostels in four cities. The typical tenant stays for six months. Satyanarayana Vejella, the firm's co-founder, plans to raise another \$10m to increase capacity by 12,000 beds in nearly 70 new hostels, all in the next two years. Operating-profit margins are in the

mid-teens.

The chain's backers include investment funds who seek social as well as financial returns. The latter would be improved if the chain dodged taxes by operating in the informal economy, like much of its competition, but it sticks to the formal side. The problems it faces are those confronted by any Hilton or Hyatt: finding properties big enough to offer over 100 beds is hard. Tenants have to be chased for payments. An attempt to cater to blue-collar workers at an even lower price didn't work out. So Aarusha is reliant on the IT and outsourcing sectors, which are hiring less eagerly than before.

Aarusha can probably depend on continuing strong demand for a room from which to make sense of it all before people can get their own places. The hostels have something of a communal feel, and parents find them reassuring because residents put up with not being able to drink, smoke, or mingle with the opposite sex. Soon enough, they will have moved on, taking their aspirations and their posters with them. ■



Aarusha Homes

成长空间

印度的繁荣之路由廉价而欢乐的旅馆铺就

如果真如联合国预计的那样，从现在到2050年会有数亿印度人从农村迁移到城市，那么在这几十年里，经营廉价旅舍的维韦克·阿赫（Vivek Aher）将会极其忙碌。他管理的5家旅舍中有一家位于浦那（Pune）市郊，富裕的浦那距孟买三小时车程。好些新来的人会在这些旅舍的1350张床位中找到一张安顿下来，第一次体验城市生活。如果最近的经验可靠的话，那么可以想见，大多数新移民会把海报钉在旅舍的墙壁上，或喋喋不休地抱怨Wi-Fi，以此来考验阿赫的耐心。

印度的经济增长受两大因素拖累。一是找工作很困难，尤其是在本乡本土。二是廉价住房长期短缺。阿赫所在的Aarusha Homes公司从2007年起就开始帮助人们抓住那些远离家乡的经济机遇。它的房间很便宜，只提供最基本的设施。屋里最多放6张床，每三到四人共用一个卫生间，还有一些公用区域，此外再无其他。每月租金（含伙食）从3500到一万卢比（52到149美元）不等。

Aarusha的大部分租客是年轻人，其中有许多是IT或业务处理外包的专业人员，正向中产阶级迈出第一步。为一套城市公寓支付高达六个月的押金已经超出他们的财力，为摩托车（这样就能住在离公司较远的地方）交首付款也一样。Aarusha的成功卖点是它的旅舍比贫民窟或非正式的“招待所”更加安全，这对妇女尤其有吸引力。目前它在四座城市拥有20家旅舍、1300个房间和4300张床位。通常租客会住六个月。该公司的联合创始人萨提安娜拉雅娜·维杰拉（Satyanarayana Vejella）计划再融资1,000万美元，在未来两年里开设近70家新旅舍、增加1.2万张床位。公司的营业利润率约为15%。

这家连锁店的投资方包括寻求社会收益和财务回报的投资基金。如果该连锁店像它的许多竞争者那样用地下经营来逃税的话，财务回报会有所改

善，但它坚持规范经营。它面临的问题和希尔顿或凯悦这样的酒店一样：很难找到足以提供100多个床位的大型房产。它还必须得追着租客讨要房费。用更低价格来迎合蓝领工人的尝试并没有成功，因此，Aarusha还是得依赖IT业和外包业，而这些行业的招聘已经没有以前那么急切了。

Aarusha也许能依赖人们对于这种房间持续的强烈需求——在他们找到自己的居所之前，在那里住一阵还是很合理的。旅舍有一种集体归属感，父母也认为旅舍令人安心，因为住客要忍住不喝酒、不吸烟、不与异性混住。很快，他们就将带上自己的抱负与海报继续前行。■



Schumpeter

Sonic boom

Masayoshi Son, a Japanese technology tycoon, begins a \$100bn shopping spree

IF YOU want to find a spectacular vision of the future, Silicon Valley is not the only place to look. In Tokyo Masayoshi Son, the boss of SoftBank, a Japanese telecoms group, is starting an investment fund worth \$100bn which, he hopes, will make him the Warren Buffett of technology. “Masa” is no stranger to risky bets: SoftBank was an early investor in Alibaba, a Chinese e-commerce company, and has sunk \$22bn in Sprint, a struggling American telecoms firm. Now he has been seized by the kind of Utopian fever that would make the Sage of Omaha choke on his Cherry Coke.

Mr Son, who is 59, believes that the world will soon encounter what is known as the Singularity, the point at which artificial intelligence exceeds the human kind. The brains of people and machines will become enmeshed. Every person will have over 1,000 devices linked by a seamless global network, with the data analysed by machines in the cloud. As well as smart glasses, people will wear smart shoes and every car and washing machine will link up to the web. This internet revolution, says Mr Son, will be more momentous than the first.

He has begun making acquisitions. Last year he spent \$31bn buying Britain’s ARM Holdings, which designs the chips in mobile devices (it will be owned jointly by SoftBank and the fund). He also invested a total of \$2bn in OneWeb and Intelsat, two satellite-technology firms that aim to launch thousands of microsatellites to orbit the Earth providing high-speed internet access. Tech firms around the world are bracing for more swoops by Mr Son, who says his aim is to build a business empire lasting 300 years. What he doesn’t mention is that he also wants to prove beyond all doubt that his fortune is due to skill, not one lucky deal.

Mr Son believes he has anticipated successive paradigm shifts in technology. The son of an ethnic-Korean pig farmer, whose childhood was spent in a shack in southern Japan, Masa wept joyfully when, as a teenager, he first saw a picture of a microchip. He learned programming while at the University of California, Berkeley, then in the 1980s sold software in Japan. He was an early investor in internet firms, buying a share of Yahoo in 1995 and the Alibaba stake in 1999. Later he invested in mobile telecoms, first in 2006 with his purchase of Vodafone's Japanese mobile arm and then of Sprint in 2013. Now SoftBank is huge, with an enterprise value (its market value plus its net debt) of \$193bn.

Yet Mr Son's career is still defined by Alibaba. In 1999 he was visited in Tokyo by Jack Ma and Joseph Tsai, co-founders of a fledgling website in Hangzhou. Mr Son tapped on a calculator as they haggled and agreed that SoftBank would buy 30% of the young firm for \$20m. The deal was "based on my sense of smell", Mr Son said later. Now Alibaba's market value is \$270bn, and, after selling some shares last year, SoftBank still owns 28%.

About 95% of SoftBank's market value is accounted for by the Alibaba stake, so the rest of what it does, from telecoms to venture capital, may be worth little, once debts are deducted. Mr Son says that SoftBank has made an internal rate of return of 43% on all its other investments, excluding Alibaba, but the basis of his calculations is unclear. There have been triumphs—SoftBank made \$5bn buying and selling Supercell, a Finnish gaming firm, between 2013 and 2016. But the group has produced little cashflow, and Mr Son's deals have left it with \$110bn of net debt.

So Mr Son has a minority investment in a great firm, but has yet to build one himself from scratch. And SoftBank's poor finances are impeding his ambitions. Because his stake is only 19%, he cannot raise cash by selling shares without weakening his grip on the firm. He could sell the rest of the Alibaba stake, but appears reluctant to let go altogether. Or he could try to

broker a merger of Sprint with T-Mobile, another American telecoms firm, allowing SoftBank to rid its balance-sheet of Sprint's \$31bn of net debt. Until now antitrust regulators have opposed a deal. But Mr Son hopes that the Trump administration will be more amenable.

The alternative is partially to bypass SoftBank, which is what the new \$100bn fund achieves. Mr Son will have more discretion over what to buy, free of grumbling public shareholders. Outside investors will give him huge firepower. Saudi Arabia's public investment fund, for example, has promised to give him buckets of cash. The fund and its debts will be kept off SoftBank's books.

| *Masachism*

Investors in the new vehicle and owners of SoftBank shares should have three worries. First, while Mr Son's ideas stand out for their intensity, they are not entirely original. Others in tech share his vision of ubiquitous, web-linked devices with their data crunched by machines, so the values of firms involved in these areas are sky-high; SoftBank paid 71 times earnings for ARM. Second, Mr Son can lose focus. Some of the startups he particularly admires, such as Uber and Airbnb, are only loosely related to his notion of the internet. Others are even more tangential. On March 20th SoftBank bought a \$300m stake in WeWork, a trendy office-rental firm with a dizzying valuation.

The third worry is governance. Mr Son's mind skips from one obsession to the next. In 2014-15 he was briefly infatuated by India's tech scene, for example, and appointed Nikesh Arora, an Indian-born former Google executive, as his heir apparent, only to ease him out a year later, in 2016. It is clear that one man with a messianic streak will dominate the fund as well as the running of SoftBank. Mr Son's dual role also produces conflicts of interest: if there is a juicy deal, who benefits—the fund or the firm?

For Mr Son, these are quibbles that will fade into irrelevance over his 300-year horizon. He has said that, looking back on his first six decades, he regrets that he “focused too much on the daily routine and didn’t really think big.” So far only 3% of his brainpower has been devoted to big investment decisions, he believes. Now more than half of his mental capacity will be directed at fulfilling his destiny. Masa is just getting started. ■



熊彼特

孙声夺人

日本技术大亨孙正义展开千亿美元大采购

要寻找壮阔的前景，硅谷并非唯一的着眼之地。在东京，日本电信集团软银的老板孙正义正在启动一个1000亿美元的投资基金，希望藉此成为科技界的巴菲特。“马沙”【译注：孙正义的昵称】并不是高风险投资的门外汉：软银是中国电子商务公司阿里巴巴的早期投资者，也曾向深陷困境的美国电信公司Sprint砸进220亿美元。如今，他已陷入一种乌托邦式的狂热梦想之中，恐怕人称“奥马哈圣人”的巴菲特听到后都会呛出一口樱桃可乐。

现年59岁的孙正义相信世界将很快来到人工智能超越人类智慧的所谓“奇点”。人类大脑将与机器融为一体。到那时，每个人都会拥有超过1000台电子设备，通过全球网络无缝连接，产生的数据由云端计算机来分析。除了智能眼镜，人们还将穿上智能鞋，每一台汽车和洗衣机都将连接到网络上。孙正义表示，这场互联网革命将比第一次网络革命更为意义重大。

他已展开收购之旅。去年，他以310亿美元买下了为移动设备设计芯片的英国安谋控股公司（ARM Holdings），该公司将由软银集团和孙正义的投资基金共同拥有。他还向卫星科技公司OneWeb和Intelsat总共投资了20亿美元，这两家公司计划向地球轨道发射数以千计的微型卫星来提供高速互联网接入。全球各地的科技公司都在准备迎接孙正义的进一步收购，而他表示，自己的目标是一个300年屹立不倒的商业帝国。他没提及的一点是，他还想证明自己的财富确实是源于能力，而非某宗幸运的交易。

孙正义认为自己预见到了科技界一连串的模式转变。他出身自韩裔猪农家庭，童年生活在日本南部的一间棚屋里。十几岁时，他第一次看到微芯片的照片，高兴地哭了起来。之后他在加州大学伯克利分校求学期间学习了编程。到上世纪80年代，他在日本销售软件。他是几家互联网公司的早期投资者，在1995年买入雅虎的股份，1999年又入股阿里巴巴。后来，他开

始投资移动通讯业，先是在2006年购入沃达丰在日本的移动业务，之后又在2013年收购了Sprint。现在的软银规模庞大，企业价值（市值加上净负债）达1930亿美元。

但孙正义事业的关键还是阿里巴巴。1999年，杭州一家刚起步的网站的创始人马云和蔡崇信来到东京拜访孙正义。孙正义按着计算器与他们讨价还价，最终同意软银将以2000万美元购买这家年轻公司30%的股份。孙正义后来表示这宗交易是“基于我的嗅觉”。现在阿里巴巴的市值为2700亿美元，在去年出售一部分股份后，软银仍持股28%。

软银集团约95%的市值都来自阿里巴巴的股份，因此除去债务后，集团旗下从电信到风险投资在内的其他业务可能价值无几。孙正义表示，不算阿里巴巴，软银其他所有投资的内部收益率达43%，但这番计算的根据并不清楚。佳绩还是有的，比如软银在2013年至2016年间收购然后出售芬兰游戏公司Supercell，以此赚得50亿美元。但集团的现金流很少，而且孙正义的多项交易给集团带来了1100亿美元的净负债。

所以说，孙正义拥有对一家伟大企业的少数股权投资，却还未能从头打造出自己的成功大企业。软银的财务状况不佳也阻碍了他施展抱负。由于仅持有19%的股份，他无法在不削弱自己对公司控制权的前提下通过出售股份来筹集资金。他可以出售余下的阿里巴巴股份，但似乎又不甘心全部脱手。或者，他可以撮合Sprint和美国另一家电信公司T-Mobile合并，令软银摆脱资产负债表上Sprint高达310亿美元的净负债。到目前为止，反垄断监管机构一直反对这项合并。但孙正义希望特朗普政府能更宽松一些。

一个替代方案是在一定程度上绕过硬银，新设的1000亿美元投资基金正可以达到此目的。孙正义在收购项目上将拥有更大的自由裁量权，而无需面对公众股东的牢骚。外部投资者将为他提供强大的火力。例如，沙特阿拉伯公共投资基金已承诺为其提供大笔资金。该投资基金及其债务将不纳入软银集团的账目。

| 马沙主义

新基金的投资者及软银的股东会有三大忧虑。首先，孙正义的想法虽然壮志可嘉，但并非全新创想。他认为未来联网设备将无处不在，所产生的数据会由机器来计算分析，而其他科技业人士也有同样的愿景，所以这些领域里的公司市价往往冲云霄：软银就是以71倍的市盈率收购了安谋。第二，孙正义可能会迷失焦点。他尤为倾慕的一些创业公司，如优步和Airbnb，其实跟他的互联网理念只是稍有关联，而其他的一些就更不相干了。3月20日，软银以3亿美元投资了估值令人目眩的时尚办公空间租赁公司WeWork。

第三个忧虑是公司治理。孙正义的痴迷没有长性。例如，在2014年至2015年，他短暂地迷上了印度科技界，并指定出生于印度的谷歌前高管尼科什·阿罗拉（Nikesh Arora）为自己的接班人，但仅仅在一年后也就是2016年就把他打发走了。显然，这位有着救世主情结的人物将主宰该投资基金及软银的运作。孙正义的双重角色也会产生利益冲突：假如存在利润丰厚的交易，该让谁获益——是投资基金还是软银？

对于孙正义来说，在他300年的展望里，这些都是终将变得无关紧要的小口角。他曾经说过，回顾人生前六十年，他的遗憾是“过分注重日常事务，还没做过真正宏大的构想。”他自认为到目前为止只把3%的脑力用到了重大投资决策上。现在，他要把一半以上的心思用于实现自己的使命。马沙之旅才刚刚启程。■



Computer security

The myth of cyber-security

Computers will never be secure. To manage the risks, look to economics rather than technology

COMPUTER security is a contradiction in terms. Consider the past year alone: cyberthieves stole \$81m from the central bank of Bangladesh; the \$4.8bn takeover of Yahoo, an internet firm, by Verizon, a telecoms firm, was nearly derailed by two enormous data breaches; and Russian hackers interfered in the American presidential election.

Away from the headlines, a black market in computerised extortion, hacking-for-hire and stolen digital goods is booming. The problem is about to get worse. Computers increasingly deal not just with abstract data like credit-card details and databases, but also with the real world of physical objects and vulnerable human bodies. A modern car is a computer on wheels; an aeroplane is a computer with wings. The arrival of the “Internet of Things” will see computers baked into everything from road signs and MRI scanners to prosthetics and insulin pumps. There is little evidence that these gadgets will be any more trustworthy than their desktop counterparts. Hackers have already proved that they can take remote control of connected cars and pacemakers.

It is tempting to believe that the security problem can be solved with yet more technical wizardry and a call for heightened vigilance. And it is certainly true that many firms still fail to take security seriously enough. That requires a kind of cultivated paranoia which does not come naturally to non-tech firms. Companies of all stripes should embrace initiatives like “bug bounty” programmes, whereby firms reward ethical hackers for discovering flaws so that they can be fixed before they are taken advantage of.

But there is no way to make computers completely safe. Software is hugely complex. Across its products, Google must manage around 2bn lines of source code—errors are inevitable. The average program has 14 separate vulnerabilities, each of them a potential point of illicit entry. Such weaknesses are compounded by the history of the internet, in which security was an afterthought.

| *Leaving the windows open*

This is not a counsel of despair. The risk from fraud, car accidents and the weather can never be eliminated completely either. But societies have developed ways of managing such risk—from government regulation to the use of legal liability and insurance to create incentives for safer behaviour.

Start with regulation. Governments' first priority is to refrain from making the situation worse. Terrorist attacks, like the recent ones in St Petersburg and London, often spark calls for encryption to be weakened so that the security services can better monitor what individuals are up to. But it is impossible to weaken encryption for terrorists alone. The same protection that guards messaging programs like WhatsApp also guards bank transactions and online identities. Computer security is best served by encryption that is strong for everyone.

The next priority is setting basic product regulations. A lack of expertise will always hamper the ability of users of computers to protect themselves. So governments should promote “public health” for computing. They could insist that internet-connected gizmos be updated with fixes when flaws are found. They could force users to change default usernames and passwords. Reporting laws, already in force in some American states, can oblige companies to disclose when they or their products are hacked. That encourages them to fix a problem instead of burying it.

| *Go a bit slower and fix things*

But setting minimum standards still gets you only so far. Users' failure to protect themselves is just one instance of the general problem with computer security—that the incentives to take it seriously are too weak. Often, the harm from hackers is not to the owner of a compromised device. Think of botnets, networks of computers, from desktops to routers to “smart” light bulbs, that are infected with malware and attack other targets.

Most important, the software industry has for decades disclaimed liability for the harm when its products go wrong. Such an approach has its benefits. Silicon Valley's fruitful “go fast and break things” style of innovation is possible only if firms have relatively free rein to put out new products while they still need perfecting. But this point will soon be moot. As computers spread to products covered by established liability arrangements, such as cars or domestic goods, the industry's disclaimers will increasingly butt up against existing laws.

Firms should recognise that, if the courts do not force the liability issue, public opinion will. Many computer-security experts draw comparisons to the American car industry in the 1960s, which had ignored safety for decades. In 1965 Ralph Nader published “Unsafe at Any Speed”, a bestselling book that exposed and excoriated the industry's lax attitude. The following year the government came down hard with rules on seat belts, headrests and the like. Now imagine the clamour for legislation after the first child fatality involving self-driving cars.

Fortunately, the small but growing market in cyber-security insurance offers a way to protect consumers while preserving the computing industry's ability to innovate. A firm whose products do not work properly, or are repeatedly hacked, will find its premiums rising, prodding it to solve the problem. A firm that takes reasonable steps to make things safe, but which is compromised nevertheless, will have recourse to an insurance

payout that will stop it from going bankrupt. It is here that some carve-outs from liability could perhaps be negotiated. Once again, there are precedents: when excessive claims against American light-aircraft firms threatened to bankrupt the industry in the 1980s, the government changed the law, limiting their liability for old products.

One reason computer security is so bad today is that few people were taking it seriously yesterday. When the internet was new, that was forgivable. Now that the consequences are known, and the risks posed by bugs and hacking are large and growing, there is no excuse for repeating the mistake. But changing attitudes and behaviour will require economic tools, not just technical ones. ■



计算机安全

网络安全之迷思

计算机从来都不安全。要应对这一风险，更需要经济手段而非技术手段

计算机安全是个自相矛盾的说法。姑且只看下去年的情况：网络窃贼从孟加拉中央银行盗走了8100万美元；电信公司威瑞森（Verizon）以48亿美元收购互联网公司雅虎的交易差点因两起大规模数据泄露而泡汤；俄罗斯黑客干扰了美国总统大选。

在这些头条之外，一个利用电脑敲诈勒索、黑客雇佣和数字商品销赃的黑市日渐繁荣。这一问题还将进一步恶化。计算机的应用途径日益增多，它们不仅处理信用卡详细信息和数据库之类的抽象数据，还涉及真实世界里的物品和脆弱的人体。现代的汽车就是装在轮子上的电脑，而飞机则是插上翅膀的电脑。物联网的到来会让所有物品都嵌上计算机，从道路标识、核磁共振扫描仪，到假肢和胰岛素泵。没有证据表明这些装置会比桌面电脑更安全可靠。黑客们已经证明了他们能远程控制联网的汽车和起搏器。

人们很容易认为，只要有了更多的技术魔法并呼吁大家提高警惕，安全问题就能得到解决。而且很多公司对待安全问题的态度确实还不够认真。这种意识需要一种长期养成的偏执，而科技界以外的公司不会自然而然地拥有这一特质。各种各样的公司都应该采纳像“漏洞悬赏”项目这样的举措——公司奖励发现缺陷的正派黑客，这样在被人利用之前就可以把漏洞修补好。

但是不可能让计算机百分之百地安全。软件极其复杂。谷歌在各种产品中必须处理约20亿行源代码，出错在所难免。一个普通程序一般有14个不同的安全隐患，每一处都是一个可能的非法入侵点。这些弱点因互联网的历史而雪上加霜：对互联网而言，安全是事后才想到的事情。

| 敞开窗口

这并不表示已经无计可施。遭遇欺诈、车祸、坏天气的风险同样无法完全

避免。不过社会各界已经研究出管理这类风险的种种方法，从政府监管到使用法定责任和保险，来鼓励更安全的行为。

先要从监管开始。各国政府的首要任务是克制会让事态恶化的举动。恐怖袭击（例如最近在圣彼得堡和伦敦发生的那些）常常会引发削弱加密的呼声，因为这样一来安保部门就能更好地监控个人在做什么。但削弱加密不可能只针对恐怖分子。保护WhatsApp等短信程序安全的措施也在用于保护银行交易和网上身份信息。对每一个人都做好加密，计算机安全才能得到最好的保护。

第二要务是设立基本的产品法规。缺乏专业知识常常会阻碍计算机用户保护自己，因此政府应当推进计算的“公共健康”。它们可以要求联网装置发现漏洞时必须修补更新，还可以强迫用户修改默认的用户名和密码。已在美国部分州实施的报告法要求公司披露它们或它们的产品被黑客攻击的情况。这鼓励它们解决问题而不是隐匿不报。

| 慢一点，解决问题

但制定最低标准的作用也就仅此而已。计算机安全的普遍问题是人们实在缺乏动力来认真对待这一问题，用户无法自我保护只是其中一个例子。因黑客入侵遭受损害的往往不是被黑设备的所有者——想想那些感染了恶意软件后攻击其他目标的僵尸网络（由桌面电脑、路由器和“智能”灯泡等设备组成的计算机网络）。

更重要的是，软件业几十年来都拒绝为产品问题造成的损害承担责任。这种做法确有好处。只有公司能相对自由地推出有待完善的新产品，硅谷“快速推进、破除陈规”的创新方式才能结出累累硕果。但是这一点很快将失去意义。随着计算机扩展到已建立了责任制度的产品，如汽车或家用产品，这一行业的免责声明会越来越违背已有法律。

公司应当认识到，如果法庭没有强制推行法定责任，公众舆论也会这么做。很多计算机安全专家对比了20世纪60年代美国汽车业的情况。当时，汽车行业忽视安全问题已长达几十年。1965年，拉尔夫·纳德（Ralph

Nader) 出版了《任何速度都不安全》(Unsafe at Any Speed)，这本畅销书揭示并痛斥了汽车制造业的懒散态度。第二年政府采取强硬手段，出台了安全带、头枕等法规。现在试想如果自动驾驶汽车导致首例儿童死亡，那么要求立法的呼声将会是怎样。

所幸网络安全保险这个虽小却不断发展的市场提供了一种方法，可以在保护消费者的同时保持计算机行业的创新能力。产品无法正常工作或是经常被黑客攻击的公司将面临保费上涨，这会敦促它解决问题。采取了合理措施来保障安全但仍然遭到伤害的公司可以向保险公司索赔，免于破产。也正是在这里，一些免赔的责任或许可以协商解决。在这方面也有先例：上世纪80年代，当美国轻型飞机制造公司面临巨额索赔以致整个行业都有破产风险时，政府更改了法律，限定了它们在旧产品上应负的责任。

今天计算机安全问题如此严峻，原因之一便是之前极少有人认真对待过这个问题。在互联网兴起之初，这种状况还情有可原。既然如今后果已经彰显，漏洞和黑客攻击带来的风险也巨大且与日俱增，那么就没有理由再重蹈覆辙。但改变观念、改变行为都需要经济手段，而不仅是技术手段。■



Chinese-American economic ties

The silk-silver axis

The world's most important economic relationship is also its most fraught

IN 1784 the *Empress of China* set sail from New York, on the first American trade mission to China. Carrying ginseng, lead and woollen cloth, the merchants aboard dreamed of cracking open the vast Asian market. But the real profit, they found, came on their return, when they brought Chinese teas and porcelain to America. As other ships followed in its wake, the pattern became clear. Americans wanted more from China than Chinese wanted from America, and the difference was made up with a steady outflow of silver from America into China. The *Empress* had launched not just commercial ties between the two great countries but also an American deficit in its trade with China.

The modern incarnation of this deficit is still driven by the flow of consumer goods, but nowadays electronic gadgets. In recent years it has reached a record size (see chart 1). When Xi Jinping, China's president, meets Donald Trump—a meeting is reportedly planned in Florida early in April—the deficit will top the agenda. In his run to the White House, Mr Trump promised a combative stance against China on trade. Some expect America to slap punitive tariffs on Chinese goods, triggering an all-out trade war. Others think a grand bargain that defuses tensions is possible.

Many American businesses, bruised in their dealings with China, cautiously welcome a harder line. For their part, Chinese businesses feel unjustly singled out. Both sides are nervous, conscious that the world's most important economic relationship is also its most complex. America and China are bound together by cross-border flows of goods, cash, people and ideas that are bigger than ever. These ties have greatly benefited the two countries' prosperity. A rupture would be severely damaging for both.

The original sin, for Mr Trump's most hawkish advisers, is the trade imbalance. Before China joined the World Trade Organisation (WTO) in 2001, China accounted for less than a quarter of America's total trade deficit; over the past five years, it has made up two-thirds. Peter Navarro, head of Mr Trump's new National Trade Council, sees the deficit as a drag on America's economy. Close it, he argues, and America's GDP will be bigger. And he sees a way to do so: take on China over its unfair trade practices, from currency meddling to export subsidies. In 2012 he released a documentary, "Death by China", as a call to arms.

Mr Navarro's views rely on crude arithmetic that defies the most basic economic logic. In fact, big deficits often accompany fast growth. And it is misleading to focus on bilateral imbalances in an age of global supply chains. Counting the bits and pieces from other countries that go into "made in China" smartphones, fridges and televisions, China's trade surplus with America is about a third smaller than officially reported.

Yet the gap ought perhaps to be smaller still. American companies insist that, with a level playing field, they would be able to sell much more to China. Some of the obstacles in their way are obvious. Carmakers, for instance, face 25% import tariffs. More often, barriers are subtler. Medical-device makers cite onerous licensing procedures and seed firms lengthy approvals.

Indeed, America had been adopting a firmer approach to China on trade long before the election. Barack Obama's administration stepped up pressure through the WTO. Of America's 25 formal WTO complaints filed after 2008, 16 were against China. The administration also initiated 99 anti-dumping and countervailing-duty investigations against China, more than against any other country (see chart 2).

China sees a pattern of unfair treatment. For Mei Xinyu, a researcher at the

commerce ministry, what is wrong with the bilateral relationship is obvious: “American protectionism”. America has to cure its own ills and building walls won’t help, he says. Most emblematic is America’s decision to withhold “market-economy status” from China, which allows higher duties to be put on Chinese imports.

Chinese officials cite another example of unequal standards—the time-worn American complaint, made especially loudly by Mr Trump, that China fiddles its currency to cheapen its exports. China certainly does manage the yuan, but over the past decade it has let it appreciate by nearly two-fifths against a broad currency basket—more than any other big economy has.

Left to its own devices, the trade relationship between China and America should become more balanced in time. As China’s middle class grows, its consumers are buying more from abroad. Chinese demand for American agricultural products, especially soyabeans, has boomed. China is already buying more services from America than vice versa. One of America’s biggest exports to China is education. The number of Chinese students in America has reached nearly 330,000—almost a third of all foreign students—and is up more than fivefold over the past decade.

| *Battle lines*

But if Mr Trump carries out his most extreme threats and whacks a 45% across-the-board tariff on Chinese goods, trade flows between the two giants—the world’s biggest bilateral trading relationship—would shrivel. Collateral damage to the global economy would be immense. The very survival of the rules-based international trading system would be at stake.

China would, in a conventional analysis, suffer more in a trade war. About a fifth of its exports go to America, equating to nearly 4% of Chinese GDP. Less than a tenth of American exports go to China, worth less than 1% of American GDP. But a fight would also hit America hard. No other country

could easily replace China in making many of the products, from toys to textiles, that fill American shops. Consumers would face sharply higher prices. American companies that have used China as a production base would struggle to reconfigure their supply chains. If American firms brought factories back home, prices would rocket. Goldman Sachs, an investment bank, estimates that the cost of producing clothing would increase by 46% and smartphones by 37%.

Moreover, China would retaliate. Even if America as a whole runs a deficit, it has industries and companies that increasingly rely on Chinese demand. Nearly half its fruit and seed exports go to China. China is in some months the world's biggest market for iPhones. Semiconductor-makers such as Qualcomm and Broadcom derive most of their revenues from China (see chart 3).

All this helps explain why Mr Trump has so far trod softly in confronting China. James McGregor, Greater China chairman of APCO Worldwide, a lobbying firm, says that American bosses have been streaming into Washington for meetings with the Trump team to appeal for calm and to teach them that "China is not a country to be toyed with." But perhaps Mr Trump has merely been distracted by the rocky start to his domestic agenda and it is only a matter of time before he lashes out at China. If he does, though, he will soon learn that trade is not the only show in town. Investment gets much less attention but is also vital to the relationship.

Start with a myth—that China can bankrupt the American government. Over the past decade, China has invested more than \$1trn in Treasuries. At its peak, America owed more money to China than to anywhere else. Pundits fret that, were China to dump its bonds, American interest rates would shoot up and the dollar plummet.

But that is to misunderstand the financial mechanics. The Federal Reserve

has demonstrated that it can buy far more government bonds than any foreign or domestic holder can sell. China thus cannot dictate interest rates in America, much less push it into penury. And the volatility of the dollar is also a Chinese concern. Because Chinese companies borrowed heavily abroad, dollar strength has made their debts more costly in yuan terms.

Financial exposure goes the other way, too. Back in 2015 the Fed was planning to embark on a series of interest-rate increases. In the end it managed to deliver its second rise only at the very end of 2016. Jitters over China's economy had stayed its hand. American investors have learned that news out of China can wreak havoc on their portfolios. Anxiety about China has triggered two of the three most recent "risk-off" episodes in global markets, as captured by the VIX, a measure of stockmarket volatility, popularly known as the "fear gauge". This is the crucial point: it is not that China has the financial upper hand over America, or vice versa; it is that they are increasingly joined at the hip.

| *Mutually assured destruction*

And these are just the financial linkages, which remain limited by China's capital controls. Look at the physical investment ties between China and America and the mutual vulnerabilities are even more glaring. According to official data, roughly 1% of the stock of American direct investment abroad (money spent on assets such as factories, warehouses and shops) is in China. But this misses much of the cash routed through the Cayman Islands or Hong Kong for accounting reasons. An analysis last year by the Rhodium Group, an American research firm, took a granular approach to calculate that the true stock of American foreign direct investment (FDI) in China built up from 1990 to 2015 was \$228bn, three times the official figure.

American companies initially lighted on China as a cheap manufacturing base; as costs there have risen, that wave of investment has tailed off. A new influx seeks to tap China's consumer demand. In 2016 China was the

leading emerging market into which American firms poured FDI. China's booming middle class is forecast by McKinsey, a consultancy, to grow from just 6% of urban households in 2010 to over half of the total by 2020.

For firms that have made it in China, the rewards have been immense. Through joint ventures with local partners, GM sells more cars, and makes more profits, in China than it does anywhere in the world. Over the next two decades, Boeing estimates, China will buy 6,000 new aeroplanes, becoming its first trillion-dollar market. Starbucks is opening new cafés in China at a pace of over one a day. On official estimates, some 1.6m people in China now work for American subsidiaries.

But success stories of American companies in China will not exactly warm the hearts of Mr Trump's band of economic nationalists. What they want is money invested in America, not more profits made abroad. Forget for a moment that this policy risks doing more harm than good (preventing Apple or GM from going big in China would hurt them financially). The more relevant point—the one likelier to sway Mr Trump—is that the bigger investment flows these days are from China into America.

Chinese investment into America used to be tiny. No longer (see chart 4). Rhodium estimates that it leapt from about \$16bn in 2015 to some \$46bn in 2016, compared with \$13bn invested by American firms in China. Chinese investments are already thought to support roughly 90,000 American jobs across several dozen states. The money is spread across virtually every area of the economy. Chinese companies have bought Hollywood production companies, car-parts- and appliance-makers, semiconductor firms and more.

China is well aware that its investors can also convey a positive message. Witness Jack Ma's meeting with Mr Trump, just before his inauguration. Mr Ma, founder of Alibaba, a Chinese e-commerce giant, boasted that his

shopping portal would create 1m jobs in America, giving small businesses and farmers a platform to export to Asia. The promise was far-fetched (Mr Trump might appreciate that). But there was a kernel of truth: Chinese investors are only getting started in America.

Were it just a question of money, these investment trends ought to be the clincher, giving America and China every reason to stay on each other's good side. But investment cannot be divorced from power, and that poses complications. Most obvious are national-security concerns. Both China and America have become more active in restricting each other's technology and blocking deals that they fear might compromise their security.

But commercial competition casts an even bigger shadow. China and America are increasingly butting heads. "Made in China 2025", an industrial plan unveiled in 2015, is indicative of how China is gunning for industries that America and other foreign countries have dominated. China aims to become a leader in ten strategic sectors, ranging from next-generation IT to agricultural machinery.

Critics in America warn that China's state-driven model for advancing in these industries will cause damage around the world. Their worry is that China will deploy much the same industrial policy that it has used in sectors from wind power to high-speed rail: pressure on foreign firms to share technology; protection of local firms; targets to phase out imports; and generous state funding. "This could lead not only to China taking over market share but, because of its scale, destroying entire business models," says Scott Kennedy of the Centre for Strategic and International Studies, a think-tank in Washington, DC.

| *Another casus belli*

How America might respond to this perceived threat remains hazy. A

committee recommended to Congress last year a ban on all investment in America by China's state-owned enterprises (SOEs)—a measure as likely to lead to a full-blown trade war as Mr Trump's 45% tariff wall. A recent review of the semiconductor industry called for a stiffer response to China's market distortions. Others argue that fears of "Made in China 2025" are overblown. Government interventions may work in industries such as solar power and railways, which are dominated by subsidies and public-sector procurement. But they have already been seen to fail in consumer industries such as carmaking.

China's government has tried to rebut critics of its industrial plan. The point, it says, is merely to give companies guidance about future trends. Meanwhile, Chinese firms, for their part, fear that obstacles in America are proliferating. He Fan, a prominent Chinese economist, says the feeling is that business in America is becoming more politicised. "You can only have long-term investment when the rules are clear," he says. "Previously that was America's strong point. Now it's uncertain."

Easily lost amid the blaze of recriminations is the extent to which competition between China and America can also yield benefits. The two countries are already spurring each other to innovate. American venture capitalists are well embedded in the software cluster in Beijing and the hardware ecosystem in Shenzhen, a city in southern China. American private-equity firms are prominent in China, making bets on industries ranging from health care to energy. American multinationals used to build shiny R&D centres in Shanghai and Beijing to please officials, but did little original work in them. Now, firms ranging from industrial conglomerates like GE to biotech giants such as Amgen are doing some of their cutting-edge research in China.

China's most inventive firms are also investing heavily in America in search of talent and new patents. Just last week, Tencent, a tech giant, said it was

spending \$1.8bn to buy 5% of Tesla, a maker of electric cars. Huawei, Alibaba and Baidu are its near-neighbours in Silicon Valley. BGI, the world's biggest genome-sequencing firm, is opening a laboratory in Seattle to be closer to the Gates foundation, a big client. Mindray, a medical-devices firm, has a couple of American R&D labs. Lenovo, the world's biggest maker of personal computers, is inventing and manufacturing B2B products in North Carolina.

One possibility is that, as these kinds of cross-border business operations become more widespread, the Chinese-American economic relationship will settle down. Competition will be welcomed as healthy, not feared as destructive. But it is likely to be a long time before that happens. It would help if the governments could see eye to eye—in particular, if they could agree on a long-stalled bilateral investment treaty; and if they could reach an understanding on trade before their disagreements threaten the WTO itself.

Both outcomes, however, are highly unlikely. The diplomacy needed to navigate the shoals of their economic ties is in short supply. China's success in low-end manufacturing has already caused a backlash in America. As Chinese firms take on companies at the heart of the American economy, the friction will surely increase. It is enough to make one nostalgic for the days when their business involved little more than swapping silver for silk. ■



中美经济关系

丝银轴心

世界上最重要的经济关系也最令人担忧

1784年，中国皇后号帆船从纽约起航，踏上美国对中国的首次通商之旅。船上满载着人参、铅和毛料，商人们渴望能够打开广阔的亚洲市场。但他们发现，从中国带回的茶叶和瓷器才是真正的利润之源。随着其他船只步其后尘，这种贸易模式逐渐清晰起来。美国人想要的中国货多过中国人想要的美国货，其中的差额由美国源源不断地向中国支付银元来补足。中国皇后号不仅开启了两个大国间的商业联系，也开启了美国对中国的贸易逆差。

这种赤字的现代化身仍由消费品贸易驱动，只不过货物变成了电子产品。近年来这一赤字已达到新高（见图表1）。据报道，中国国家主席习近平将于4月初在佛罗里达与特朗普会晤，届时贸易赤字将成为首要议题。在总统竞选期间，特朗普承诺将就贸易问题对中国采取强硬姿态。有人预计美国会对中国商品征收惩罚性关税，引发全面贸易战。其他人则认为双方可能会达成“大妥协”以缓和紧张局势。

许多在跟中国打交道时吃过苦头的美国企业谨慎欢迎政府更强硬地处理经贸关系。而中国企业觉得独自己成为矛头所向有失公允。双方都有些紧张，都意识到世界上最重要的经济关系也是最复杂的。中美之间货物、资金、人员和思想的跨国往来规模空前，关系密不可分，大大有利于两国的繁荣。关系一旦破裂，两方都会严重受损。

特朗普的强硬派顾问大多认为，双边关系的原罪是贸易不平衡。中国于2001年加入世贸组织之前，在美国总贸易逆差中只占了不到四分之一；过去五年中，中国已经占到三分之二。彼得·纳瓦罗（Peter Navarro）是特朗普新组建的全国贸易委员会的主席，他认为贸易赤字拖累了美国经济。纳瓦罗说，如果消除这一赤字，美国的GDP总量会更大。他认为有个办法可以消除贸易赤字：挑战中国从货币干预到出口补贴等不公平贸易的做

法。2012年，纳瓦罗发布了纪录片《致命中国》（Death by China），如同贸易战的檄文。

纳瓦罗的观点基于粗略的计算，违背了最基本的经济逻辑。事实上，高逆差往往伴随着高增长而出现，而且在全球供应链的时代紧盯双边贸易失衡问题会有误导性。“中国制造”的智能手机、冰箱和电视机里有很多零部件来自其他国家，如果算上这些的话，中国对美国的贸易顺差比官方公布的结果要少三分之一。

然而，这一差距也许本应该更小一些。美国公司坚持认为，在公平竞争的环境下，它们能够向中国出口的产品要多得多。美国公司面临的贸易壁垒有些是显而易见的，例如，汽车制造商需缴纳25%的进口关税。但在更多情况下，贸易壁垒更为隐蔽，比如医疗器械制造商办理进口许可时程序繁琐，种子审批时间过长。

事实上，美国早在大选很久之前就已在贸易问题上对中国采取更为强硬的做法。奥巴马政府通过世贸组织施加了更多压力。2008年以后美国向世贸组织提出的25项正式投诉中，有16项是针对中国。奥巴马政府还对中国发起了99次反倾销和反补贴调查，多于任何其他国家（见图表2）。

而中国则看到了一种不公平待遇。商务部研究员梅新育认为双边关系的症结显而易见，那就是“美国保护主义”。他说美国必须先解决自己的问题，搭建藩篱并无好处。这种保护主义最具代表性的动作是美国决定不给予中国“市场经济地位”，这样便可对进口自中国的产品征收更高的关税。

中国官员还指出了另一个双重标准的例子——美国一直老生常谈地抱怨中国操纵货币以降低出口产品价格，特朗普喊得尤其大声。中国的确在管理人民币，但是在过去十年里，它已经让人民币对广泛的货币篮子升值了近五分之二，比任何其他大经济体的货币升值幅度都大。

顺其自然的话，中美贸易关系最终应该会变得更平衡。随着中国中产阶级的壮大，消费者会购买更多进口产品。中国对美国农产品（尤其是大豆）的需求一直在增长。而中国对美国的服务贸易已经为逆差；教育是美国对

华最大的出口产品之一，留美的中国学生人数已接近33万，几乎是外国学生总数的三分之一，而且在过去十年中增加了五倍多。

| 战线

但倘若特朗普果真兑现了他最偏激的威吓之言，对中国商品全面征收45%的关税，那么中美两大国之间的贸易往来就会萎缩，这一全球最大的双边贸易关系的倒退会令全球经济连带遭受巨大损害，基于规则的国际贸易体系将岌岌可危。

按照传统的分析，中国在贸易战中损失会更大。中国约五分之一的出口流向了美国，相当于中国GDP的近4%；而美国只有不到十分之一的出口流向中国，不到美国GDP的1%。但贸易战也将令美国遭受重创。美国的商场里摆满了中国制造的产品，从玩具到纺织品无不如此，在这一点上没有其他国家可以轻易地取代中国。消费者将面临价格暴涨的局面，以中国为生产基地的美国公司将必须重新配置供应链，困难重重。假如美国公司把工厂迁回本国，价格将会飙升。投资银行高盛估计，服装生产成本将增长46%，智能手机生产成本将增长37%。

此外，中国一定会报复。即使美国对中国的贸易整体处于赤字，它的某些行业和企业还是日益依赖中国市场的需求。近一半的美国水果和种子都出口到中国；中国一度是全球最大的iPhone销售市场；高通和博通等半导体制造商的大部分收入都来自中国（见图表3）。

鉴于以上原因，迄今为止特朗普应对中国时一直小心谨慎。游说机构安可顾问公司（APCO Worldwide）大中华区董事长詹姆斯·麦格雷戈（James McGregor）说，美国企业老板纷纷前往华盛顿与特朗普团队会晤，呼吁他们保持冷静，让他们明白“对待中国不可儿戏”。但特朗普也许只是在国内事务上开局不利，有些分心，对付中国是迟早的事。不过，如果特朗普真要开始瞄准中国，他很快就会知道，贸易并不是唯一影响双边关系的问题。投资问题受到的关注要少得多，但对两国关系同样至关重要。

先从一个谬见说起，即认为中国能让美国政府破产。在过去十年中，中国

投资美国国债超过一万亿美元。在高峰期，中国是美国最大的债权国。专家担心一旦中国抛售美国国债，美国利率会暴涨，美元则会暴跌。

但这种判断误解了金融机制。美联储已经证明，不论国内外持有人抛售多少国债，美联储都有能力收购，财力绰绰有余。因此，中国无法左右美国利率，更不能把美国推向绝境。而美元的波动也会让中国担忧。因为中国企业在海外大量举债，美元走强会让这些债务以人民币计价的成本更加高昂。

金融风险也是双向的。在2015年，美联储计划进行一系列加息，最终只在2016年底才完成了第二次加息，对中国经济的担忧让美联储放缓了加息。美国投资者明白了一个道理，中国的任何风吹草动都可能会重创其投资组合。VIX是股票市场的波动指标，即人们常说的“恐慌指数”，其数据显示，全球市场近期历经了三次大规模“风险规避”，其中两次都是出于对中国经济的焦虑。有一点至关重要：在金融领域，中国并不比美国更占上风，反之也是如此；实情是两国之间的联系日渐紧密，休戚与共。

| 一损俱损

这些还只是金融领域的联系，而这些联系仍然受到中国资本管制的限制。再看看中美之间的实际投资关系，双方相互依赖又相互威胁的情况则更为明显。官方数据显示，美国的对外直接投资存量（投资于工厂、仓库和商店等资产的资金）约1%在中国，但这个数据未包括因会计原因经由开曼群岛或香港流入中国的大部分资金。美国研究公司荣鼎集团（Rhodium Group）去年采用精细方法进行分析，结果显示在1990年至2015年间，美国在中国的对外直接投资存量实际为2280亿美元，是官方数字的三倍。

美国公司最初将中国作为廉价制造业基地来投资，随着中国生产成本的上升，这一轮投资大潮已近尾声。新一轮资本涌入中国，意在挖掘中国市场的消费需求。2016年，美国企业对外直接投资的首选新兴市场是中国。中国的中产阶级不断壮大，2010年，中产阶级仅占城镇家庭的6%，咨询公司麦肯锡预测，2020年这一数字将增长到一半以上。

在中国获得成功的企业回报巨大。通过与当地合作伙伴合资经营，通用汽车在中国市场的汽车销量和盈利要好于在世界上任何其他地方。波音公司估计，在接下来的20年中，中国将购买6000架新飞机，成为波音首个万亿美元市场。星巴克在中国每天都新开设一家以上的连锁店。据官方估计，目前中国约有160万人就职于美国企业的子公司。

然而，美国公司尽管在中国获得了成功，却并不能让以特朗普为首的那班经济民族主义者回心转意。他们希望看到钱投资在美国，而不是在国外赚取更多的利润。先不管这一政策有可能弊大于利（阻止苹果或通用汽车在中国发展将有损它们的经济利益），更重要、也更有可能是改变特朗普心意的一点是，如今中国对美国的投资要多过美国对中国的投资。

过去，中国对美国的投资规模很小。今非昔比（见图表4）。中国对美国的投资在2015年约为160亿美元，荣鼎集团估计，这一数字在2016年大幅上涨至约460亿美元，而美国企业在中国的投资仅为130亿美元。据信，中国的投资已经为几十个州的美国人带来了约九万个工作岗位。而且中国的投资几乎涉及所有经济领域。中国公司收购了好莱坞影视制作公司、汽车零部件企业、家电制造商以及半导体公司，不一而足。

中国很清楚其投资者也能传递一个积极的信息。看看马云在特朗普就职前和他进行的会面，这位中国电子商务巨头阿里巴巴的创始人夸口说，他的购物门户网站将在美国创造100万个就业机会，为小企业和农民提供出口亚洲的平台。这个承诺有些牵强（尽管特朗普可能很欣赏），但有一点不假：中国投资者在美国才刚刚开始伸展拳脚。

如果一切仅仅是钱的问题，这些投资趋势就应该足以决定大局，让美国和中国都有充分的理由相互尊重对方的利益。但投资不能孤立于政治，而政治将局面复杂化了。这其中最明显的是国家安全问题，对于中美双方认为可能会损害各自国家安全的技术和交易，它们都已更积极地加以限制和阻碍。

但商业竞争带来了更大的阴影，中美之间的角力日益激烈。“中国制造

2025”是2015年发布的一项产业计划，表明中国力图在美国和其他国家主导的行业里奋起直追。在包括下一代IT和农业机械的十个战略领域里，中国都志在成为领导者。

美国的批评家警告说，中国由国家推动这些行业发展的模式将在全球范围内造成破坏。中国在风力发电和高铁等多个行业里采用的产业政策是施压外国企业分享技术、保护本地企业、逐步替代进口，以及国家大力资助。他们担心中国继续沿用类似的策略。华盛顿特区的智库战略与国际研究中心（Centre for Strategic and International Studies）的斯科特·肯尼迪（Scott Kennedy）表示：“这不仅可能让中国获取市场份额，而且由于其规模巨大，还可能破坏整个商业模式。”

| 另一条导火索

美国会如何应对这种潜在的威胁仍不明朗。一个委员会去年向国会提出建议，禁止中国国有企业对美国的所有投资，这和特朗普45%的关税壁垒一样可能会引发全面贸易战。最近一份半导体行业的报告要求对中国扭曲市场的行为作出更强硬的回应。其他人则认为对“中国制造2025”的担心有些过度。诸如太阳能发电和铁路等行业的发展主要依靠补贴和政府采购，在这些领域政府的干预措施可能会发挥作用，但在汽车制造等消费行业，这种干预已经有过失败的先例。

中国政府试图反驳对其产业计划的批评，表示这一计划只是为了在未来发展趋势方面给予企业指引。同时，中国企业也担心美国的壁垒激增。著名中国经济学家何帆表示，美国市场让人感觉越来越政治化了。“规则明确才能有长期投资，”他说，“这以前是美国的强项，现在就难说了。”

在一片相互指责声中，很容易忽略一个事实，即双方的竞争在一定程度上也会带来益处。两国已经相互激发创新了。美国的风险资本家已经深入到北京的软件产业集群和深圳的硬件生态系统中；美国私募股权投资公司在中国市场表现突出，广泛投资于医疗保健、能源等各个行业。美国跨国公司为讨好政府官员，曾在上海和北京建立了光鲜靓丽的研发中心，但并未在那些地方开展多少原创性工作。现在，各大美国企业都正在中国进行一

些前沿性研究，包括通用汽车等工业集团和安进（Amgen）等生物科技巨头。

中国最具创造性的企业也在美国大量投入，搜罗人才和新专利。就在上周，科技巨头腾讯表示，将斥资18亿美元收购电动汽车制造商特斯拉5%的股份。华为、阿里巴巴、百度和腾讯在硅谷都是近邻。世界上最大的基因组测序公司华大基因正在西雅图开设实验室，因为这里更接近其大客户盖茨基金会。医疗器械公司迈瑞在美国也有几个研发实验室。世界上最大的个人电脑制造商联想也正在北卡罗来纳研发和制造B2B产品。

有一种可能性是，随着这类跨境企业运营越来越普遍，中美经济关系也将趋于稳定。双方会视竞争为健康而非破坏性的，因而会欢迎而不是惧怕竞争，但要发展到那一步可能还要很久。如果双方政府能取得共识，尤其是如果能就搁置已久的双边投资协定达成一致，并能在双边分歧威胁到世贸组织的存亡之前能就贸易问题达成谅解，将对双边关系有所助益。

然而，出现这两个结果的可能性都很小。目前应对双边经济问题的外交手段比较匮乏。中国在低端制造业方面的成功已经引发了美国的抵制。随着中国企业挑战处于美国经济核心的公司，摩擦势必会更多。这足以让人怀念做生意仅以白银交换丝绸的年代，那时候一切都要简单多了。■



China's economic diplomacy

Closer to centre-stage

China is increasingly comfortable with the international financial institutions

THE IMF “systematically impoverishes foreigners”, and the World Bank’s advice has “negative value to its best clients”. These harsh words were voiced not by lefty critics of the Washington Consensus, but by two men (David Malpass and Adam Lerrick, respectively) whom Donald Trump has picked to lead his Treasury’s dealings with the rest of the world, including the international financial institutions (IFIs), such as the World Bank and IMF, and the G20 group of leading economies.

Their future boss, Steven Mnuchin, America’s treasury secretary, is not much more reassuring to the global financial establishment. At his first G20 meeting, in Baden-Baden in Germany on March 17th-18th (pictured), he vetoed a long-standing pledge to “resist all forms of protectionism”. It had often been breached. But hypocrisy is the tribute vice pays to virtue.

To veterans of international economic affairs, this combative stance is baffling. America’s government now seems to disdain a set of institutions it nurtured into life—institutions that are more commonly criticised for following America’s will too closely. “The United States is just handing the leadership over to China of the multilateral system,” Jeffrey Sachs of Columbia University told Bloomberg in late March.

But if there is a vacancy, is China qualified or even interested in the job? In January President Xi Jinping seemed to audition for the role in a speech praising globalisation at the World Economic Forum in Davos, Switzerland. As evidence of its capabilities, China can also point to a hefty portfolio of chequebook diplomacy. The China Development Bank, one of its policy lenders, already has a bigger book of overseas assets than the World Bank.

Another institution, the Export-Import Bank of China, is not far behind. In addition, the country's central bank has extended currency-swap lines to over 30 countries, including many that America's Federal Reserve would not touch.

What about its willingness? Most of China's economic diplomacy to date has been bilateral, allowing it to win loyalty, reward friends and secure contracts for its companies. Over 60 countries will, for example, supposedly benefit from Mr Xi's nostalgic vision of a revived Silk Road (the "Silk Road Economic Belt and 21st Century Maritime Silk Road", mercifully shortened to "One Belt, One Road", or OBOR).

As for multilateral efforts, China's most eye-catching initiatives have worked around the existing system, not through it. It set up two multilateral lenders of its own, the New Development Bank (known as the BRICS bank, based in Shanghai, with financial contributions from Brazil, Russia, India and South Africa as well as itself), and the Asian Infrastructure Investment Bank (AIIB), in Beijing, which just increased its membership to 70, including every G7 country except Japan and America.

So it might seem that China has little interest in filling any gaps America might leave in the old multilateral system. But that would ignore another, less heralded trend. Overshadowed by its bilateral boondoggles and multilateral innovations, China's relationship with the incumbent IFIs has been warming. It has become more "compliant" with G20 commitments, according to the G20 Research Group at the University of Toronto (see chart). Its currency is now more fairly valued and its current-account surplus has narrowed, removing a bone of contention with the IMF.

The IMF's decision in 2015 to include the yuan as one of five reserve currencies in its Special Drawing Rights basket has also helped to rebut the notion that the fund is an arm of an American policy of containment.

Moreover, since China's ham-fisted devaluation earlier that year, it has often sought the IMF's advice on managing the transition to a more flexible yuan and communicating its policy to the markets.

China is similarly happy to learn what it can from the World Bank, which has advised it on everything from managing the debt of its provinces to cleaning the air in its cities. The bank's suggestions are not always taken. But at least China seems to value its advice non-negatively.

China's relationship with these institutions is also becoming more generous. It is now the 11th-biggest donor to the International Development Association (IDA), the arm of the World Bank that helps the world's poorest countries. The China Development Bank has co-financed several World Bank projects in Africa.

Last autumn, when the IMF was looking for money to help Egypt, it phoned China, which agreed to extend a currency-swap line worth 18bn yuan (\$2.6bn). The call took only five minutes and China's generosity embarrassed the G7 into stumping up some money in addition. China had been similarly helpful to the IMF bail-out of Ukraine a year earlier.

The World Bank and the IMF are imperfect vehicles for China's economic diplomacy. The bank's capital constraints might inhibit a big expansion in its lending and China's voting power and financial stake in the IMF will rise only if America permits. It took Congress six years to approve the last reform and it is hard to imagine the next round, due in 2019, winning much support from Mr Trump. But by adding extra dollops of financing to favoured bank and fund programmes, China can nonetheless steer the multilateral system indirectly, by adding its weight where it sees fit.

In the long term, if China becomes the world's leading economy, it is conceivable it will become the biggest financial contributor to the bank and

the fund. At that point, according to their articles of agreement, their headquarters would have to decamp to China. All the more reason for the World Bank to help Beijing clean its air. ■



中国的经济外交 走近舞台中央

在和国际金融机构打交道方面，中国越来越自如

国际货币基金组织（IMF）“有组织地让外国人越来越穷”，而世界银行的建议“对其最佳客户有负面效应”。如此刺耳的评价并非出自反对“华盛顿共识”的左翼评论家之口，而是分别来自特朗普选定的大卫·马尔帕斯（David Malpass）和亚当·莱瑞克（Adam Lerrick）。特朗普任命这两人负责处理财政部的国际事务，包括与世行、IMF等国际金融机构，以及全球领先经济体集团G20打交道。

他们未来的上司、美国财政部长史蒂文·努钦（Steven Mnuchin）同样不让全球金融机构放心。3月17日至18日，当他在德国巴登巴登第一次参加G20会议时（见图），他否定了一项确立已久的承诺——“反对任何形式的贸易保护主义”。人们曾经常常违背这一承诺。不过，虚伪是恶向善的致敬。

对于熟悉国际经济事务的资深人士来说，这种好斗的姿态令人困惑。现在的美国政府似乎对亲自培养起来的一些机构不屑一顾，而这些机构更多被批评太过紧随美国的意愿。哥伦比亚大学的杰弗里·萨克斯（Jeffrey Sachs）3月底对彭博社说：“美国正在将多边体系的领导权拱手让给中国。”

但是如果有空缺，中国是否够格、甚至是否对这个位置感兴趣呢？1月，在瑞士达沃斯举行的世界经济论坛上，习近平看似以一篇褒扬全球化的演讲试演了这一角色。要证明其能力，中国还可以摆出巨额的支票外交作为证据。中国国家开发银行是其政策性贷款机构之一，其账簿上的海外资产已经超过了世界银行。另一家机构中国进出口银行也相差不多。而且中国央行已经与30多个国家签订了货币互换协议，包括很多美联储不肯碰的国家。

那么它的意愿又如何？中国到目前为止的经济外交大部分是双边的，这让它能够赢得忠诚、回馈友邦并且为中国公司争取到合同。比如，有60多个国家可能会从习近平提出的“丝绸之路复兴”的怀旧愿景中受益（该项目名为“丝绸之路经济带和21世纪海上丝绸之路”，简称“一带一路”或OBOR）。

至于多边活动，中国最引人注目的举措都选择了绕开而不是通过现有的体系来实施。它设立了两个自己的多边贷款机构：新开发银行（又称金砖银行，总部设在上海，由巴西、俄罗斯、印度、南非和中国出资）和位于北京的亚洲基础设施投资银行。后者的成员国刚刚增至70个，其中包括除日本和美国之外的所有七国集团成员。

由此看来，中国也许对于填补美国在旧有多边体系中留下的空缺毫无兴趣。但这会忽略另一个征兆并不显著的趋势。在劳民伤财的双边形象工程和多边创新的背后，中国与既有国际金融机构的关系也一直在升温。多伦多大学的G20研究小组认为，中国变得更为“遵守”G20的承诺（见图表）。其货币现在的定价更为合理，而且它的经常账户盈余也已缩减，解除了与IMF争论的一个焦点问题。

2015年IMF决定将人民币纳入其特别提款权（Special Drawing Rights）篮子，成为五种储备货币之一，此举也有助于驳斥关于该基金组织是美国遏制政策的一部分的言论。而且，自从2015年初中国笨拙地让人民币贬值之后，它已常常就如何过渡到更灵活的人民币汇率机制、如何将政策传递给市场向IMF征询意见。

中国也同样乐于向世界银行学习，从管理各省负债到净化城市空气，世行已经就各种各样的问题向中国提供了建议。对于这些建议，中国并不是全盘采纳。但至少中国看似并未否定世行的建议。

中国在同这些机构打交道时也变得更加大方。它现在是世界银行帮助全球最贫困国家的分支机构国际开发协会的第11大捐款国。中国国家开发银行联合资助了世界银行在非洲的多个项目。

去年秋天，当IMF筹措资金援助埃及时，它致电中国，中国同意签署一份

价值180亿人民币（26亿美元）的货币互换协议。这通电话只花了五分钟，而中国的慷慨让七国集团汗颜，它们只好也掏出钱来。2015年，中国在IMF纾困乌克兰时也提供了类似的帮助。

对于中国的经济外交来说，世界银行和IMF并非完美的载体。世行的资本约束可能抑制了其贷款大幅扩张，并且只有获得美国的同意，中国在IMF的投票权和份额才能增加。美国国会花了六年时间才通过上一次改革方案，很难想象将于2019年实施的下一轮改革能从特朗普那儿赢得多少支持。但是通过向它所青睐的银行和基金项目注入额外的资金，中国仍然可以在它觉得合适的地方增加自己的分量，从而间接掌控多边体系。

从长远角度看，如果中国成为世界领先经济体，可以想见它将成为世界银行和IMF最大的出资国。到那时，根据这些机构的协议条款，它们的总部将不得不搬到中国。这样一来，世界银行就更有理由帮北京净化空气了。





American trade policy

Done deals

A review of bilateral and regional trade deals will disappoint Donald Trump

ACCORDING to a document crafted by the Trump administration, a model trade agreement has 24 elements. Second on the list is “trade-deficit reduction”, giving a hint as to why Mr Trump wants to review America’s existing agreements. In January Sean Spicer, his press secretary, said the administration would “re-examine all of the current trade deals.” A presidential order to do just that is reported to be in the offing.

America boasts 14 bilateral and regional free-trade agreements (FTAs). Mr Trump seems to blame these agreements for America’s large trade deficit. Most economists disagree, seeing it as reflecting macroeconomic imbalances. The FTAs are in any case with countries representing just two-fifths of America’s two-way trade in goods, and less than 10% of its goods-trade deficit (see chart). Most (77%) of America’s deficit stems from trade with China, the European Union and Japan. None has an American FTA.

A focus on trade deficits means that tiddly deals such as those with Jordan and Oman will not face much heat. NAFTA (an agreement with Mexico and Canada), and KORUS (South Korea), will face more scrutiny because of chunky American deficits with these countries. Israel is the next biggest trade-deficit offender. But Mr Trump seems unlikely to attack that FTA, America’s oldest.

A review of trade deals is hardly revolutionary. More recent ones, like KORUS, have committees dedicated to monitoring them. And both the Mexican and the Canadian governments have accepted that NAFTA should be updated for things like e-commerce. They saw the Trans-Pacific Partnership, agreed to in 2016 by the NAFTA three and nine other Pacific

Rim countries (and jettisoned by Mr Trump), as part of that process.

Last year geeks at the United States International Trade Commission (USITC) published a 373-page, evidence-based assessment of America's trade deals. It found that they were positive, but not transformative, raising GDP by 0.2% in 2012 and, in 2014, saving consumers \$13bn through lower tariffs. Also, the USITC estimates that each of America's trade deals has tended to improve the bilateral trade balance. Without NAFTA, the USITC estimates that the goods deficits with Canada and Mexico would be larger by around 3% of total bilateral trade. Trade deals tend to slash other countries' tariffs more than American ones.

So it is unclear how poring over trade deals will achieve Mr Trump's goal of squashing the trade deficit. Others have a different worry. Trade agreements are supposed to be win-win. Concessions must be sold domestically. As Michael Froman, Barack Obama's trade representative, notes, "other countries have politics, too." ■



美国的贸易政策

既成事实

审查美国的双边和区域贸易协定会让特朗普失望

特朗普政府制定的一份文件指出，一个模范贸易协定要包含24个要素。其中排在第二的是“减少贸易赤字”，这暗示了特朗普想要审查美国现有协定的原因。白宫发言人肖恩·斯派塞（Sean Spicer）1月表示，政府将“重新审视目前所有的贸易协定”。据报道，相关总统令即将出台。

美国签署了14个双边和区域自由贸易协定。特朗普似乎将美国的巨额贸易逆差归咎于这些协定。而大多数经济学家却并不同意，他们认为逆差反映了宏观经济的失衡。无论如何，与美国签订自由贸易协定的国家只占美国双边货物贸易额的五分之二，占美国货物贸易逆差不到10%（见图表）。美国的贸易逆差大多（77%）源于对中国、欧盟和日本的贸易。而美国跟它们并没有签订自由贸易协定。

关注贸易逆差意味着同约旦和阿曼等国之间无足轻重的协定不会招致太多火力。而《北美自由贸易协定》（美国与墨西哥和加拿大达成的协定）以及《美韩自由贸易协定》（KORUS）将面临更多审查，因为美国对这些国家存在巨额逆差。以色列是另一个让美国产生巨额逆差的国家。但特朗普似乎不可能对与以色列间的自由贸易协定下手，这是美国的第一个自由贸易协定。

对贸易协定的审视称不上什么创举。像《美韩自由贸易协定》这样较近的协议都有专门的委员会对其进行监督。墨西哥和加拿大政府都同意，《北美自由贸易协定》应该在电子商务等方面有所更新。它们把2016年由《北美自由贸易协定》三国和环太平洋其他九国签订（却被特朗普抛弃）的《跨太平洋伙伴关系协定》（TPP）视为这个过程的一部分。

去年美国国际贸易委员会（USITC）的学究们发布了一份对美国贸易协定长达373页的实证评估。评价报告发现这些协定具有积极意义，但并未带

来大的转变。它们在2012年增加了0.2%的GDP，2014年通过降低关税为消费者节省了130亿美元。该委员会还认为，美国的每个贸易协定往往都会改善双边贸易平衡。它估计，如果没有《北美自由贸易协定》，美国对加拿大和墨西哥的货物贸易逆差将会增加，增幅为双边贸易总额的3%左右。贸易协定对其他国家关税的削减往往要多于美国。

因此并不清楚仔细审视贸易协定将如何实现特朗普遏制贸易逆差的目标。其他国家则有不同的烦恼。贸易协定应当是双赢的。让步必须被国内所接受。正如奥巴马的贸易代表迈克尔·弗罗曼（Michael Froman）指出的那样，“其他国家内部也有政治角力。”■



The mining business

The richest seam

An industry only just emerging from crisis hopes that electric vehicles and batteries will unleash a new, green supercycle

FOR mining investors there is something sinfully alluring about Glencore, an Anglo-Swiss metals conglomerate. It is the world's biggest exporter of coal, a singularly unfashionable commodity. It goes where others fear to tread, such as the Democratic Republic of Congo (DRC), which has an unsavoury reputation for violence and corruption. It recently navigated sanctions against Russia to strike a deal with Rosneft, the country's oil champion.

Yet Glencore could still acquire a halo for itself. It is one of the world's biggest suppliers of copper and the biggest of cobalt, much of which comes from its investment in the DRC. These are vital ingredients for clean-tech products and industries, notably electric vehicles (EVs) and batteries.

The potential of "green" metals and minerals, which along with copper and cobalt include nickel, lithium and graphite, is adding to renewed excitement about investing in mining firms as they emerge from the wreckage of a \$1trn splurge of over-investment during the China-led commodities supercycle, which began in the early 2000s. The most bullish argue that clean energy could be an even bigger source of demand than China has been in the past 15 years or so.

Optimism about the mining industry is a remarkable turnaround in itself. In the past four years the business has endured a slump that Sanford C. Bernstein, a research firm, judges to have been as deep as in the Depression. In 2014-15 the four biggest London-listed miners—BHP Billiton, Rio Tinto, Glencore and Anglo American—lost almost \$20bn of

core earnings, or EBITDA, as commodities plunged. Glencore, which was hit hardest, scrapped its dividend and issued shares to rescue its balance-sheet.

Commodity valuations rebounded last year, and again led by Glencore, mining-company share prices rallied. Recent results show that the four biggest firms not only swung from huge losses to profits but also cut net debt by almost \$25bn in 2016. BHP and Rio made unexpectedly large payouts to shareholders. Ivan Glasenberg, Glencore's tough-talking boss, says the company is now in its strongest financial position in 30 years. "What a difference a year makes," he exclaims.

Underpinning the turnaround have been curbs on supply—both voluntary, to push up commodity prices, and involuntary, such as strikes and stoppages. Capital expenditure has fallen by over two-thirds since 2013 (see chart). All the firms are reluctant to embark on big new mining projects. Mr Glasenberg says the industry's pipeline of new copper projects, for example, is shorter than it was before the China boom. Rio's giant Oyu Tolgoi copper site in Mongolia's Gobi Desert is a rare exception. The main focus at all the mining firms is on rebuilding balance-sheets and rewarding shareholders who kept the faith.

Even as they promise capital discipline, however, demand for green metals and minerals is tempting them to spend. Last year BHP declared that 2017 could be the year "when the electric-car revolution really gets started". A recent surge in the prices of battery ingredients, such as copper, cobalt and lithium, has added to the excitement. China, the world's biggest manufacturer of EVs, is gobbling up supplies. In November China Molybdenum, which is listed in Shanghai, became the majority owner of Tenke Fungurume, a vast copper and cobalt mine in the DRC. Tellingly, the price of platinum, which is used in catalytic converters in internal combustion engines, has lagged behind.

BHP, which has looked closely at EV-related demand, estimates that an average battery-powered EV will contain 80 kilograms of copper, four times as much as an internal-combustion engine. This is split between the engine (the largest share), the battery and the wiring harness. It forecasts that by 2035 there could be 140m EVs on the road (8% of the global fleet), versus 1m today. Manufacturing them could require at least 8.5m tonnes a year of additional copper, or about a third extra on top of today's total global copper demand.

According to Sanford C. Bernstein, which uses a bold estimate that almost all new cars will be electric by 2035, global copper supplies would need to double to meet demand by then. Finding and digging up all the metals that stand to benefit, plus new smelting and refining capacity, could require up to \$1trn in new investment by mining companies, it says. Hunter Hillcoat of Investec, a bank, says the transition could require the addition of a copper mine the size of Chile's Escondida, the world's biggest, every year.

Therein lies the rub. By one estimate, it takes at least 30 years to go from finding copper deposits to producing the metal from them at scale. Some of the big ones in operation today were discovered in the 1920s. Because of declining ore grades, community resistance, lack of water and other factors, copper supply will be overtaken by demand in the next year or two. But prices would have to rise considerably to spur the necessary investment in mines.

Sharply higher prices for copper could, however, spur the search for alternative battery and EV materials such as aluminium. When prices of nickel, an additive in stainless steel, soared a decade ago, stainless-steel manufacturers found ways to make products less nickel-dependent.

Another difficulty in supplying a future electric-vehicle revolution is the often inhospitable location of some of the most promising minerals.

Cobalt, for instance, is a by-product of copper and nickel. Total volumes are about 100,000 tonnes, and about 70% lies in the DRC. Unregulated artisanal miners produce a lot of it, which has led to worries about “conflict cobalt”.

Indeed, the DRC is likely to be the main source of many of the minerals needed for EVs and batteries. Paul Gait of Sanford C. Bernstein calls it the Saudi Arabia of the EV boom, referring to the kingdom’s role in oil markets. But firms such as BHP and Rio are thought to be reluctant to invest there because of concerns about the country’s stability, transparency and governance.

In the short term the mining industry remains gun-shy about new investments. As Glencore’s Mr Glasenberg notes, it has been fooled before by estimates that demand for copper will double—the latest such misjudgment came as recently as 2008. The very biggest firms, BHP and Rio, have an additional reason to hesitate before splurging on battery materials. Their cash cows are iron ore and coking coal, the raw materials of steel, which are used more heavily in petrol and diesel engines than in EVs. BHP also produces oil, demand for which could one day be affected by battery-powered vehicles. Anglo American has a large platinum and palladium business, feeding demand for diesel and petrol catalytic converters.

All the firms insist that such diverse mineral exposures in fact provide them with a “hedge” whichever way the vehicle fleet develops (though they play up the copper in their portfolio as possibly the best bet of all). Rio is unique among them in also having a lithium-borate project, in Serbia, which it is developing as an option on a batteries boom.

For an unhedged bet, it may be small miners such as Canada-based Ivanhoe that are best placed for a surge in EVs and batteries. Ivanhoe recently said it

planned to develop the Kamoakakula deposit in the DRC (pictured), which it calls the biggest copper discovery ever, containing the highest-grade copper that the world's big mines produce. Zijin, a Chinese miner, sees the same opportunity and is paying Ivanhoe \$412m for half of its majority stake in Kamoakakula. Ivanhoe's founder, billionaire Robert Friedland, speaks of the metal as the king of them all. "Based on world ecological and environmental problems," he says, "every single solution drives you to copper." ■



采矿业

利润最丰厚的矿藏

一个刚刚走出危机的产业希望电动汽车及电池会引发一轮全新的绿色超级周期

对采矿投资者来说，嘉能可（Glencore）这家英瑞金属企业集团有种让人无法自拔的吸引力。这家公司还是煤这种格外不时髦的大宗商品的全球最大出口商。它去往他人不敢涉足之地，例如因暴力及腐败而声名不佳的刚果民主共和国（DRC，以下简称刚果（金））。最近它还设法绕过俄罗斯遭受制裁这一情况，与该国最大的石油公司俄罗斯石油公司（Rosneft）达成交易。

不过嘉能可本身也自带光环。它是世界最大的铜供应商之一，也是世界最大的钴供应商，二者大部分都来自于公司在刚果（金）的投资项目。这两种金属是清洁科技产品及产业的重要元素，尤其是电动汽车和电池。

在本世纪初由中国引领的大宗商品超级周期中，投资者向矿业公司豪掷一万亿美元。近期该行业终于从当时这种过度投资造成的破败局面中走出，投资者也重新燃起投资采矿的热情。如今，包括铜、钴、镍、锂以及石墨在内的“绿色”金属及矿物的潜力令他们愈加振奋。看涨情绪最为高昂的人认为，清洁能源对这些金属和矿物的需求或许比中国在过去约15年里的需求还要大。

对采矿业的乐观情绪本身就是一个显著好转。过去四年来采矿业遭遇大滑坡，研究公司盛博（Sanford C. Bernstein）判断，其程度之深重堪比大萧条时期。2014年到2015年间，随着大宗商品价格暴跌，于伦敦上市的四大矿业公司必和必拓（BHP Billiton）、力拓（Rio Tinto）、嘉能可以及英美资源集团（Anglo American）几乎损失了200亿美元的核心盈利，或者说税息折旧及摊销前利润（EBITDA）。受冲击最大的嘉能可通过取消派息和发行新股挽救自己的资产负债表。

去年，大宗商品价格回升，采矿公司股价反弹，嘉能可再次一马当先。近

期的业绩显示，四大矿业公司不仅摆脱了巨额亏损，实现了盈利，还在2016年削减了将近250亿美元的净负债。必和必拓和力拓也出人意料地向股东们派发了大笔股息。嘉能可言辞强硬的老板伊凡·格拉森伯格（Ivan Glasenberg）说，30年来，公司如今的财务状况最为强健。他感叹：“只一年的功夫，就有了这么大的转变。”

行业状况实现好转靠的是限制供给——既有为推高大宗商品价格的自愿因素，也有罢工和停工这样不得已的状况。自2013年来，各大矿业公司资本支出的降幅已超过三分之二（见图表）。所有这些公司都不太愿意开发新的大型采矿项目。例如，格拉森伯格称，行业内新铜矿项目的储备要比中国带来的矿业繁荣期出现前要少。力拓位于蒙古戈壁、规模巨大的奥尤陶勒盖（Oyu Tolgoi）铜矿则是一个鲜见的例外。这几个矿业公司的主要重点都是重建资产负债表，以及回馈一直对自己保有信心的股东。

虽说这些公司保证会坚持资本约束，不过市场对绿色金属及矿物的需求正诱惑它们解开钱袋。去年，必和必拓宣称2017年将会是“电动汽车革命真正开始”的年份。近期电池材料如铜、钴以及锂的价格飙升，更令业界感到兴奋。中国作为世界最大的电动汽车制造商，正在大量消耗这些材料。去年11月，于上海上市的洛阳钼业（China Molybdenum）成为刚果（金）大型铜钴矿Tenke Fungurume的大股东。不难发现，相较而言内燃机里的催化转换器所使用的铂的价格已被甩在了后面。

密切关注电动汽车相关需求的必和必拓估计，制造一辆普通的以电池驱动的汽车将需要80公斤的铜，是内燃机汽车所需铜的四倍。这些铜分布在发动机（需要的铜最多）、电池以及电路中。必和必拓预测，到2035年也许会有1.4亿辆电动汽车上路，占全球汽车保有量的8%，而如今的数字是100万辆。要将这些车辆生产出来，每年至少需增加850万吨的铜产量，也就是在如今全球总需求的基础上再增加三分之一的产量。

到2035年几乎所有新生产的汽车都会是电动的——根据这一大胆的估计，盛博认为到那时全球铜的供应量将需要翻倍才能满足需求。它指出，为了找到并将所有可能获利的金属采挖出来，以及提高冶炼和提纯的能力，采

矿公司或许需增加高达一万亿美元的投资。天达银行（Investec）的亨特·希尔科特（Hunter Hillcoat）说，要应对汽车行业的这一转变，每年都得新增一个铜矿，与世界最大铜矿智利的Escondida规模相当。

问题也出在这里。据估计，从发现铜矿床到将这种金属大规模生产出来至少需要30年。如今还在开采中的大型铜矿中，有些是在上世纪20年代发现的。由于矿石品位下降、一些社群对开矿的抵制以及缺水等因素，到明年或后年铜将供不应求。但铜价得大幅上涨才会激励企业对铜矿进行必要的投资。

然而，铜价急剧上涨也许会促使制造商去寻觅电池及电动汽车所需原料的替代品，例如铝。当十年前不锈钢的添加剂镍价格飙升时，不锈钢制造商便想办法让产品减少对镍的依赖。

要满足未来电动汽车革命的需求还有另一个难题：某些前景最好的矿物往往位于不宜涉足的地方。例如，作为铜和镍的副产品，钴的全球总产量约为10万吨，刚果（金）约占其中的70%。这之中有很大一部分都是在没有法律监管的情况下由矿工手工开采出来的。这引发了国际社会对“冲突钴”的担忧【译注：冲突矿石是指在武装冲突和侵犯人权的情况下开采的矿物】。

事实上，汽车和电池所需的矿物中，可能很多种都将主要来自刚果（金）。盛博的保罗·盖特（Paul Gait）将该国比作电动汽车繁盛期的沙特阿拉伯，意指其相当于该王国在石油市场上的角色。但有人认为必和必拓和力拓这样的公司并不愿投资刚果（金），因为它们对该国的稳定、透明度及政府对国家的治理感到担忧。

短期内采矿业对新投资仍心有余悸。嘉能可的格拉森伯格指出，之前该行业曾被“铜的需求量会翻番”的估计愚弄过。距今最近的一次判断失误就发生在2008年。行业龙头必和必拓以及力拓更有理由在大笔投资电池材料之前犹豫再三。这两家公司的现金牛是用于生产钢材的原材料铁矿石和焦煤。汽油车和柴油车使用到的钢材要比电动汽车多得多。必和必拓也生产

石油，也许某一天市场对这一产品的需求将因电池驱动的汽车而受到影响。英美资源集团还开展庞大的铂和钯业务，来满足市场对柴油及汽油发动机内的催化转化器的需求。

这几家公司都坚持认为，拥有多种矿藏其实给它们以“对冲”：无论汽车行业如何发展，它们都能妥善应对（不过它们还是将铜作为投资组合中的重要部分，认为这可能才是最稳妥的做法）。力拓是它们当中最独特的一个。它目前还在塞尔维亚开发一个硼酸锂的项目，应对接下来的电池大发展。

对于单一下注模式来说，像加拿大的艾芬豪（Ivanhoe）这样的小型采矿公司也许在电动汽车及电池蓬勃发展时最具优势。艾芬豪近期表示计划开发位于刚果（金）的Kamoa-Kakula铜矿（如图），那里蕴藏的矿石是世界大型铜矿所产矿石中品位最高的那种。艾芬豪称其为有史以来最重大的铜矿勘探发现。中国的紫金矿业也看准了这一机会，正以4.12亿美元的价格从艾芬豪手中购买Kamoa-Kakula一半的股份。艾芬豪的创始人、亿万富翁罗伯特·弗里德兰（Robert Friedland）称铜为金属之王。“面对全球各种生态和环境问题，”他说，“哪一种解决方案都会引导你去追逐铜。”■



Uber's future

Hard driving

The ride-hailing giant is going through the biggest crisis in its short history

AS A teenager, Travis Kalanick's first job was to knock on strangers' doors and sell them knives. Now he is trying to dodge the daggers aimed at him and at Uber, a ride-hailing firm that is the world's most valuable startup. On March 19th Jeff Jones, the company's president, stepped down after six months, declaring that "the beliefs and approach to leadership that have guided my career are inconsistent with what I saw and experienced at Uber." At least six key executives and high-ranking employees have left in the past nine weeks. They include Uber's head of mapping, a former head of self-driving car technology, and an artificial-intelligence (AI) expert who had been put in charge of the firm's AI research lab only three months ago.

Aggressive and unrelentingly ambitious, Mr Kalanick built his eight-year-old company into America's largest privately owned technology firm by treading on the toes of different groups, including traditional taxi drivers, other tech companies and regulators. He pushed into new markets abroad and raised an unprecedented amount of capital, to the tune of around \$12.5bn, including debt. The firm has a valuation of close to \$70bn (see chart).

Yet a remarkable run of bad news for Mr Kalanick, combined with some setbacks for Uber itself, threatens to halt the firm's momentum. "I have never seen someone have such a bad couple of months," commiserates the boss of a large, public tech firm. Politics struck first: in January Mr Kalanick was widely criticised for serving on Donald Trump's business advisory committee and for apparently intervening in a strike by taxi drivers opposed to Mr Trump's ban on refugees. A campaign, called #DeleteUber, took off, encouraging users to stop using the Uber app.

Then worries about Uber's culture mounted. A former employee wrote a blog post on how Uber's human-resources department failed to act on her sexual-harassment complaint. Next, an Uber driver filmed Mr Kalanick arguing with him about fare cuts and uploaded the material, including the boss lamenting that "some people don't like to take responsibility for their own shit". The latest embarrassment was the revelation that Uber had secretly designed and used a software feature, called Greyball, to evade city officials attempting sting operations to catch Uber drivers violating local regulations.

Two questions face the company. One is whether Uber will continue prospering under Mr Kalanick's leadership. Silicon Valley and its denizens may celebrate his type, but his public words and actions have made people close to the firm squirm. Bill Gurley, a venture capitalist and early Uber backer who sits on the board, is helping direct a search for a chief operating officer to keep Mr Kalanick in check and bring experience and discipline to the firm. It is certainly hard to keep on top of the firm's growth: last year, its headcount doubled.

If Mr Gurley and the rest of the board cannot find an experienced candidate willing to work with Mr Kalanick, calls for him to step down may grow louder. But that is his decision to take. Uber is a prominent example of founders' power at fast-growing tech firms. On its own, Uber's board does not have the clout to change the CEO, because of his super-voting shares and those of his co-founder, Garrett Camp: together they control a majority of the voting stock.

The second question concerns Uber's longer-term business prospects. One of the firm's early-stage investors says that recent events have been a series of "body blows", but he worries that there could be a "knockout blow" that would permanently damage Uber's momentum. So far, he says, it looks as if Uber is merely bruised.

From the start of the year to the first week in March, Uber's market share in America has fallen from around 80% to 74%, according to 7Park Data, which tracks the industry. Lyft, a smaller ride-hailing firm, seems to have been the chief beneficiary. The dip in market share for Uber could reverse, though the firm is unlikely to grow as effortlessly as in the past. There is, at least, still plenty of room to expand at home. Only around 6% of American mobile-phone users hail a ride through Uber and Lyft once a month or more.

Yet Uber's enormous valuation also depends on the firm pulling off a harder task: dominating most markets for ride-hailing around the world. Fortunately, there is little evidence that Mr Kalanick's antics have dented its prospects outside America. But the goal of worldwide dominion remains distant, even though no other private technology firm has ever spent so much money to gain a global foothold. It is competing against a strong competitor, Grab, in South-East Asia and was spending billions to compete against its Chinese rival, Didi, until it struck a deal last year to withdraw from the country in exchange for a 20% stake in that firm.

Investors particularly want to see the ride-hailing giant reach profitability in developed markets. Its sales, of around \$5.5bn in 2016, are growing rapidly, but it has to spend a lot in American cities where there are rival local firms such as Lyft and (smaller) ones such as Juno and Via. For every dollar that Lyft spends in subsidising fares, it costs Uber four times the amount to hold onto customers and drivers, because of its far larger size. Foreign expansion adds still more expense, and it is unclear whether the competition at home and abroad, which hurts Uber's chance of becoming profitable, will ever ease up.

There are other threats to watch out for. Uber's performance depends on its software working smoothly and not being hit by outages, and this could suffer if more executives on the technical side leave. It may also struggle to

hire talented engineers during this rough patch.

Another looming problem is regulation. Later this year the European Court of Justice, the European Union's highest court, will decide on whether Uber is a transport company or just a digital service; if it is judged to be the former, it will need to comply with stricter licensing, insurance and safety rules, lifting its costs significantly in Europe. Last month an American court upheld a law from Seattle allowing Uber drivers a vote to unionise. Other cities are expected to follow suit. A British court will soon need to rule on whether Uber has to pay value-added tax.

As for Uber's race to move away from human drivers to autonomous driving, obstacles lie ahead. In February Waymo, a self-driving car unit that is owned by Google's parent company, sued Uber, claiming that former employees of Google had stolen some of Waymo's proprietary technology when they set up their own autonomous-driving startup, Otto. Last year Uber bought Otto, which makes self-driving kit for lorries, for around \$700m.

Patent disputes are common in the tech industry and can take years to play out, but Waymo is being particularly aggressive. It has asked a judge to ban Uber's use of its lidar technology, which uses lasers to scan a vehicle's surroundings and is employed in self-driving cars. Uber may settle for a large sum, but the affair adds uncertainty.

Some people close to Uber ask whether all the difficulties will force Mr Kalanick, who has said he never wants to take the firm public, to consider doing just that. It will now be far harder to raise money in the private markets at Uber's stratospheric valuation. But it is possible to argue the opposite: Mr Kalanick will need the clouds of controversy to clear before going public.

His company's problems could occur at many startups, but the fact that they have all struck at once suggests its immaturity and a lack of professional management. Given the sums at stake and the blow to the prestige of many in Silicon Valley if Uber failed, there will be no shortage of pressure on Mr Kalanick to prove that he is the right person to stay at the wheel. ■



优步的前景 艰难行车

网约车巨头正在经历其短暂历史中最大的危机

特拉维斯·卡兰尼克（Travis Kalanick）在十几岁时做的第一份工作是上门向陌生人推销刀具。如今他则在努力躲避朝他和优步（这家网约车公司是全球估值最高的创业公司）飞来的刀子。3月19日，该公司的总裁杰夫·琼斯（Jeff Jones）在上任六个月后辞职，并宣称“在优步的见闻体验与自己职业生涯中一直遵循的领导理念和方式有冲突。”过去九周内，至少已有六位核心高管及高层员工离职，其中包括优步的地图测绘部门主管、自动驾驶汽车技术部门的一名前主管，以及一位三个月前才开始掌管优步人工智能研究实验室的AI专家。

好斗的而具有不懈雄心的卡兰尼克不惜开罪传统出租车司机、其他科技公司和监管机构等不同团体，把这家创立八年的公司打造成美国最大的非上市私人科技公司。他努力开拓海外市场，筹集到前所未有的巨额资本，包括借债在内约达125亿美元。该公司目前估值接近700亿美元（见图表）。

然而，坏消息接二连三地向卡兰尼克袭来，加上优步本身遭遇的一些挫折，公司的发展势头受到威胁。“我从没见过有人像这样倒霉好几个月的。”一家大型上市科技公司的老板同情地说。先是政治方面的冲击：今年1月，卡兰尼克因加入特朗普的经济顾问团，以及疑似干扰出租车司机反对特朗普难民禁令的停运活动而广受批评。网民们发起名为“#删除优步”（#DeleteUber）的行动，鼓动优步用户卸载该应用。

随后，针对优步企业文化的忧虑升温。一名前员工发表博文称，优步人力资源部门对她遭性骚扰的投诉坐视不理。接着又有一名优步司机把自己与卡兰尼克就车费下调问题的争吵拍摄下来并上传到网上，卡兰尼克在其中哀叹“有些人就是不愿意为自己的屁事负责”。最新曝光的丑闻则是优步秘密设计并使用一款名为“灰球”（Greyball）的软件来逃避政府监管人员的执法钓鱼行动，使违反当地法规的优步司机得以逃脱。

该公司面临两个问题。一是优步在卡兰尼克的领导下能否继续繁荣发展。硅谷及其科技精英们也许对卡兰尼克这类人赞赏有加，但他的公开言论及行为却令与优步有切身利益的人困窘难当。风险投资家、同时也是优步早期的投资人兼董事会成员的比尔·格利（Bill Gurley）正协助物色一名首席运营官来制衡卡兰尼克，并希望藉此将经验和规矩引入该公司。公司增长迅速，管理难度必然大增：去年，其员工数量翻了一番。

假如格利及董事会其他成员找不到愿意与卡兰尼克共事的资深人选，要求卡兰尼克下台的呼声可能会高涨。但这个决定却是要由他本人来做出。在创始人掌控高速增长科技公司方面，优步是个突出例子。优步的董事会单凭自身力量是无权更换CEO的，因为他和另一创始人格瑞特·坎普（Garrett Camp）都拥有超级投票权股份：两人控制了大部分的投票权股份。

第二个问题事关优步的长期业务前景。该公司的一位早期投资者表示，最近的事件是一连串的“沉重打击”，而他担心优步可能会遭到“致命一击”，令发展势头受到永久性伤害。他说，目前为止，优步看起来还只是受了点皮外伤。

据追踪该行业市场况的市场调查公司7Park Data的数据，从今年初到3月第一周，优步在美国的市场份额已从约80%下降至74%。较小型的网约车公司Lyft似乎是主要受益者。虽然优步已不大可能像以前那样毫不费力就实现增长，但它还是有可能扭转微跌的市场份额。至少在美国国内还有很大的扩张空间。在美国手机用户中，仅6%会每月通过优步和Lyft打车一次或以上。

但要撑起它的巨额估值，优步还要完成一项更艰巨的任务：成为全球多数市场的网约车霸主。幸运的是，几乎没有迹象表明卡兰尼克的乖张言行有损公司在美国以外市场的前景。但要实现称霸全球的目标依旧遥遥无期，尽管还没有哪家私人科技公司像优步一样花费巨资来建立全球布局。优步正与强劲的对手Grab争夺东南亚市场。而之前优步已花费数十亿美元与中国的竞争对手滴滴出行一较高下，直至去年与之达成协议而退出中国市

场，换取了滴滴20%的股份。

投资者尤其希望这家网约车巨头能在发达市场实现盈利。其销售额在2016年约为55亿美元，正快速增长，但优步需要在有本土对手公司Lyft以及Juno和Via等更小型公司出没的美国城市花费大量资金扩展。Lyft每花一美元补贴车费，优步就需要花四倍的成本来挽留顾客和司机，因为它的规模大得多。海外扩展进一步增加了支出，国内外的竞争削弱了优步实现盈利的机会，而这些竞争是否会减弱还是个未知数。

还有其他威胁需要留心。优步的表现要靠其软件不间断地顺畅运行，假如更多技术高管离职，这方面可能受到影响。在这段艰难时期，优步要觅得才华出众的工程师也非易事。

另一个渐渐浮现的问题是监管。今年晚些时候，作为欧盟最高法院的欧洲法院将判定优步是运输公司还是仅仅是一家数字服务公司。假如被判定为前者，优步将需要遵守更严格的营运牌照、保险及安全规定，这样一来它在欧洲的运营成本将大大增加。上月，西雅图一项法规获得了美国一家法院的支持，该法规允许优步司机投票组织工会。其他城市估计将会仿效。英国一家法院也即将裁定优步是否需要缴纳增值税。

而在从人类司机转向自动驾驶的竞赛中，优步仍面临诸多障碍。2月，谷歌母公司的自动驾驶部门Waymo起诉优步，称谷歌的前员工窃取了Waymo的部分专利技术创立了自动驾驶公司Otto，为货车提供自动驾驶技术。而去年优步以约七亿美元收购了Otto。

专利纠纷在科技行业司空见惯，往往历时数年才有结果，但Waymo这次尤为咄咄逼人，要求法官禁止优步使用其激光雷达技术（安装在自动驾驶汽车上，以激光扫描汽车周围环境）。优步可能选择以大手笔和解，但这件事令变数加大。

卡兰尼克曾表示从没想过让公司上市，但有些与优步密切相关的人想知道，当前这些难题会否迫使他改变想法。以其天价估值，优步现在要从私人市场融资将远比之前困难。但反过来想也完全有可能：卡兰尼克将需要

等风波平息后再上市。

优步的问题在许多创业公司都有可能发生，但这些问题同时爆发，显示出优步的不成熟和缺乏专业管理。假如优步败下阵来，硅谷的许多企业 and 个人的声望都会遭受沉重打击，而且牵涉的资本巨大。有鉴于此，卡兰尼克若要证明自己是掌舵的不二人选，肩头的压力肯定不小。■



The AIDS crisis in America

Chronicles of death foretold

NEWS of a fatal new disease affecting gay men first broke in 1981. But it took many years and very many deaths before the public noticed. In New York, the plague's epicentre, a new case of AIDS was soon being diagnosed every day, yet Ed Koch, the mayor, did next to nothing to prevent its spread. According to a new book, "How to Survive a Plague", the virus had infected 7,700 people in America by 1984 and killed 3,600, yet a question about it at a White House press conference aroused laughter. It was only in 1985, after Rock Hudson, a Hollywood star, was hospitalised with AIDS, that President Ronald Reagan publicly acknowledged the virus. But he did little to help the epidemic's largely gay victims. In 1987, after nearly 20,000 Americans had died, he quipped: "When it comes to preventing AIDS, don't medicine and morality teach the same lessons?"

David France's masterful account of the epidemic offers plenty of opportunity for outrage. America's response to this public-health crisis was one of federal neglect, bureaucratic incompetence, corporate greed and brazen prejudice. AIDS would claim over 300,000 Americans—a third of them in New York—before a pharmaceutical breakthrough in 1996 enabled the infected to lead ordinary lives. For those who have survived, Mr France writes that the betrayal of so many politicians, doctors, clergymen and family members remains "impossible to forget".

At a time when several states still banned gay sex, many Americans saw AIDS as a punishment for sinful behaviour. Early patients were thrown out of hospitals, ignored by ambulances and locked out of their homes. Nearly every New York undertaker refused to handle the corpses. The popular press initially avoided the story; it took two years and 600 dead before the

New York Times covered it on the front page. When reports became inevitable, editorials frequently castigated gay men as public-health menaces. Anti-gay hate crimes surged, rarely resulting in arrests. Gay foreigners entering the country were often quarantined and deported.

HIV, which causes AIDS, was a tenacious foe, genetically far more complex than other known retroviruses. AIDS suppressed the immune system and by 1990 one American was dying from the disease every 12 minutes, often after succumbing to a preventable infection. But even as hospitals overflowed with AIDS patients, the federal government failed to help states treat and prevent the disease, and federal research remained sluggish and disorganised. Drugs that officials called promising in 1985 had still not been tested five years later. Others that were transforming lives in off-market experiments, such as an anti-blindness drug called DHPG, still awaited clinical trials, ensuring that many AIDS patients would go blind unnecessarily. Federal officials dithered for years before issuing guidelines on treatable infections. Nine years of the country's war on AIDS had extended the average 18-month lifespan of patients by a mere three months.

Public indifference and political ineptitude drove activists to take matters into their own hands. Gay men began circulating materials promoting "safe sex" in 1983. Condoms became popular, bath houses closed and transmission rates for all sex-related diseases slowed dramatically. Yet it would take over a decade for Washington to fund a safe-sex campaign nationally. The government's flat-footed strategy for researching and testing new drugs and the crippling high costs of developing therapies spurred black-market clubs that peddled unapproved drugs by the truckload. Activists staged protests to highlight the cost of federally approved drugs, and they learned enough about virology, chemistry and immunology to propose essential drug-trial innovations. Federal and private researchers eventually took note of what they were saying. Never

before had a group of patients done so much to guide the agenda of so-called experts.

As a gay man in New York during this time, Mr France buried many friends and lovers. His own story is one of those he knits together in this riveting account of the men and women who refused to surrender in the face of AIDS. Despite its grim subject, this is an inspiring book. At a time when many Americans are worried once again about the wisdom and compassion of their elected leaders, “How to Survive a Plague” offers a salient reminder of what can be achieved by citizens who remain unbowed and unbroken. ■



美国的艾滋病危机

预知死亡纪事

1981年，关于男同性恋者感染一种新型致命疾病的消息首次披露，但经过很多年、发生大量死亡病例后才引起公众的关注。在这一疫病的集中爆发地纽约，很快就出现每天都有艾滋病例被确诊的情况，但时任市长的郭德华（Ed Koch）在防止该病的传播方面几无作为。根据新书《瘟疫求生指南》（How to Survive a Plague）的数据，到了1984年，美国已有7700人感染这一病毒，3600人因其死亡，但在白宫的某次新闻发布会上，一个关于该疾病的提问却引来一阵笑声。直到1985年好莱坞明星罗克·赫德森（Rock Hudson）因患艾滋病入院后，里根总统才公开承认这一病毒的存在。然而他几乎没有给这种病的受害者（大部分是男同性恋者）任何帮助。1987年，在近两万美国人因此丧生之后，他还出言讥讽：“说到预防艾滋病，药品和道德给出的教训难道有什么不同吗？”

大卫·弗朗斯（David France）对这一疫病的记述驾轻就熟，屡屡让读者义愤填膺。美国对这一公共健康危机的反应体现出联邦政府的失职、官僚的无能、企业的贪婪以及厚颜无耻的偏见。1996年医药领域的一项重大突破让感染者得以过上正常的生活，而在此之前，艾滋病可能已经导致三十多万名美国人死亡，其中三分之一是纽约人。弗朗斯写道，对于那些幸存者来说，如此之多的政客、医生、牧师和家人的背叛仍然“无法忘却”。

当美国仍有几个州严禁同性性行为之时，很多美国人都认为艾滋病是对这一罪恶行为的惩罚。早期的病人被赶出医院，救护车对他们视而不见，甚至家人也将他们拒之门外。在纽约，几乎每个殡葬服务人员都拒绝处理艾滋病死者的尸体。大众媒体起初对此病避而不谈，直到两年后，经历了600人的死亡，《纽约时报》才在头版刊登了报道。当报道变得不可避免时，社论开始频频谴责男同性恋者威胁公共健康。反对同性恋的仇恨犯罪行为飙升，而最终被逮捕的人却寥寥无几。国外同性恋者入境时常被隔离检疫并遭驱逐出境。

导致艾滋病的病毒HIV异常顽固，它的基因比其他已知的逆转录病毒复杂得多。艾滋病抑制免疫系统，到1990年每12分钟就有一名美国人死于艾滋病，常常是死于某种可预防的感染。然而即便医院里艾滋病人爆满，联邦政府仍未能帮助各州治疗并预防这一疾病，此外联邦层面的研究也依旧迟缓而无序。官员们在1985年声称大有希望的药物五年后仍未进行测试。其他一些在实验室里能改变病患生活的药物，如防失明的DHPG，仍要等待临床试验，令许多原本未必会失明的艾滋病患者丧失了视力。联邦官员犹豫数年才针对可治疗的HIV感染发布指南。美国抗击艾滋病九年，只将患者平均18个月的生命延长了三个月。

公众的淡漠和政治的无能迫使活动人士只能依靠自己的力量去解决问题。1983年，男同性恋者开始发放材料宣传“安全性行为”。避孕套得以推广，公共浴场关门，所有与性相关的疾病传播速率都大幅减缓。但是华盛顿在十几年以后才开始资助全国范围内倡导安全性行为的行动。政府在研究和测试新药上拖沓缓慢、毫无新意，加上治疗方法的研发成本高得惊人，刺激了黑市交易团体的出现，它们大批贩卖未经批准的药物。活动人士举行抗议活动，强调联邦政府已批准的药物费用过高。他们还充分学习了病毒学、化学和免疫学方面的知识，提出了至关重要的药物试验创新。联邦和私人研究人员终于开始留意他们的主张。从来没有一群病人在指引所谓专家的工作方面付出了如此之多的努力。

作为当时身在纽约的一位男同性恋者，弗朗斯送别了许多朋友和爱人。他自己的故事和其他很多故事一道，交织成一部引人入胜的记录。其中的男男女女直面艾滋，毫不屈服。虽然是关于一个严峻的主题，但这本书却给人以鼓舞。当很多美国人再一次为他们选出的领袖的智慧与恻隐之心感到担忧时，《瘟疫求生指南》是一个亮眼的提醒：不屈不挠、坚不可摧的公民可以取得怎样的成就。■



Materials science

A film worth watching

Keeping cool without costing the Earth

ABOUT 6% of the electricity generated in America is used to power air-conditioning systems that cool homes and offices. As countries such as Brazil, China and India grow richer, they will surely do likewise. Not only is that expensive for customers, it also raises emissions of greenhouse gases in the form both of carbon dioxide from burning power-station fuel and of the hydrofluorocarbons air conditioners use as refrigerants.

As they describe in a paper in this week's *Science*, Ronggui Yang and Xiaobo Yin of the University of Colorado, in Boulder, have a possible alternative to all this. They have invented a film that can cool buildings without the use of refrigerants and, remarkably, without drawing any power to do so. Better yet, this film can be made using standard roll-to-roll manufacturing methods at a cost of around 50 cents a square metre.

The new film works by a process called radiative cooling. This takes advantage of that fact that Earth's atmosphere allows certain wavelengths of heat-carrying infrared radiation to escape into space unimpeded. Convert unwanted heat into infrared of the correct wavelength, then, and you can dump it into the cosmos with no come back.

Dr Yang and Dr Yin are not the first to try to cool buildings in this way. Shanhui Fan and his colleagues at Stanford University, in California, demonstrated a device that used the principle in 2014. Their material, though, consisted of seven alternating layers of hafnium dioxide and silicon dioxide of varying thicknesses, laid onto a wafer made of silicon. This would be difficult and expensive to manufacture in bulk.

Dr Yang's and Dr Yin's film, by contrast, was made of polymethylpentene, a commercially available, transparent plastic sold under the brand name TPX. Into this they mixed tiny glass beads. They then drew the result out into sheets about 50 millionths of a metre (microns) thick, and silvered those sheets on one side. When laid out on a roof, the silver side is underneath. Incident sunlight is thus reflected back through the plastic, which stops it heating the building below.

Preventing something warming up is not, though, the same as cooling it. The key to doing this is the glass beads. Temperature maintenance is not a static process. All objects both absorb and emit heat all the time, and the emissions are generally in the form of infrared radiation. In the case of the beads, the wavelength of this radiation is determined by their diameter. Handily, those with a diameter of about eight microns emit predominantly at wavelengths which pass straight through the infrared "window" in the atmosphere. Since the source of the heat that turns into this infrared is, in part, the building below, the effect is to cool the building.

That cooling effect, 93 watts per square metre in direct sunlight, and more at night, is potent. The team estimates that 20 square metres of their film, placed atop an average American house, would be enough to keep the internal temperature at 20°C on a day when it was 37°C outside.

To regulate the amount of cooling, any practical system involving the film would probably need water pipes to carry heat to it from the building's interior. Manipulating the flow rate through these pipes as the outside temperature varied would keep the building's temperature steady. Unlike the cooling system itself, these pumps would need power to operate. But not much of it. Other than that, all the work is done by the huge temperature difference, about 290°C, between the surface of the Earth and that of outer space. ■



材料科学

值得关注的薄膜

无需破坏地球环境就能保持凉爽

美国的发电量约有6%用于驱动空调系统，给居所和办公室降温。随着巴西、中国和印度等国变得富裕，它们无疑也将效仿。这不仅令用户花费大笔金钱，还会增加温室气体排放，包括火电厂燃烧燃料释放的二氧化碳和空调用做制冷剂的氢氟烃。

在本周发表于《科学》上的一篇文章中，博尔德市科罗拉多大学的杨荣贵和尹晓波（Xiaobo Yin，音译）表示，他们找到了可能的替代方法。他们发明了一种薄膜，无需制冷剂就可以为建筑降温。它还无需耗费电力，令人称奇。更妙的是，这种薄膜还可以用标准的卷到卷方式制造，成本约为每平方米50美分。

这种新型薄膜的工作原理是辐射冷却。这是利用了特定波长的载热红外辐射可以不受阻碍地穿过地球大气散逸到太空的特性。先把不需要的热量转化为特定波长的红外线，然后这些热量就会被抛入宇宙，一去不回。

在杨荣贵和尹晓波之前，就有人尝试用这种方法为建筑制冷。加州斯坦福大学的范善辉（Shanhui Fan，音译）和他的同事在2014年展示了一种基于这一原理的装置。不过，他们的材料是由七层不同厚度的二氧化铪和二氧化硅交替叠加在一块硅晶片上制成。这种方法难以大批量制造且成本高昂。

相比之下，杨荣贵和尹晓波的薄膜由聚甲基戊烯制成，这是一种已商业化生产的透明塑料，商品名为TPX。他们在TPX中掺入细小的玻璃微珠，然后把制成品拉成约50微米厚的薄片，再将其中一面镀上银。在屋顶上铺设时，镀银的一面朝下。这样入射的太阳光就被塑料反射回去，从而使其下的建筑免于受热。

然而防止升温和制冷并不是一回事。制冷的关键是玻璃微珠。温度的保持并非一个静态过程。所有物体都一直在吸收和放射热量，发出的热量通常以红外辐射的形式存在。玻璃微珠的直径决定了它们所发出红外线的波长。很容易操作的是，直径在8微米左右的玻璃微珠所发射的红外线多数都可以直接穿越大气的红外窗区。由于转化为这些红外线的热源的一部分正是薄膜下的建筑，这种效应就可以冷却建筑。

这种冷却效应相当强劲，在阳光直射时为每平方米93瓦，在夜间会更高。研究小组估计，在美国一栋普通房子的屋顶铺设20平方米这种薄膜，就足以在室外温度达37°C时把室内温度保持在20°C。

如果要调制冷量，任何应用这种薄膜的实用系统可能都需要水管把热量从室内传送到制冷系统。在室外温度变化时控制水管中的水流速度就可以保持室内温度恒定。不同于制冷系统本身，这些水泵需要电力驱动，但也不会耗费太多。除此之外，所有其他工作都由地球表面和外太空之间约290°C的巨大温差完成了。■



Smartphone diagnostics

Pictures of health

The rise of the medical selfie

OF THE millions of photos shared online every day, which most faithfully represent their subjects? The popular #nofilter hashtag would suggest it is those that have not been digitally altered. But photographs of the same thing can differ greatly, depending on ambient light and the distance and angle they were taken from. So the right manipulation can actually make a picture more honest—and therefore more useful for medical purposes.

That is the idea behind an app from Healthy.io, an Israeli firm. Dip.io, as this app is known, uses mobile-phone cameras for clinical-grade urine analysis. The patient follows the instructions, waits for the colours on the dipstick to develop and then takes a picture of it against the background of a proprietary colour card. The app uses the card to correct the colours so that the dipstick appears as if in a neutral, standard ambient light. The result is then analysed automatically, in light of the patient's medical history. If this analysis suggests a consultation or prescription is needed, that can also be arranged automatically.

The first urine-dipstick test was developed in 1956, to look for glucose, which indicates diabetes. Since then, sticks have been used to test for the presence of blood, of protein, of hormones indicating pregnancy and also of various bacteria that cause urinary-tract infections. Some sticks, notably those employed for pregnancy tests, can be bought over the counter and used at home. But for tests that require colour-matching, rather than merely checking whether a single line is present or absent, home analysis is regarded as unreliable.

| *Point, click, treat*

It is this unreliability that Healthy.io is attempting to deal with. The firm is, for instance, working with doctors in Israel on a system that lets pregnant women at risk of pre-eclampsia (dangerously high blood pressure, which is signalled by protein in the urine) use dip.io to monitor themselves at home. In Britain, meanwhile, the National Health Service (NHS) is starting to employ a version of the app to monitor those suffering from multiple sclerosis whose bladders are affected by the disease. Members of this group, which is around 60,000-strong, are at particular risk of urinary-tract infections. About 5,000 of them develop severe infections every year. At the moment, when someone in this position spots early symptoms he must go to a clinic to be tested. Home-testing, followed by a prescription posted to those who need it, should obviate that need, speed up treatment and also save the NHS around £10m (\$12m) a year.

A third dipstick test the app may soon be applied to is chronic kidney disease. In America alone some 26m people have this condition, which is often associated with diabetes and high blood pressure in a phenomenon known as metabolic syndrome. Patients in the late stages of kidney disease need costly dialysis. But if the illness is detected early, by screening the urine of those at risk to check for protein, sufferers can be given drugs that lower their blood pressure and thus slow the disease's progress.

Nor is urine analysis the only part of medical practice that may benefit from healthy.io's standardised selfies. Dermatology should profit, too. To diagnose a skin condition from a picture, or to monitor its development over the course of time, dermatologists need not only to control the colour of an image, but also its size and the angle from which it is taken. In this case Healthy.io's answer involves a sticking plaster printed with coloured hexagons that is placed near the relevant patch of skin. Like the dipstick card, the plaster acts as a reference which the app uses to correct and standardise the resulting image.

Yonatan Adiri, Healthy.io's founder, has ambitions beyond even this. As he observes, phones are everywhere and are improving all the time without his firm having to lift a finger. By using their built-in cameras, the company can piggyback on phone-makers' research and development. Soon, his app may be able to employ spectroscopy—a detailed analysis of the frequencies of light making up an image—or extend its range beyond visible light into the infrared and ultraviolet parts of the spectrum. This may help analyse wounds and surface infections, by studying characteristics that are invisible to the naked eye. That will save both doctors and patients time, and should result in better outcomes all round. ■



手机诊断

健康自拍

医用自拍照的兴起

每天在网上分享的数百万张照片里，哪些最忠实地还原了被拍摄者？流行的话题标签#无滤镜（#nofilter）会告诉你是那些未经数字化加工的照片。然而，由于环境光、拍摄距离及角度不同，拍摄同一个事物的照片可能会千差万别。因此，恰当的操控实际上可以令一张照片变得更诚实，也因此对医疗更有用。

这正是以色列的Healthy.io公司研发的一款应用背后的创意所在。这款名为Dip.io的应用使用手机摄像头来做临床应用级别的尿液分析。病人按指示操作，等待试纸显色，然后把它和一张专用色卡放在一起，拍一张照片。该应用借助这张色卡来矫正照片的颜色，使试纸呈现在中性的标准环境光下的样子。而后该应用会根据病人的病史来自动分析结果。假如分析结果显示病人需要咨询医生或配药，应用也可以自动为其安排。

历史上首次尿液试纸检测于1956年被开发出来，用于检测葡萄糖以诊断糖尿病。自那时起，试纸被用于检测尿液中是否存在血液、蛋白、显示怀孕的荷尔蒙，以及导致尿路感染的各种细菌。一些试纸（特别是验孕棒）可以无需处方购买而在家中使用。但是，有些检测则需要比较颜色，而不仅仅是查看是否出现一条线，在家中自行进行的分析就会被认为不可靠。

| 对准、拍摄、治疗

Healthy.io想要解决的正是这种不可靠。比如，该公司正和以色列的医生合作开发一个系统，让有罹患先兆子痫（一种危险的高血压，尿液中出现蛋白可作为指示物）风险的孕妇使用dip.io在家中自我监测。同时，在英国，国家医疗服务体系（NHS）已开始使用该应用的某个版本来监测那些因患有多发性硬化症而导致膀胱功能受影响的人群。这一群体总数约达六万，他们发生尿路感染的风险尤其高。其中每年约5000人会出现严重感染。目前，当这类人发现早期症状时只能去诊所检测。有了自行检测（测

试后需要治疗者还会收到处方），就不再需要去诊所，还能加快治疗进程，同时每年为NHS节省约1000万英镑（1200万美元）。

这款应用可能很快会用于第三种试纸测试：慢性肾病检测。仅在美国就有约2600万人患有这种疾病，它常因一种被称为“代谢综合征”的现象而由糖尿病及高血压引发。处于肾脏疾病晚期的病患需要做费用昂贵的透析治疗。但如果有患病风险的人可以通过检测尿液中的蛋白来及早发现疾病，就可以使用降血压药物，从而延缓疾病的发展。

能因healthy.io研发的这种标准化自拍而受益的医疗手段或许不止尿液分析。它对皮肤病治疗应该也有帮助。如果要从一张照片来诊断某种皮肤病，或者在一段时间里监测其发展，皮肤病医生不仅需要控制照片的颜色，还要控制拍摄的尺寸和角度。这种情况下，Healthy.io的解决方案是把一块印有彩色六角形的橡皮膏贴在问题皮肤的旁边。和验尿色卡一样，它被用作校正照片并使之标准化的参照物。

Healthy.io的创始人约纳坦·埃迪里（Yonatan Adiri）的抱负还不止于此。在他看来，手机无处不在，而且哪怕自己的公司不费吹灰之力，手机也一直在发展。通过使用这些手机内置的摄像头，他的公司可以借助手机制造商的研发成果。用不了多久，他的应用或许就能运用光谱学（对构成影像的光线频率的详细分析），或者将其适用范围从可见光扩展至光谱中的红外和紫外部分。由此或许能研究肉眼看不见的特征，帮助分析伤口和表皮感染。这将节省医生和病人的时间，并全面带来更好的治疗结果。■



Buttonwood

A port in a storm

The mood in Singapore's financial sector is subdued

SINGAPORE owes its existence, and its prosperity, to its place at the heart of intra-Asian trade. In more than 50 years of independence, the city-state has striven mightily to attract investment from all over the world. Such has been its success, indeed, that others hope to imitate its open, low-tax model. In Britain, for example, there has been talk of the country turning into a “European Singapore” once withdrawal from the EU is complete. (It would be a nice start if London’s Tube operated with anything like the same efficiency as Singapore’s subway network.)

The current mood in Singapore, however, is far less buoyant than you might imagine. Singapore has survived and thrived by steering a middle course between America and China. It has been alarmed both by the isolationist rhetoric of President Donald Trump and by recent, highly unusual, public spats with China.

Global trade growth has slowed in recent years. Despite signs of a pickup, this has had a big effect in a city that has the world’s second-busiest port and that (according to Barclays, a bank) is the country most exposed to the global value chains created by multinational companies. Annual GDP growth in 2016 was just 1.8%, the slowest rate since 2009. Even in this famously open economy, the government has been allowing in fewer foreign workers in the face of pressure from the voters.

The city still has enormous potential as a regional financial centre. Thanks to its political stability and strong legal and regulatory systems, Singapore looks like a natural haven—an Asian Switzerland. In particular, Indian offshore wealth is being attracted to the city, which hopes to be a hub for

the budding market in *masala* bonds (rupee-denominated debt issued outside India).

Singapore has a rare AAA credit rating. The IMF last year described its banks as “well capitalised”, with adequate provisions for bad loans, despite worries about their exposure to oil-and-gas firms. Singapore is now the third-biggest trading centre for foreign exchange in the world (having overtaken Tokyo in 2013). It also has a growing derivatives market with daily over-the-counter volume of \$400bn, as of October 2015. Finance comprises 13% of the country’s GDP, considerably more than the 8% share it contributes to Britain’s.

But Singapore faces a strong challenge as a regional finance hub from Hong Kong, which benefits from far stronger links to the Chinese economy. Hong Kong has the upper hand over Singapore in terms of investment banking, particularly in corporate-finance businesses such as mergers and acquisitions. Hong Kong’s capital markets are much deeper; the local economy in Singapore is simply not large enough to generate the same volume of business. Many of South-East Asia’s businesses are family-owned and rely on banks (or reinvested profits) rather than the markets for finance. Singapore’s daily stockmarket turnover in 2016 was around S\$1.1bn (\$797m), down by 19% on 2013 and less than a tenth of the Hong Kong stock exchange’s daily volume.

Indeed, the magnetic pull of China may only increase if America under Mr Trump retreats from its Asian role. Multinationals may feel that they simply have to locate more resources in Hong Kong than Singapore for the sake of proximity to the regional superpower.

Singapore’s long-term prospects may depend on how two trends resolve themselves. Asians are becoming wealthier and are looking for other ways to invest their money aside from bank deposits and property. As Asian

economies become more important to the world economy, so banks, insurance companies and fund managers will look to increase their operations in the region. As the thief Willie Sutton said when asked why he robbed banks: “That’s where the money is.”

At the same time, however, technology means that investors can manage their money with the click of a mouse or the swipe of an app. And they can do so at very low cost. Vanguard, an index-tracking fund manager, attracted more global mutual-fund inflows last year than its ten largest rivals combined. Index-tracking managers don’t need to have a regional base in a gleaming office tower in Singapore or Hong Kong.

This city is trying to ride this trend by becoming known as a hub for “fintech”, whereby new, technology-driven groups take aim at established, high-cost finance firms. But this is a tricky tightrope to walk. Fintech may cannibalise existing financial businesses without generating many additional jobs. The next 50 years may present Singapore with even greater challenges than its first half-century. ■



梧桐

风暴中的港口

新加坡金融业的氛围有些压抑

新加坡的存在及繁荣都归功于其在亚洲内部贸易的核心地位。独立50多年以来，这个城市国家一直大力争取吸引来自世界各地的投资。它确实取得了成功，其他国家也希望能效仿其开放、低税率的模式。例如在英国，有人提出完成脱欧之后，英国可以发展为“欧洲的新加坡”。（如果伦敦的地铁运营能像新加坡的地铁网络那样高效，倒是一个不错的开始。）

然而，新加坡当前的氛围远不如想象中那么轻松。新加坡依靠在中美两国之间保持平衡以求得生存并繁荣发展。特朗普的孤立主义言论，以及新加坡近期与中国非同寻常的公开口角都让该国惶惶不安。

近年来，全球贸易增长放缓。尽管有好转的迹象，全球贸易不振对这个拥有世界第二繁忙港口的城市国家来说仍影响巨大，而且根据巴克莱银行的说法，新加坡还是最容易受跨国公司所创造的全球价值链影响的国家。2016年，新加坡GDP年增速仅为1.8%，是2009年以来的新低。即使在这个以开放著称的经济体中，政府也在选民的压力之下同意减少外籍劳工。

作为区域金融中心，新加坡仍有巨大潜力。新加坡政治稳定，法律和监管体系完善，似乎是一个天然避风港，堪称亚洲的瑞士。特别值得注意的是，新加坡吸引了大量印度离岸资金，并希望成为玛莎拉债券（在印度境外发行、以卢比计价的债券）新生市场的枢纽。

新加坡享有全球少见的3A信用评级。国际货币基金组织去年对新加坡银行的评价是“资本充足”，有足够的坏账拨备，虽然对油气公司的风险敞口令人担忧。新加坡现在是世界第三大外汇交易中心（2013年超越东京），衍生品市场也在不断壮大，截至2015年10月，日均场外交易额高达4000亿美元。金融业占新加坡GDP的13%，显著高于英国8%的比重。

然而新加坡区域金融中心的地位面临来自香港的巨大挑战。香港与中国经济的联系要紧密得多，也因此而受益。在投资银行方面，特别是在并购等企业融资业务方面，香港也比新加坡更有优势。香港的资本市场要深厚得多，而新加坡的地方经济规模不够大，不足以产生相同的业务量。东南亚的许多企业都为家族所有，融资依靠的是银行（或利润再投资），而不是金融市场。2016年，新加坡日均股票市场交易额约为11亿新元（7.97亿美元），较2013年下降19%，还不到香港证券交易所每日交易额的十分之一。

事实上，如果特朗普领导下的美国放弃在亚洲所扮演的角色，中国的吸引力可能会只增不减。为了靠近中国这个区域强国，较之新加坡，跨国公司可能会觉得它们必须在香港部署更多资源。

新加坡的长远前景可能取决于两种趋势的走向。亚洲人变得愈加富有，正在寻找银行存款和房地产之外的其他投资方式；亚洲经济对世界经济而言也日益重要，银行、保险公司和基金公司都将寻求增加在该地区的业务。就像银行大盗威利·萨顿（Willie Sutton）在被问及为什么要抢劫银行时所回答的那样：“因为那里有钱。”

然而，与此同时，技术的日新月异让投资者只需点击鼠标或打开手机应用就能轻松管理财富，而且成本低廉。指数基金公司领航（Vanguard）去年吸引的全球共同基金比其十大竞争对手的总和还要多，而指数基金公司并不需要在新加坡或香港那些炫目的办公楼里设立地区总部。

新加坡正试图通过成为“金融科技”（技术驱动型的新企业将矛头对准了高成本的成熟金融公司）的枢纽来顺应这一趋势。但这是一根难走的钢丝，金融科技可能会冲击现有的金融业务，却不会创造很多新岗位。新加坡今后50年所面临的挑战也许会比它成立的前50年更大。■



Free exchange

An impossible mind

For a man keenly aware of his intellectual limits, Kenneth Arrow had few

SOME great economists are Aristotelians, discerning the logic of markets from tangible examples around them. Others are Platonists, using their powers of reasoning to grasp ideal economic forms, of which actually existing markets are but flickering shadows. Kenneth Arrow, who died on February 21st aged 95, was both. His ideas gave economics some of its most compelling abstractions and most fruitful applications.

The abstractions won him the Nobel prize at the age of 51. (He remains the youngest winner and the most cited by others in their prize lectures.) He established the conditions under which prices might successfully co-ordinate production and exchange, eliminating shortages and surpluses. Adam Smith provided the best metaphor for this underappreciated feat: the “invisible hand”, guiding resources to their best uses. Ken Arrow and his co-author, Gérard Debreu, provided the best algebra.

To economists versed in mathematics, a well co-ordinated economy is like a system of simultaneous equations, which all hold true at the same time. The solution to these equations is a set of prices that equates demand and supply for scarce commodities in every market, including the market for labour and capital. Earlier economists had breezily assumed that such a solution existed, making their case with “cheerful prose and appeals to common sense”, as E. Roy Weintraub of Duke University has put it. Mr Arrow and Mr Debreu spelled out precisely when that good cheer was justified.

Mr Arrow showed similar rigour in exploring one alternative to market co-ordination: collective decision-making. A colleague studying America’s

strategic contest with the Soviet Union had asked him whether it was safe to treat an entire country as an individual “player”, with coherent preferences. What was required, Mr Arrow knew, was a robust, reasonable rule to translate the preferences of Americans, say, into the preferences of America. But to his surprise, he discovered that such a rule was “impossible” to find. “Most systems are not going to work badly all of the time,” he said. “All I proved is that all can work badly at times.”

Together, these two achievements showed when markets could work, and why collective decision-making could fail. Given these intellectual preoccupations, you might assume Mr Arrow was a man of the right. But the opposite was the case.

Born in New York in 1921, he remembered the “gasping struggles” of relatives during the Depression. He was struck by the paradoxical coexistence of unmet needs and unused resources, a simultaneous equation that prices failed to solve. The son of Jewish immigrants from Romania (his last name and “olive complexion” led an acquaintance to assume he was native American), he attended City University of New York, “the Harvard of the Proletariat”. Unlike many of his peers, he rejected Marxism early (put off by the horrors of Stalin’s 1930s show trials—as well as the inadequacies of the labour theory of value), but socialism rather late.

Precisely because he knew the conditions required for markets to work, he understood the ways they could fall short. In economics, the future impinges on the present; what might happen has an effect on what does. So to co-ordinate the economy seamlessly, markets need an impossible reach: they must price all the goods on offer today, all that will be on offer in the future, and all that might be on offer, if contingencies arise. In the absence of full insurance and futures markets, the state could do more to share risks and co-ordinate investments, he suggested in 1978. In fact, the state retreated in the decades that followed and markets expanded, creating

derivatives partly inspired by his work.

A different market failure became clear when he trained as an actuary: buyers of insurance often know more about their condition and behaviour than the seller. To cover its risks, an insurer might raise premiums, but that will only drive away the safest customers, leaving an “adverse selection” of the riskiest buyers. These insights helped him write one of the founding articles of health economics in 1963. They also help explain why the Obamacare mandate is so hard to replace in 2017.

Fortunately for economics, Mr Arrow abandoned a career as an actuary, because there was “no music in it”. He was, famously, a polymath, steeped in philosophy and literature, who once held his own at a dinner party with a scholar of Chinese art. He spent a decade at Harvard, which he chose over MIT because of its strength in the humanities, and the bulk of his career at Stanford University in California, where “we plan and build on ground that may open beneath us”. Like his brother-in-law, Paul Samuelson (whom he once compared to Humphrey Chimpden Earwicker, the protagonist of James Joyce’s “Finnegan’s Wake”), he popped up in different places and guises, offering insights into prediction markets, learning-by-doing, antimalarial drugs, discrimination between the races, equality between the generations, petrol-price controls, arms reduction, advertising, public investment, the “carrying capacity” of the Earth and the cost-effectiveness of airframes.

| *Systematically agnostic*

Whatever his political sympathies, he never had the certitude required for activism. He once called himself an “agnostic” in his beliefs, if a “systematiser” in his talents. Keenly aware that not everything could be known, he wanted what could be grasped to be known as systematically as possible. He summed up his vision in the words of the mathematician Hermann Weyl: “If the transcendental is accessible to us only through the

medium of images and symbols, let the symbols at least be as distinct and unambiguous as mathematics will permit." Or to put it in his terms, we should plan and build as solidly as we can, even if the intellectual ground may occasionally open up beneath us. ■



自由交流

超凡心智

深感自己智识有限的肯尼斯·阿罗实则博学广闻

一些伟大的经济学家属于亚里士多德学派，从周遭实例中辨析市场逻辑。另一些则是柏拉图主义者，他们运用推理能力，去参悟“经济的完美理型”——实际存在的市场只是这种理型摇曳不定的影子而已。肯尼斯·阿罗（Kenneth Arrow，2月21日去世，享年95岁）则二者兼而有之。他的理念为经济学带来了一些最为震撼的抽象理论和最富成效的实际应用。

那些抽象理论让阿罗在51岁时赢得了诺贝尔奖。他是迄今最年轻的获奖者，也是他人发表获奖演讲时提及最多的人。他的理论解释了在什么条件下价格能有效协调生产和交换，从而消除短缺和过剩。亚当·斯密（Adam Smith）用一个最精妙的比喻概括了指引资源实现最优配置这一被低估的功绩：那只“看不见的手”。肯尼斯·阿罗和杰拉德·德布鲁（Gérard Debreu）则共同以最佳的代数方程演绎了它的原理。

在精通数学的经济学家看来，协调良好的经济就像一个联立方程组，组内各方程式同时成立。这些方程式的解就是一组价格，令每个市场中稀缺商品的供需都相等，包括劳动力和资本的市场。早期的经济学家一直乐观地以为这样的“解”是存在的，正如杜克大学的罗伊·温特劳布（E. Roy Weintraub）所说，他们“以乐观的笔调及诉诸常识”来论证观点。而阿罗和德布鲁则精确地说明了在什么条件下这种乐观论点才能成立。

阿罗以同样严谨的态度探索“市场协调”的一个替代办法：集体决策。一位研究美苏战略竞赛的同事曾问他，把整个国家视为喜好一致的个人“玩家”，这种做法是否妥当？阿罗知道，这其中需要一个强大而合理的规则，把美国人的喜好转化为美国的喜好。但出乎意料地，他发现这样的规则是“不可能”找到的。“大多数系统都不会一直运作不良，”他说，“而我所证明的是，所有系统都可能偶尔运转失灵。”

这两方面的成果显示了市场机制在什么时候可能发挥作用以及为什么集体决策可能失败。从阿罗专注研究的这些主题来看，你可能会以为他是个右派人士。但事实正好相反。

1921年出生于纽约的他还记得在大萧条时期亲戚们陷入“令人窒息的苦况”。他吃惊地注意到一个矛盾的局面：人们的需求没能得到满足，同时却又有资源在闲置——一个价格机制无法解开的方程组。作为一名罗马尼亚犹太移民的后裔（他的姓氏和“橄榄色的皮肤”令某位熟人以为他是印第安原住民），他入读了有“无产阶级的哈佛”之称的纽约城市大学。与众多同侪不同，他很早就拒绝接受马克思主义（除了因劳动价值理论本身的不足之外，也出于对斯大林在20世纪30年代执导的可怕的“公审秀”的厌恶），但在较晚期才摒弃社会主义。

正因为他知道市场机制发挥作用所需的条件，他也明白它可能失灵的情形。在经济学中，未来会影响现在；可能要发生的事会影响切实发生的事。因此，要无缝地协调经济，各市场系统就需要一个不可能达成的目标：必须为现在供应的、未来将要供应的，以及意外情况下可能供应的所有商品定价。他在1978年提出，在没有全额保险和期货市场的时候，政府可加大力度分担风险及协调投资。而事实上，之后几十年里，政府减少了干预，市场得到扩展，并诞生了衍生品（部分源于其理念）。

在接受精算师培训时，他意识到另一种市场失灵：投保人往往比保险公司更了解自身的情况和行为。为弥补风险，保险公司可能会提高保费，但这只会吓跑最安全的客户而剩下最危险的买家，从而形成“逆向选择”。在这些见解的基础上，他在1963年撰写了健康经济学的一大奠基之作。这些理念也有助解释为何奥巴马医改方案如此难以在2017年被替换。

阿罗没选择以精算师为业，因为那“没意思”。这对经济学领域实属一件幸事。他出了名地博学多才，哲学、文学样样精通，曾与一位中国艺术方面的学者在晚宴上谈笑自若。他没选麻省理工学院，而是在哈佛待了十年，看重的便是后者人文学科的优势。他学术生涯的大部分时间是在加州斯坦福大学度过，在那里“我们在可能开裂的大地上规划和建造”。与姻兄保罗

· 萨缪尔森（Paul Samuelson，阿罗曾将他比作詹姆斯·乔伊斯所著《芬尼根的守灵夜》的主角伊厄威克）一样，阿罗以不同形象活跃在不同领域，提出的见解涵盖预测市场、实践学习、抗疟药物、种族歧视、世代平等、油价控制、裁减军备、广告、公共投资、地球“承载能力”以及飞机机身制造的成本效益。

| 系统性不可知

不论其政治倾向为何，阿罗从未展现出行动主义所要求的确信无疑。他称自己在才能上是一个“系统化者”，而在信仰上是“不可知论者”。他深知世间万物并非一切可知，希望把那些可以掌握的事物尽可能地系统化解释。他用数学家赫尔曼·韦尔（Hermann Weyl）的话来概括自己的想法：“假如超验对象只能通过影像和符号才能被我们获知，那么至少要在数学允许的范围内让这些符号尽可能地清晰明确。”或套用阿罗自己的说法，我们应该尽可能坚实地规划建设，即便脚下智识的地基也许偶尔会开裂。■



The future of America

Bland comfort

Why Americans need to beware of becoming complacent

AMERICA is the land of opportunity, they say. Inspired by the ambition of its Founding Fathers, its people revel in their dynamism. Diversity is their strength, as captured in the national motto—*E pluribus unum* (“Out of many, one”). Americans embrace change and reinvention, and this, they like to think, sets their country apart from Europe or Asia.

Tyler Cowen, an economist, believes that this ideal is self-indulgent nonsense. America is losing its vim, he says, and Americans are settling into stagnation. In his new book, “The Complacent Class”, Mr Cowen shows not only that Americans move less now, crossing state lines at around half the average rate that they did between 1948 and 1971, and stay longer in their jobs, but American entrepreneurialism is floundering too. Markets are becoming more concentrated. Fewer new companies are being started, and many struggle to grow. Even in the vaunted technology sector the creation and expansion of new firms peaked in 2000. Sluggish growth in productivity and living standards is making America more like Europe and Japan.

On the surface, Americans enjoy more choice than ever before. From over 1,400 types of music on Spotify, a music-streaming service, to a swipeable menu of dating options, and rare books available at the click of a button, consumers have never had it so good. But there is a dark side to being able to select the perfect product, neighbourhood or partner. Freedom to choose means that it is ever easier for people to marry, live near or school their children with other people of the same kind. In the South, the proportion of black students in majority-white schools was 44% in 1988; in 2011 that figure was 23%—lower than in 1968. Segregation by income has risen

dramatically in the past few decades. The American elite might celebrate diversity in dinner-table conversation, but in practice Americans are cocooning themselves in enclaves of like-minded folk.

Segregation shuts off growth and stymies innovation. Poorer states used to be able to attract talented people by offering them a combination of promising job opportunities and cheaper housing. But now no one expects Louisiana to catch up with Silicon Valley. For the past few decades poorer states have been caught in a vicious circle, says Mr Cowen, where the expectation that they will not catch up makes it harder for them to do so.

When it comes to economic segregation, market forces are not helping, or at least not when they are combined with restrictions preventing the construction of more low-cost housing. A housing market that allocates the nicest housing to the highest bidder will inevitably push poor folk out of sight—and thus out of mind. Richer, well-educated people want to live near each other, and high house prices conveniently discourage poorer people from spoiling the view.

There will be consequences, says Mr Cowen. Hyman Minsky, an economist who grew up during the Great Depression, had a theory that financial stability would breed overconfidence, sowing the seeds of future instability. Largely ignored in his lifetime as he pushed against the prevailing wisdom that efficient markets would protect capitalist society against disaster, his idea became widely celebrated only after the financial crisis appeared to confirm it in 2007-08. Complacent financiers, regulators and central bankers allowed risk to build and put the whole system in danger.

Extending the idea to all society, as Mr Cowen does, is tricky because of the difficulty in telling the difference between complacency, contentment and submission. He is unclear who the complacent class really are, and who

exactly is responsible for the mess. Are Americans betraying their history of reaching for the American dream, or are they suffering because of a rotten system? (Were the bankers greedy, or responding to incentives?)

Still, there is some truth to Mr Cowen's diagnosis that America's strength is undermined by its divisions and by a willingness to protect the powerful. Pockets of rich Americans and the lack of opportunity implied for those who are shut out of those pockets represent a festering problem, says Mr Cowen. In a crisis, the system's creakiness will leave it ill-equipped to cope. In the final chapter he reveals his fear that the biggest story of the last 15 years is the growing likelihood that "a cyclical model of history will be a better predictor than a model of ongoing progress."

The main question Mr Cowen raises is whether a dose of disorderliness will jolt America back to strength. He offers an optimistic scenario, in which driverless cars allow Americans to overcome the pain of having to commute over longer distances, or where global crises convince them that they should live for the moment. Artificial intelligence, clean cheap energy and alternatives to tranquillising opioids could all return America's lost dynamism.

But the pessimism of his analysis sits uncomfortably with these rosy scenarios. Other, likelier forms of chaos include populist politicians bent on sowing division, or even international violence. The path from those to a restored, vibrant America seems longer and rockier. In cycles, things often go down before they go up. ■



美国的未来

无味的舒适

为什么美国人需要提防自满

有人说，美国是一片充满机遇的土地。美国人在开国元勋们的雄心鼓舞下尽情挥洒自己的活力。多样性是美国的优势所在，也写在了美国的国家格言——E pluribus unum（“合众为一”）中。美国人拥抱变化与再创造，而他们也乐意认为这一点将美国与欧洲或亚洲国家区别开来。

经济学家泰勒·考恩（Tyler Cowen）认为这种完美之说是洋洋自得的无稽之谈。他说，美国正在失去激情，美国人也渐渐安于停滞。在他的新书《自满阶级》（The Complacent Class）中，考恩表明，美国人搬家比以往更少，穿越州界的频次是1948年至1971年间平均频次的一半。他们持续做一份工作的时间更长了。美国的创业精神也陷入了困境。市场正变得越来越集中。新创立的公司更少了，许多创业公司为了增长而苦苦挣扎。即使在志得意满的技术行业，新公司创建和扩张的数量已在2000年达到了顶峰。生产力和生活水平增长缓慢让美国变得更像欧洲和日本了。

从表面上看，美国人享有的选择比以往任何时候都要多。从音乐流媒体服务Spotify上提供的超过1400种音乐类型，动动手指就可挑挑拣拣的约会人选，到点一个按钮就可阅览的绝版书籍，消费者从来没有像现在这样优越过。但是，能够选择完美的产品、居住地或伴侣也有其阴暗的一面。自由选择意味着人们从来没有像这么容易地与同类人结婚、聚居或把孩子送入同一所学校。在南部，白人占多数的学校在1988年时黑人学生的比例为44%，而2011年这一数字为23%——比1968年时还低。因收入造成的隔离在过去几十年里急剧上升。美国的精英们在餐桌上交谈时可能会歌颂多元化，但实际上美国人正在把自己封闭在志同道合者的小圈子里。

隔离会抑制增长、阻碍创新。贫穷的州以前还能够通过提供有前途的就业机会加之更便宜的住房来吸引优秀人才。但现在，没有人觉得路易斯安那能赶上硅谷。考恩说，过去几十年间，较贫穷的州陷入了一个恶性循环：

人们不期望它们能够赶上，这使得它们更难翻身。

就经济隔离而言，市场力量帮不上什么忙，至少在许多仍限制建造更多廉价房屋的市场里是这样。将最好的住房分配给出价最高者的住房市场将不可避免地把穷人推到视线之外——于是眼不见心不烦了。受过良好教育的富裕人群希望相互比邻而居，高房价很方便地防止了穷人在旁边煞风景。

考恩说这会带来严重后果。在大萧条时期长大的经济学家海曼·明斯基（Hyman Minsky）有一套理论，认为金融稳定会滋生过度自信，撒下未来不稳定的种子。他不认同高效市场能保护资本主义社会免受灾难这一流行观念，因而他生前很大程度上被忽视。直到2007年至2008年的金融危机证实了他的理论，他的思想才得到了广泛的承认。自满的金融家、监管机构和央行行长听任风险累积起来，将整个体系置于危险之中。

像考恩那样用这套理论解释全社会就有问题了，因为要区分自满、知足与屈服并非易事。他并不清楚自满阶级具体是谁，以及到底谁该为这个烂摊子负责。是美国人背叛了追逐美国梦的传统，还是因一个腐烂的体制而受苦？（银行家们是贪婪，还是对激励做出了反应？）

尽管如此，考恩的诊断，即美国的优势被分裂和保护强者的意愿所削弱仍有一定的道理。考恩说，美国富人的钱袋，以及被钱袋拒之门外者缺乏机会是一个不断恶化的问题。在危机时，体制的腐朽会让它没有能力应对。他在最后一章中揭示了他的担忧，即过去15年中最重要的事越来越可能是“历史的周期性模型的预测能力比持续进步模型更强”。

考恩提出的主要问题是，一定量的无序能不能震动美国，使之重新恢复优势。他提供了一个乐观的情景：无人驾驶汽车让美国人摆脱了通勤距离加长的痛苦，或全球危机让他们相信自己应该活在当下。人工智能、清洁廉价的能源和阿片类镇静药物的替代品都可能让美国找回失去的活力。

但在这些美好的情景中，他的分析仍然不安地表现出了悲观的情绪。更有可能出现其他形式的混乱，如民粹主义政客播撒分裂的种子甚至是跨国暴力。要从这样的状况回到一个恢复元气、充满活力的美国，路途似乎更加

遥远和坎坷。在周期中，上升之前往往要下跌。■



Violence and inequality

Apocalypse then

Only catastrophic events really reduce inequality, according to a historical survey

AS A supplier of momentary relief, the Great Depression seems an unlikely candidate. But when it turns up on page 363 of Walter Scheidel's "The Great Leveler" it feels oddly welcome. For once—and it is only once, for no other recession in American history boasts the same achievement—real wages rise and the incomes of the most affluent fall to a degree that has a "powerful impact on economic inequality". Yes, it brought widespread suffering and dreadful misery. But it did not bring death to millions, and in that it stands out.

If that counts as relief, you can begin to imagine the scale of the woe that comes before and after. Mr Scheidel, a Vienna-born historian now at Stanford University, puts the discussion of increased inequality found in the recent work of Thomas Piketty, Anthony Atkinson, Branko Milanovic and others into a broad historical context and examines the circumstances under which it can be reduced.

Having assembled a huge range of scholarly literature to produce a survey that starts in the Stone Age, he finds that inequality within countries is almost always either high or rising, thanks to the ways that political and economic power buttress each other and both pass down generations. It does not, as some have suggested, carry within it the seeds of its own demise.

Only four things, Mr Scheidel argues, cause large-scale levelling. Epidemics and pandemics can do it, as the Black Death did when it changed the relative values of land and labour in late medieval Europe. So can the complete collapse of whole states and economic systems, as at the end of

the Tang dynasty in China and the disintegration of the western Roman Empire. When everyone is pauperised, the rich lose most. Total revolution, of the Russian or Chinese sort, fits the bill. So does the 20th-century sibling of such revolutions: the war of mass-mobilisation.

And that is about it. Financial crises increase inequality as often as they decrease it. Political reforms are mostly ineffectual, in part because they are often aimed at the balance of power between the straightforwardly wealthy and the politically powerful, rather than the lot of the have-nots. Land reform, debt relief and the emancipation of slaves will not necessarily buck the trend much, though their chances of doing so a bit increase if they are violent. But violence does not in itself lead to greater equality, except on a massive scale. “Most popular unrest in history”, Mr Scheidel writes, “failed to equalise at all.”

Perhaps the most fascinating part of this book is the careful accumulation of evidence showing that mass-mobilisation warfare was the defining underlying cause of the unprecedented decrease in inequality seen across much of the Western world between 1910 and 1970 (though the merry old Great Depression lent an unusual helping hand). By demanding sacrifice from all, the deployment of national resources on such a scale under such circumstances provides an unusually strong case for soaking the rich.

Income taxes and property taxes rose spectacularly during both world wars (the top income-tax rate reached 94% in America in 1944, with property taxes peaking at 77% in 1941). Physical damage to capital goods slashed the assets of the wealthy, too, as did post-war inflations. The wars also drove up membership in trade unions—one of the war-related factors that played a part in keeping inequality low for a generation after 1945 before it started to climb back up in the 1980s.

The 20th century was an age of increasing democratisation as well. But Mr

Scheidel sees this as another consequence of its total wars. He follows Max Weber, one of the founders of sociology, in seeing democracy as a price elites pay for the co-operation of the non-aristocratic classes in mass warfare, during which it legitimises deep economic levelling. Building on work by Daron Acemoglu and colleagues, Mr Scheidel finds that democracy has no clear effect on inequality at other times. (A nice parallel to this 20th-century picture is provided by classical Athens, a democracy which also saw comparatively low levels of income inequality—and which was also built on mass-mobilisation, required by the era's naval warfare.)

Catastrophic levellings will be less likely in future. Pandemics are a real risk, but plagues similar in impact to the Black Death are not. Nor are total revolutions and wars fought over years by armies of millions. On top of that, since the Industrial Revolution general prosperity, regardless of inequality, has risen. And in past decades global inequality has fallen.

Good news in general, but news which leaves readers who would like to see significantly less unequal individual economies in a bit of a pickle. Futile though Mr Scheidel thinks it may prove, attempts to ease inequality democratically through redistributive policies and the empowerment of labour at least show no signs of doing actual harm. They may, indeed, keep the further growth of inequality in check, but they can hardly dent the direction of change. And they may have opportunity costs; if history provides no support for thinking that deep, peaceful reduction of inequality is possible, perhaps progressives should set themselves other tasks.

There are two other possibilities. One is to note that historical circumstances change. As Mr Scheidel shows, the 20th century was quite different from all those that came before. Is it not possible that another less horrible but equally profound transformation in the way that people and nations get along with each other, or fail to, is yet to come? If, for example,

increasingly economically important non-human intelligences decided that they would rather not be owned by anyone, thus in effect confiscating themselves from their owners, could that not make a difference?

The other possibility is that some may see civilisational collapse as a price worth paying for the Utopia they might build in the rubble—or may just like to see the world burn. Individuals and small groups can dream of nuclear- or biotechnologically-mediated violence today on a scale that was inconceivable in the past. Wealth may ineluctably concentrate itself over time; the ability to destroy does not. ■



暴力和不平等

史上大灾变

一项历史考察发现，唯有灾难性事件真正缩减了不平等

要说那些能让人暂时喘口气的事，人们大概不大会想到大萧条。但当它出现在沃尔特·沙伊德尔（Walter Scheidel）所著《大调平器》的第363页时，却奇怪地成了一桩受欢迎的事。这是头一遭，也仅此一回，因为美国历史上没有哪次衰退拥有同样的成就——实际工资上涨，最富裕人群的收入大减，乃至“对经济不平等产生了强大冲击”。诚然，大萧条带来了普遍的痛苦和可怕的不幸。但它并没有导致数百万人丧生，这一点令它脱颖而出。

如果这也算得上是一个慰藉，你可以想象在它以前或以后发生的灾难的规模了。出生于维也纳、目前任职于斯坦福大学的历史学家沙伊德尔把托马斯·皮凯蒂（Thomas Piketty）、安东尼·阿特金森（Anthony Atkinson）、布兰科·米拉诺维奇（Branko Milanovic）等人在近期著述中对不平等加剧的探讨放置于广阔的历史长河中考察，看看哪些情形能减少不平等。

他汇集了庞杂的学术文献，纵览始于石器时代的历史，结果发现国家内部的不平等水平几乎总是居高不下或处于上升态势，这是因为政治和经济权力相互巩固，且两者都代际传递。不平等并不像一些人所想的那样自带灭亡的种子。

沙伊德尔提出，只有四类事物会导致大规模的“调平”。其一是区域或全球性传染病，比如黑死病改变了中世纪晚期欧洲土地和劳动力的相对价值，从而实现“调平”。整个国家和经济体系的完全瓦解也有这样的效果，比如中国唐朝末期和西罗马帝国的解体。当所有人都变得穷困时，富人的损失最为惨重。俄罗斯或中国的那种彻底革命是另一类“调平器”。这些革命在20世纪的同类——大规模动员的战争也是如此。

大概也就是这些了。金融危机加剧或减少不平等的机会差不多相同。政治改革大多无甚影响，这在一定程度是因为它们的目标常常是在纯富人与政治权贵之间进行权力平衡，而不会涉及广大的穷人。土地改革、债务减免以及解放奴隶不一定能够多么大力地扭转不平等的上升趋势，但如果伴随暴力，改变趋势的几率则略微上升。不过暴力本身也不会带来更多的平等，除非是大规模的暴力。“那些历史上最著名的动乱大多完全没能让社会变得更平等。”沙伊德尔写道。

或许，本书最精彩的部分是作者仔细搜罗了证据，显示了1910至1970年间，大部分西方世界里不平等程度空前降低，其根本原因是大规模动员的战争（虽然那场久远的大萧条也提供了不同寻常的一臂之力）。在这样的情形下，如此大规模地调动全国资源要求所有人都做出牺牲，这为“劫富”提供了异常有力的理由。

两次世界大战期间所得税和财产税都飙升了（所得税的顶峰出现在1944年的美国，达94%；财产税的顶峰出现在1941年，为77%）。资本品遭到的损坏也令富人资产大减，战后通货膨胀的威力也一样。战争还使得工会成员增加——这是1945年后帮助压低了一代人不平等水平的各种战争相关因素之一。到了1980年代，不平等又开始回升。

二十世纪也是个不断民主化的年代。但沙伊德尔认为这是全面战争的另一个结果。他和社会学奠基人之一的马克思·韦伯一样，将民主视为大规模战争中精英们为非贵族阶级的合作所付出的代价，这样的战争令大幅的经济调平合法化。沙伊德尔以达龙·阿西莫格鲁（Daron Acemoglu）和同僚的研究成果为基础，发现在其他时间里民主并没有对不平等产生明显的影响。（可与这幅二十世纪图景媲美的是古代雅典，这一民主社会收入不平等的程度相对也较低，而这种民主也是建立在那个时代发动海上战争所需的全民动员之上。）

通过灾难来“调平”的可能性在未来会更小。大范围传染病是一个切实的风险，但能造成黑死病那种冲击的瘟疫则已不大可能。也不会有数百万大军持续战斗数年的彻底革命和战争。此外，自工业革命以来，无论不平等状

况如何，人类总体的繁荣程度上升了。而在最近几十年里，全球范围的不平等已经缩减。

这在总体上是好消息，但让那些期望看到单个经济体内不平等显著减少的读者有点坐立难安。尽管可能如沙伊德尔所认为的，通过再分配政策和赋予劳工阶层更多权力等民主化举措来减轻不平等的尝试将被证明是无效的，但至少没有迹象显示它们会造成实际损害。它们可能确实会阻止不平等进一步加剧，但并不能扭转变化的方向。而且它们可能还要承担机会成本。假如从历史经验看，深入但却和平地减少不平等并无可能，那么改良主义者可能该给自己找点别的事干干了。

有两种其他的可能性。其一是注意到历史条件会改变。正如沙伊德尔所展示的，二十世纪和之前的世纪大不相同。那么，是否有可能，一场不那么可怕但同样深刻且有关人与人、国与国的相处方式的变革（也可能是无法再和平相处）尚未到来？假如，举例来说，在经济发展中地位日益重要的非人类智能不想再从属于任何人，结果主动脱离了它们的主人，这难道不会带来变化吗？

另一个可能性是一些人或许会把文明的崩溃视作为了从废墟中建立乌托邦而值得付出的代价，或者也许他们就是想看到整个世界被付之一炬。今天的个人和小团体可以想象利用核或生物科技的暴力活动，其规模之大在过去是不可想象的。财富可能会随时间无可避免地自我集中，但破坏的能力却不会。 ■



The future of home delivery

Heel!

Pedestrians will soon have to get used to sharing the pavements with parcel-carrying robots

WHO would be a delivery driver? As if a brutal schedule, grumpy motorists, lurking traffic wardens and the risk of an aching back were not bad enough, they now face the fear of robots taking their jobs. Though the buzzing, parcel-carrying aerial drones planned by the likes of Amazon and Google get most of the press, a more serious threat may come from a new breed of 'droids that are about to take to the world's pavements.

The latest, called Gita, was unveiled in February by Piaggio Fast Forward, a subsidiary of Piaggio, an Italian firm that is best known for making Vespa motor scooters. Gita's luggage compartment is a squat, drumlike cylinder that has been turned on its side. This, as the picture above shows, is fitted with two wheels of slightly larger diameter than the drum. These let the whole thing roll smoothly along, keeping the luggage compartment upright, at up to 35kph (22mph). Normally, though, Gita does not travel anything like that fast. Instead, it follows at walking pace a metre or two behind its human owner—or, more accurately, an electronic belt that the owner wears. A wireless connection to a stereoscopic camera on this belt lets it map its surroundings, better enabling it to trail its owner around street corners or through doors.

Gita can carry up to 18kg of cargo for about eight hours between charges. That makes it ideal for ferrying the shopping of those who still prefer to visit stores in person, rather than ordering goods online. Eventually, though, it will serve the online market too, using its own cameras, maps and ultrasonic sensors to carry out deliveries by itself.

| *Streetwalkers*

Piaggio is now putting a dozen or so Gitas to work in pilot projects around America, doing things like carrying tools for workers, guiding people through airports and assisting with deliveries. And it is not alone. Starship Technologies, an Estonian company started by Ahti Heinla and Janus Friis, two of the founders of Skype, has similar ambitions. Starship's as-yet unnamed suitcase-sized robot has six small wheels, travels at 6kph and holds 10kg of cargo. Rather than doggedly following a human being, it navigates itself around using cameras and ultrasonic sensors—though a remote operator can take control of it to supervise tricky manoeuvres such as crossing roads.

Starship already has dozens of these robots trundling around delivering packages, groceries and takeaway food to customers in several European cities, and also in Washington, DC, and parts of Silicon Valley. When the kinks have been ironed out, it hopes to offer such deliveries commercially for about \$1 a pop. The firm says that its robots have covered tens of thousands of kilometres and met millions of people so far, with no accidents. And although each robot currently requires its own human overseer, the plan is that, ultimately, a single person will be able to herd a flock of up to 100 of them online.

One problem faced by the designers of 'bots such as these is that unlike roads, which have well-established rules, lane markings and traffic signals to guide autonomous vehicles using them, the pavements running alongside those roads are what roboticists refer to as “unstructured environments”. People can walk, jog or roller-skate wherever they please on them, and there is an ever-shifting array of dogs, prams, signs and rubbish to avoid, as well.

The key to robotic navigation is to understand the way people use the space the robot is in, says Matt Delaney, an engineer who has worked on

autonomous cars and lunar rovers, and is now starting his own robotic-delivery firm, Marble, in San Francisco. “The pedestrian environment is very cultural,” he says. “If you monitor people over many long repetitions in testing, a robot can learn the best routes.”

Marble will not yet say exactly how its robots adapt themselves from the fast-paced streets of Manhattan to the laid-back hills of San Francisco—possibly because the Bay Area’s pavements are filling rapidly with aspiring rivals. Dispatch, also in San Francisco, is testing tricycle “Carry” robots, which look a bit like beer-cooling picnic boxes on wheels, on two Californian university campuses. And, down the road in Palo Alto, another newly started firm, Robby, is also working on a delivery ’bot.

Irritating though they may eventually become to some, however, lightweight, slow-moving robots like Piaggio’s and Starship’s do not generate the safety concerns that accompany autonomous cars (which are heavy and fast-moving) and flying drones (which can fall out of the sky onto your head, and also cause a significant noise nuisance). As a result, they do not attract the same level of official regulation. Starship has successfully sponsored legislation in some American jurisdictions explicitly permitting autonomous delivery of the sort it is proposing to carry out. It has found, though, that most cities welcome the robots with open arms. They have the potential to reduce pollution and congestion by taking vans off the roads, to increase convenience and to reduce costs. And they have one other advantage. When they do bring something to your doorstep, they do not expect a tip. ■



快递的未来 跟上来！

行人很快就得习惯和快递机器人共用人行道了

谁愿意做快递司机呀？工作繁忙劳碌，路上的司机脾气火爆，交通管理员神出鬼没，还有可能落下背疼的毛病。这还不够，现在他们还得担心机器人会来抢工作。虽然亚马逊和谷歌等公司规划中的嗡嗡作响的快递无人机最受媒体关注，但更严重的威胁可能来自于一种新型机器人，而且它们很快就会走上各地的人行道。

最新的快递机器人名叫Gita，由Piaggio Fast Forward公司在2月推出。其母公司是以制造Vespa踏板摩托车而知名的意大利比亚乔集团（Piaggio）。Gita的货舱部分是一个侧立起来的矮胖的鼓状圆柱。如上图所示，它两边各装有一个直径比鼓面略大的轮子。这种设计可以让机器人在保持整个货舱直立的同时平稳地向前滚动，时速可高达每小时35公里。不过通常Gita不会走这么快，而是以步行速度跟在主人身后，保持一两米的距离。或者更准确地说，是跟着主人佩带的电子皮带前进。皮带上的立体摄像机与Gita无线连接，让它得以勘察周围环境，更好地跟随主人转过街角或进出房门。

Gita可以运载18公斤的货物，每次充电可以工作约8小时。对于那些仍喜欢自己去商店而不是在网上购物的人来说，有Gita帮忙拿东西再好不过了。不过，有朝一日它也会为网购市场服务，利用自身安装的摄像头、地图和超声波传感器自行递送包裹。

| 行走街头

比亚乔目前在美国各地的试点项目中投放了十几台Gita，工作内容包括帮工人拿工具、在机场提供引导、协助运送包裹等。比亚乔并非唯一做此尝试的公司。由Skype的两位创始人阿迪·赫恩拉（Ahti Heinla）和雅努斯·弗里斯（Janus Friis）创办的爱沙尼亚公司Starship Technologies也有类似的抱负。Starship尚未命名的机器人大小如手提箱，装有六个小轮子，

时速6公里，可装载10公斤货物。它不是一味紧跟人类，而是使用摄像头和超声波传感器来给自己导航。不过远程操作员也可以接管机器人，指导它完成类似过马路这样的复杂动作。

Starship已在欧洲几个城市、华盛顿特区以及硅谷部分地区投放了几十台这样的机器人。它们缓缓地前行着，为客户运送包裹、杂货和外卖。待到技术细节问题解决之后，Starship打算将这些运送服务商业化，每次收费1美元。Starship公司称，它们的机器人迄今行程已达数万公里，见过数百万人，从未发生过意外。尽管每台机器人目前都需要一个专门的管理员，但公司的计划是最终一个人就可以在线管理多达100台机器人。

此类机器人的设计者面临这样一个问题：按机器人专家的说法，机动车道旁的人行道是“非结构化环境”，不像机动车道那样具有已被广泛遵守的规则，也没有明确的车道标记和交通信号来引导自动驾驶车辆。在人行道上，人们可以随意散步、慢跑或溜旱冰，而且还有各种出没不定的障碍物，如狗、婴儿车、标志牌和垃圾。

自动驾驶汽车和登月车工程师马特·德莱尼（Matt Delaney）说，自动导航的关键是弄清楚人们如何使用机器人身处的空间。如今他正在旧金山创建自己的机器人快递公司Marble。“行人环境非常具有文化特点，”他说，“如果在测试中反复长久地监测人们的行为，机器人就能学会选择最佳路线。”

Marble公司并不会明确解释自己的机器人如何能适应在不同环境下行走（例如从曼哈顿快节奏的街道到旧金山悠闲的坡道），可能是因为旧金山湾区人行道上雄心勃勃的竞争对手在迅速增多。同在旧金山的Dispatch公司正在加州两所大学的校园里测试三轮机器人Carry，它的模样看起来有点像带轮子的野餐用啤酒冷藏箱。在旧金山附近的帕洛阿尔托（Palo Alto），另一家新成立的公司Robby也在开发一款快递机器人。

虽然机器人最终可能会让一些人反感，但像比亚乔和Starship公司那样慢速行进的轻型机器并不会像自动驾驶汽车（车身重，速度快）和无人机

（有可能从天上掉下来砸到你的头，还有严重的噪音滋扰）那样，令人担忧其安全问题。因此，它们没有受到同等程度的政府监管。Starship已成功地在一些美国司法辖区牵头立法，明确允许了它想要开展的那类自动快递业务。不过Starship发现，大多数城市其实十分欢迎快递机器人。有了它们，路上送货的车辆会减少，这可能会减少污染和交通阻塞，为生活带来方便并降低成本。快递机器人还有一个好处，就是送货上门的时候不会要小费。 ■



Regenerative medicine

A tissue of truths

The routine printing of human body parts may not be far away

EVERY year about 120,000 organs, mostly kidneys, are transplanted from one human being to another. Sometimes the donor is a living volunteer. Usually, though, he or she is the victim of an accident, stroke, heart attack or similar sudden event that has terminated the life of an otherwise healthy individual. But a lack of suitable donors, particularly as cars get safer and first-aid becomes more effective, means the supply of such organs is limited. Many people therefore die waiting for a transplant. That has led researchers to study the question of how to build organs from scratch.

One promising approach is to print them. Lots of things are made these days by three-dimensional printing, and there seems no reason why body parts should not be among them. As yet, such “bioprinting” remains largely experimental. But bioprinted tissue is already being sold for drug testing, and the first transplantable tissues are expected to be ready for use in a few years’ time.

| *Just press “print”*

Bioprinting originated in the early 2000s, when it was discovered that living cells could be sprayed through the nozzles of inkjet printers without damaging them. Today, using multiple print heads to squirt out different cell types, along with polymers that help keep the structure in shape, it is possible to deposit layer upon layer of cells that will bind together and grow into living, functional tissue. Researchers in various places are tinkering with kidney and liver tissue, skin, bones and cartilage, as well as the networks of blood vessels needed to keep body parts alive. They have implanted printed ears, bones and muscles into animals, and watched

these integrate properly with their hosts. Last year a group at Northwestern University, in Chicago, even printed working prosthetic ovaries for mice. The recipients were able to conceive and give birth with the aid of these artificial organs.

No one is yet talking of printing gonads for people. But blood vessels are a different matter. Sichuan Revotek, a biotechnology company based in Chengdu, China, has successfully implanted a printed section of artery into a monkey. This is the first step in trials of a technique intended for use in humans. Similarly, Organovo, a firm in San Diego, announced in December that it had transplanted printed human-liver tissue into mice, and that this tissue had survived and worked. Organovo hopes, within three to five years, to develop this procedure into a treatment for chronic liver failure and for inborn errors of metabolism in young children. The market for such treatments in America alone, the firm estimates, is worth more than \$3bn a year.

Johnson & Johnson, a large American health-care company, is so convinced that bioprinting will transform parts of medical practice that it has formed several alliances with interested academics and biotechnology firms. One of these alliances, with Tissue Regeneration Systems, a firm in Michigan, is intended to develop implants for the treatment of defects in broken bones. Another, with Aspect, a biotechnology company in Canada, is trying to work out how to print parts of the human knee known as the meniscuses. These are crescent-shaped cartilage pads that separate the femur from the tibia, and act as shock absorbers between these two bones—a role that causes huge wear and tear, which sometimes requires surgical intervention.

More immediately, bioprinting can help with the development and testing of other sorts of treatments. Organovo already offers kidney and liver tissue for screening potential drugs for efficacy and safety. If this takes off it will

please animal-rights activists, as it should cut down on the number of animal trials. It will please drug companies, too, since the tissue being tested is human, so the results obtained should be more reliable than ones from tests on other species.

With similar motives in mind, L'Oréal, a French cosmetics firm, Procter & Gamble, an American consumer-goods company, and BASF, a German chemical concern, are working on printing human skin. They propose to use it to test their products for adverse reactions. L'Oréal already grows about five square metres of skin a year using older and slower technology. Bioprinting will permit it to grow much more, and also allow different skin types and textures to be printed.

| *Skin in the game*

Printed skin might eventually be employed for grafts—repairing burns and ulcers. Plans are also afoot, as it were, to print skin directly onto the surface of the body. Renovacare, a firm in Pennsylvania, has developed a gun that will spray skin stem cells directly onto the wounds of burns victims. (Stem cells are cells that proliferate to produce all of the cell types that a tissue is composed of.) The suggestion is that the stem cells in question will come from the patient himself, meaning that there is no risk of his immune system rejecting the new tissue.

The real prize of all this effort would be to be able to print entire organs. For kidneys, Roots Analysis, a medical-technology consultancy, reckons that should be possible in about six years' time. Livers, which have a natural tendency to regenerate anyway, should also arrive reasonably soon. Hearts, with their complex internal geometries, will take longer. In all cases, though, printed organs would mean that those awaiting transplants have to wait neither for the altruism of another nor the death of a stranger to provide the means to save their own lives. ■



再生医学

器官真相

在不远的将来，打印人体组织也许会成为常规

每年约有12万个器官（主要是肾脏）从一个人身上移植到另一个人身上。有时器官由仍健在的志愿者捐赠，但通常情况下捐赠者都是因事故、中风、心脏病或类似突然事件而猝然离世的健康人。但因缺少合适的捐赠者，特别是在汽车变得更安全、急救变得更有效的情况下，上述途径供应的器官已十分有限。因此，许多人在等待移植的过程中就去世了。这促使研究人员着手研究从零打造器官的问题。

一个有望成功的方法是3D打印。现在很多东西都是通过3D打印制造出来的，用这项技术来打印人体器官似乎也没什么不可以。到目前为止，这种“生物打印”仍然主要是实验性的，但是生物打印的器官组织已经上市，供药物测试使用。预计第一批可移植的组织可在几年内用于手术。

| 只需按“打印键”

生物打印起源于21世纪初。当时研究人员发现活体细胞可以通过喷墨打印机的喷嘴喷出而不会受损。今天，使用多个打印头，将不同类型的细胞连同保持细胞结构不变的聚合物一起喷射出来，就可以使细胞一层层沉积，最后结合在一起生长成为活体功能组织。各地的研究人员都在尝试打印肾脏和肝脏组织、皮肤、骨骼和软骨，以及保持人体器官存活所需的血管网络。研究人员已经将3D打印的耳朵、骨骼和肌肉移植给动物，观察它们能否很好地与受体相融合。去年，芝加哥西北大学的一个研究小组甚至打印出了具有生物学功能的卵巢假体并移植到小白鼠体内。接受移植的小白鼠借助这些人工器官得以成功受孕并分娩。

现在还没有人谈及为人类打印性腺的问题，但血管就是另一回事了。位于中国成都的生物科技公司四川蓝光英诺已成功将一段3D打印的动脉血管植入猴子体内，这是将该技术应用于人体的试验进程中迈出的第一步。圣地亚哥的公司Organovo也做了类似的尝试。该公司在去年12月宣布已将打印

的人体肝脏组织移植到小白鼠体内，移植后的组织成功存活且可正常工作。Organovo希望能在三到五年内把这种手段发展成为一种治疗方案，用以治疗慢性肝衰竭和幼儿先天性代谢缺陷。该公司估计，仅在美国，这种疗法的市场价值每年就超过30亿美元。

美国大型保健企业强生公司深信生物打印将改变部分医疗手段，为此它已与相关学术机构和生物科技公司成立若干联盟。其中与密歇根州的“组织再生系统”公司（Tissue Regeneration Systems）的联盟是为了开发用于修补骨折缺损的植入物，另一个和加拿大生物科技公司Aspect的联盟正在试图攻克打印人体膝盖半月板的课题。半月板是将股骨与胫骨分开的新月形软骨垫，在这两块骨头之间起减震器的作用。这使它容易出现严重的磨损和撕裂，有时需要通过外科手术来修复。

相较之下，会更快实现的是利用生物打印来开发和测试其他类型的治疗手段。Organovo已经可以提供肾脏和肝脏组织来根据疗效和安全性筛选潜在药物。如果这种方法进展顺利，动物保护主义者会很高兴，因为它可以减少动物试验的发生。这一做法也会令制药公司满意，因为测试使用的是人体组织，故而获得的结果应该比来自其他物种的测试结果更可靠。

出于类似的目的，法国化妆品公司欧莱雅、美国消费品公司宝洁和德国化工企业巴斯夫（BASF）都在研究打印人类皮肤，打算使用打印皮肤来检测自家产品的不良反应。欧莱雅已使用较老旧且低效的技术每年人工培养出约5平方米的皮肤。生物打印将让它得以培养出多得多的皮肤，而且还能打印不同类型和肌理的皮肤。

| 皮之所存

打印皮肤最终或许可用于皮肤移植，以修复烧伤和溃疡造成的损伤。一些想要把皮肤直接打印到人体表面的计划似乎也在进行中。宾夕法尼亚州的Renovacare公司开发了一种皮肤修复枪，可以将皮肤干细胞直接喷射到烧伤病人的伤口上（干细胞可快速增殖，生成构成组织的所有类型的细胞）。这意味着所使用的干细胞将来自患者自身，以令新组织免遭免疫系统的排斥。

所有这些努力的真正目标是打印整个器官。医疗技术咨询公司“根源分析”（Roots Analysis）估计打印肾脏应该可在大概六年后实现。肝脏天然就具有再生能力，肝脏打印应该也会较快实现。心脏的内部构造复杂，实现打印将需要更长的时间。不过，在上述各种情况下，打印器官都将让那些等待移植的病人既不再需寄希望于另一个人的无私奉献，也不必再等待一个陌生人的死亡来拯救自己的生命。 ■



Health care

The wonder drug

Digitising the health-care industry is a huge business opportunity

WHEN someone goes into cardiac arrest, survival depends on how quickly the heart can be restarted. Enter Amazon's Echo, a voice-driven computer that answers to the name of Alexa, which can recite life-saving instructions about cardiopulmonary resuscitation, a skill taught to it by the American Heart Association. Alexa is accumulating other health-care skills, too, including acting as a companion for the elderly and answering questions about children's illnesses. In the near future she will probably help doctors with grubby hands to take notes and to request scans, as well as remind patients to take their pills.

Alexa is one manifestation of a drive to disrupt an industry that has so far largely failed to deliver on the potential of digital information. Health care is over-regulated and expensive to innovate in, and has a history of failing to implement ambitious IT projects. But the momentum towards a digital future is gathering pace. Investment into digital health care has soared (see chart).

One reason for that is the scale of potential cost-savings. Last year Americans spent an amount equivalent to about 18% of GDP on health care. That is an extreme, but other countries face rising cost pressures from health spending as populations age. Much of this expenditure is inefficient. Spending on administration varies sevenfold between rich countries. There are huge differences in the cost of medical procedures. In rich countries about one-fifth of spending on health care goes to waste, for example on wrong or unnecessary treatments. Eliminating a fraction of this sum is a huge opportunity.

Consumers seem readier to accept digital products than just a few years ago. The field includes mobile apps, telemedicine—health care provided using electronic communications—and predictive analytics (using statistical methods to sift data on outcomes for patients). Other areas are automated diagnoses and wearable sensors to measure things like blood pressure.

If there is to be a health-care revolution, it will create winners and losers. Andy Richards, an investor in digital health, argues that three groups are fighting a war for control of the “health-care value chain”.

One group comprises “traditional innovators”—pharmaceutical firms, hospitals and medical-technology companies such as GE Healthcare, Siemens, Medtronic and Philips. A second category is made up of “incumbent players”, which include health insurers, pharmacy-benefit managers (which buy drugs in bulk), and as single-payer health-care systems such as Britain’s NHS. The third group are the technology “insurgents”, including Google, Apple, Amazon and a host of hungry entrepreneurs that are creating apps, predictive-diagnostics systems and new devices. These firms may well profit most handsomely from the shift to digital.

The threat to the traditional innovators is that as medical records are digitised and new kinds of patient data arrive from genomic sequencing, sensors and even from social media, insurers and governments can get much better insight into which treatments work. These buyers are increasingly demanding “value-based” reimbursement—meaning that if a drug or device doesn’t function well, it will not be bought.

The big question is whether drug companies will be big losers, says Marc Sluijs, an adviser on investment in digital health. More data will not only identify those drugs that do not work. Digital health care will also give rise

to new services that might involve taking no drugs at all.

| *Lunches eaten*

Diabetes is an obvious problem for the pharma business in this regard, says Dan Mahony, a partner at Polar Capital, an investment firm. Since evidence shows that exercise gives diabetics better control of their disease (and helps most pre-diabetics not to get sick at all), there is an opening for new services. UnitedHealthcare, a big American insurer, for example, has a prevention programme that connects pre-diabetics with special coaches at gyms.

An app or a wearable device that persuades people to walk a certain distance every day would be far cheaper for insurers and governments to provide than years of visits to doctors, hospitals and drugs. Although Fitbits are frequently derided for ending up in the back of a drawer, people can be motivated to get off the sofa. Players of Pokémon Go have collectively walked nearly 9bn kilometres since the smartphone game was released last year.

That is the backdrop to a new firm called Onduo, a joint venture that Google's health-care venture, Verily Life Sciences, and Sanofi, a French drug firm, set up last year. Onduo will start by developing ways to help diabetics make better decisions about their use of drugs and their lifestyle habits. Later on, Onduo wants to help those who are at risk of diabetes not to develop it. The startup is a good hedge for Sanofi, which faces a slowdown in sales of its blockbuster insulin medication, Lantus, which lost patent protection in 2015.

This kind of thinking does not come easily to drug firms. Switzerland's Novartis is one of the few to have acknowledged that digital innovation will mean selling products based on patient outcomes. But if pharma firms do not design solutions that put the patient, rather than drug sales, at the

centre of their strategy, they risk losing relevance, says Mr Sluijs.

Large hospitals, some of which count as both incumbents and traditional innovators, will also be affected. The rise of telemedicine, predictive analytics and earlier diagnoses of illnesses are expected to reduce admissions, particularly of the emergency kind that are most lucrative in commercial systems. The sickest patients can be targeted by specialist services, such as Evolution Health, a firm in Texas that cares for 2m of the most-ill patients across 15 states. It claims to be able to reduce the use of emergency rooms by a fifth, and inpatient stays in hospitals by two-fifths.

Rapid medical and diagnostic innovation will disrupt all businesses that rely heavily on physical facilities and staff. A mobile ultrasound scanner made by Philips, called Lumify, means that a far larger number of patients can be seen by their own doctors. As for data-based diagnostics, one potential example of its power to change business models is Guardant Health, a startup that is analysing large quantities of medical data in order to develop a way of diagnosing cancer from blood tests. If the firm can devise an early test for breast cancer, demand for mammograms and the machines that take them would fall, along with the need for expensive drugs and spells in hospital.

| *From ER to AI*

There is also good news for hospitals, however. Increasingly, machine-learning programs are able to make diagnoses from scans and from test results. An intriguing recent project has been to stream and analyse live health data and deliver alerts on an app that is carried around by doctors and nurses at the Royal Free Hospital in London. The app, which is the work of DeepMind, a British artificial-intelligence (AI) research firm owned by Google, identifies the patients at greatest risk of a sudden and fatal loss of kidney function. The Royal Free says that the app is already saving nurses' time.

Naturally enough, the health-care entrepreneurs have the boldest visions. The point of care will move rapidly into the home, they say. People will monitor their heart conditions, detect concussions, monitor the progress of diseases and check up on moles or ear infections using apps, mobile phones and sensors. Last year the FDA approved 36 connected health apps and devices. A new app, called Natural Cycles, was recently approved in Europe for use as a contraceptive. Its failure rate for typical use was equivalent to that of popular contraceptive pills. A smartphone may eventually be able to predict the onset of Alzheimer's, Parkinson's or even the menopause (if the information is wanted).

In emerging economies, where regulations on health data are less onerous and where people often already expect to pay to see a doctor, there is faster growth and innovation. China, which is building 400 hospitals a year, saw its two largest VC investments in digital health care last year. One went into a Chinese medical-service app, Ping An Good Doctor, which raised \$500m; a video-consultations app called Chunyu Yisheng raised \$183m. India is another innovator. To take one example, LiveHealth, based in Pune, is an app that lets patients assemble all their health records in one place, see test results and communicate with doctors.

In the short term, the greatest disruption will come from a growing array of apps in many countries around the world that give consumers direct access to qualified GPs on their mobile phones. Overall, telemedicine is expected to grow rapidly. In America, GPs will conduct 5.4m video consultations a year by 2020, says IHS Markit, a research firm. Britain's NHS is testing a medical AI from a London-based startup called Babylon which can field patients' questions about their health. A paid service called Push Doctor offers an online appointment almost immediately for £20 (\$24). The firm maximises the efficiency of its doctors by reducing the time they spend on administrative duties. They spend 93% of their time with patients compared with only 61% in Britain's public sector. Babylon reckons that

85% of consultations do not need to be in person.

In the longer term, the biggest upheaval may come from the large technology firms. Amazon and Google are not the only giants to be stalking health care. Apple has expressed a strong interest in it, though it is taking time to decide exactly what it wants to do. For several years it has provided a way of bringing together health data on its iPhone, and tools for health researchers to build apps. As personal-health records accumulate on its platform, from sensors such as Fitbits to medical-grade devices, it will encourage more app development.

An app using data from an iPhone or another smartphone might be able to warn users that a sedentary lifestyle will exacerbate a heart condition or that, based on social-media patterns, they are at risk of depression, for example. Apple and other tech firms may also be able to help patients take greater control of their existing health records. For now medical records mostly remain under the guard of those who provided the care, but this is expected to change. If patients do gain proper access to their own data, Apple is in a particularly strong position. Its platform is locked and fairly secure, and the apps that run on it are all screened by the firm.

None of this will materialise quickly. Regulated health-care systems will take time to deal with concerns over accuracy, security and privacy. In Britain the Royal Free is already under scrutiny over how it shared its patients' data. That suggests a broader worry: that technology companies are too cavalier with their users' data. Such firms typically use long agreements on data rights that are hard for individuals to understand. The medical world places importance on informed consent, so a clash of cultures seems unavoidable.

Yet enormous change looks inevitable. Investors hope for billion-dollar health-tech "unicorns". Payers eye equally sizeable savings. Amid such talk

it is worth remembering that the biggest winners from digital health care will be the patients who receive better treatment, and those who avoid becoming patients at all. ■



医疗保健

灵丹妙药

医疗保健行业的数字化是一大商机

如果有人心脏骤停，他的生存几率取决于心跳恢复的速度。喊一声“Alexa”启动亚马逊的语音智能音箱Echo，她可以背诵出心肺复苏急救说明。这一急救技能是由美国心脏协会（American Heart Association）教授的。

Alexa还在积累其他保健技能，包括充当老年人的陪伴者，以及回答有关儿童疾病的问题。在不久的将来，她还可能会帮助在治疗时弄脏了手的医生记笔记和请求扫描，还能提醒病人按时服药。

Alexa是力图颠覆医疗行业的一大例证。该行业在很大程度上尚未充分发掘数字信息的潜力。医疗保健行业监管过度，创新成本高，而且一向未能成功实施宏伟的IT项目。不过，朝向数字化未来发展的势头正在加快，数字医疗保健领域的投资已经飙升（见图表）。

出现这种变化的原因之一是数字化在节约成本方面的潜力。去年美国人在医疗保健上的花费大约相当于GDP的18%。这是个极端情况，但随着人口年龄增长，其他国家也都面临着医疗保健支出上涨的压力，而且大部分支出的使用效率都很低下。富裕国家在管理支出上相差很大，最高达七倍。医疗程序上的成本也存在巨大差异。在富裕国家，由于错误或不必要的治疗等原因，约五分之一的医疗保健支出都白白浪费了。减少一小部分的浪费就意味着巨大的机会。

消费者似乎也比几年前更愿意接受数字医疗产品。该领域包括移动应用、利用电子通信手段提供的远程医疗保健，以及预测分析（使用统计方法为患者筛选结果数据）。其他应用领域包括自动诊断和用于测量血压等指标的可穿戴传感器。

如果要来一场医疗保健革命，那么既会有赢家也会有输家。数字健康投资人安迪·理查兹（Andy Richards）认为，有三类企业正在为争夺“保健价

价值链”的掌控权而交战。

一类由“传统创新者”组成——制药公司、医院，以及医疗科技公司如GE医疗、西门子、美敦力和飞利浦。第二类由“现有玩家”组成，包括医疗保险公司、药品福利管理机构（批量采购药品）以及英国NHS等单一支付医保体系。第三类是科技“叛军”，包括谷歌、苹果、亚马逊和一大批野心勃勃的企业家。它们在不断地创造各类应用、预测诊断系统和新设备。在向数字化的转变中，这些企业很可能获利最多。

传统创新者面临这样的威胁：由于医疗记录已经数字化，而基因组测序、传感器，甚至是社交媒体也给出了新型的患者数据，保险公司和政府因而能更好地了解哪些治疗方法是有效的。这些医疗保健产品的买家越来越多地要求“按价值”报销，即如果药物或设备的功效不佳，就不会再买了。

数字健康投资顾问马克·斯卢易斯（Marc Sluijs）说，最大的问题在于制药公司是否会沦为输家。更多的数据不仅可以帮助识别没有用的药，数字医疗保健还可能催生无需服用任何药物的新服务。

| 午餐没了

投资公司Polar Capital的合伙人丹·马宏尼（Dan Mahony）说，就这一点而言，糖尿病便是制药企业所面临的一个显著的问题。证据表明，运动有助糖尿病患者更好地控制病情（还能帮助大多数前驱糖尿病人避免发病），新的服务因而出现，例如美国大型保险公司UnitedHealthcare就有一个预防项目，为前驱糖尿病患者与健身房里专门的教练牵线。

相比连年看医生、跑医院和吃药的费用，那种鼓励人们每天行走一定距离的应用或可穿戴设备对于保险公司和政府来说要便宜得多。虽然经常有人嘲笑Fitbit运动手环最终都是被扔进抽屉，但这些程序或设备确实可以鼓励人们不再赖在沙发上。自去年智能手机游戏“精灵宝可梦Go”（Pokémon Go）发布以来，其玩家总共已经步行近90亿公里。

这正是新公司Onduo成立的背景。这家合资公司由谷歌旗下医疗保健企业Verily生命科学公司（Verily Life Sciences）和法国制药公司赛诺菲

（Sanofi）于去年成立。Onduo首先将开发解决方案，帮助糖尿病患者在使用药物和生活习惯方面做出更好的决策。之后，Onduo想要帮助那些有糖尿病风险的人避免患病。这家创业公司为赛诺菲提供了很好的风险对冲，因为赛诺菲在2015年失去了热销胰岛素药来得时（Lantus）的专利保护，面临销售下滑。

接受这种思维方式对制药公司来说并非易事，仅有瑞士诺华等少数公司认识到数字创新意味着产品销售将由疗效决定。然而，据斯卢易斯说，如果制药公司不设计解决方案来把患者而非药物销售放在战略中心，它们就可能变得不合时宜。

大型医院（其中一些既算是现有玩家，也是传统创新者）也将受到影响。远程医疗、预测分析和疾病早期诊断的兴起预计将会减少就医人数，尤其是在私立医院中利润最大的急诊。重症患者可以成为专家服务的对象，例如得克萨斯州的Evolution Health公司为15个州的200万名重症患者提供服务。它声称能够将去急诊的次数减少五分之一，将住院人次减少五分之一。

医疗和诊断的快速创新将颠覆所有严重依赖实体医疗设施和员工的企业。飞利浦公司制造的移动超声波扫描仪Lumify让更多患者可以直接看家庭医生。基于数据的诊断将能改变商业模式，创业公司Guardant Health或许就是一个例子。该公司正在通过分析海量的医疗数据来开发一种通过验血诊断癌症的方法。如果公司能够开发出乳腺癌的早期检验方法，那么对乳房X光及X光机的需求将会下降，对昂贵药物和住院治疗的需求也会下降。

| 从急诊到人工智能

然而，对医院来说也有好消息。越来越多的机器学习程序能够根据扫描和检验结果做出诊断。最近在伦敦皇家自由医院（Royal Free Hospital）有一个有趣的项目：在一款应用上上传并分析实时健康数据，必要时向随身携带此应用的医生和护士发出警报。该应用由谷歌在英国的人工智能研究公司DeepMind开发，可识别哪些患者最有可能突然发生致命的急性肾功能丧失。伦敦皇家自由医院表示该应用已经开始节省护士的时间。

自然，医疗保健企业家的愿景最为大胆。他们称治疗地点将迅速转入家庭。人们将可以通过应用、手机和传感器来监测心脏状况、检测脑震荡、追踪疾病发展以及检查痣或耳部感染。去年美国食品药品监督管理局（FDA）批准了36个医疗保健类联网应用和设备。一个用于避孕的新应用Natural Cycles最近在欧洲获批，其典型使用失效率等同于常见避孕药。智能手机也许最终将能预测出阿尔茨海默病、帕金森病的发病时间，甚至更年期开始的时间（如果想要了解这一信息的话）。

在新兴经济体中，对医疗数据的法规要求没那么繁多，而且通常人们已经有了看病要花钱的预期，因而数字医疗在那里有更快的增长和创新。中国每年建造400所医院，去年在数字医疗保健方面出现了两个最大的风投资项目：一个是医疗服务应用“平安好医生”，融资5亿美元；另一个是叫做“春雨医生”的视频咨询应用，融资1.83亿美元。印度是另一个创新国度。举个例子，由总部位于普纳的公司开发的应用LiveHealth让患者可以集中所有的健康记录、查看检验结果并和医生沟通。

短期内，最大的颠覆将来自许多国家日益增加的各种应用，它们让患者可以在手机上直接与注册家庭医生交流。总体而言，远程医疗预计将快速增长。研究公司IHS Markit的数据显示，到2020年，美国的家庭医生每年将提供540万次视频咨询服务。英国的NHS正在测试伦敦创业医疗机构Babylon的一个人工智能医疗程序，它可以解答患者提出的健康问题。这个叫作Push Doctor的服务每次收费20英镑（24美元），可提供几乎实时的在线问诊。Babylon公司通过减少医生在行政工作上花费的时间，最大限度地提高了医生的效率，让他们能把93%的工作时间花在病人身上，而在英国的公立医院这个数字只有61%。Babylon认为85%的问诊都无需面对面进行。

长远来看，最大的颠覆可能来自大型科技公司。紧盯保健医疗行业的科技巨头不仅仅有亚马逊和谷歌，苹果也表达了浓厚的兴趣，不过它也并没急着决定到底要做什么。几年来，苹果一直让用户能在iPhone上汇集健康数据，并提供工具让医疗研究人员构建应用。随着来自Fitbit手环等传感器以及医疗级设备的个人健康记录在其平台上不断积累，苹果还将鼓励开发

更多的应用。

利用来自iPhone或其他智能手机的数据，一款应用也许能够对用户面临的健康风险提出警告，例如久坐的生活方式会加重心脏病，或者其在社交媒体上的行为规律指向抑郁症风险。苹果和其他科技公司也可能会帮助患者更好地管控其现有的健康记录。现在的医疗记录大多由那些提供医疗服务的机构保存，但预计这将有所改变。如果患者真的可以恰当地获得自己的数据，苹果就会处于特别有利的地位，因为其平台是封闭式的，还算安全，平台上运行的应用也都经过了苹果的筛选。

但这类前景无一会迅速实现。受监管的医疗保健系统需要时间来解决人们对准确性、安全性和隐私问题的担忧。在英国，皇家自由医院已经在就其分享患者数据的方式接受审查。从中可见一种更广泛的担忧：科技公司对用户的数据安全太过漫不经心。科技公司惯于使用个人用户难以理解的冗长的数据权利协议，但医学界重视知情同意，由此而来的文化冲突似乎不可避免。

然而巨变似乎同样不可避免。投资者希望出现市值超十亿美元的医疗技术“独角兽”公司。医疗费用的支付方也期待同样数额巨大的开支节省。在此类讨论中有一点值得记住：数字医疗的最大赢家将是获得更好治疗的患者以及躲过了疾病的人。■



Cargo shipping

Still at sea

Why there has been so little scrapping in an industry beset by overcapacity

TOO many new ships, too few old ones scrapped. Since the financial crisis, after which trade growth slowed, the Baltic Dry Index—a measure of bulk freight rates—has fallen by 93%. Prices for transporting containers have plunged by the same amount on some routes. In 2008 it cost \$2,000 to send a 20-foot box from China to Brazil; now it costs \$50. The industry is drowning in red ink. Hanjin Shipping of South Korea, the world's seventh-largest line, went bust last August, and even Maersk Line, which has the lowest costs in the industry, lost \$367m in 2016.

But there was some optimism at European Shipping Week opened in late February in Brussels, an industry event. Bosses at bigger lines reckon the worst is over. Higher levels of scrapping will cut overcapacity, argues Rolf Habben Jansen, CEO of Hapag-Lloyd, a German line. The industry may break even this year, predicts Rahul Kapoor of Drewry, a consultancy.

But many shipowners are still too reluctant to send their hulks to the scrapheap. The problem can be clearly seen in the container-shipping business. Last year firms scrapped 194 ships, accounting for 3% of global tonnage—a record high. But new ships will add 8% more capacity this year; the net increase is over twice the level of forecast growth in demand.

The surge in shipbuilding was originally prompted by Maersk Line's order in 2011 for 20 huge Triple-E class vessels. These ships cut Maersk's costs relative to its rivals, which retaliated with their own orders for supersize ships. At first the industry was able to mask the extra capacity by reducing sailing speeds by a third, but that ruse has reached its limit.

Executives at bigger lines hope that their own new fuel-efficient liners will push small, independent shipowners to scrap older ones. Yet these are often family businesses and have no such intention, says Basil Karatzas, an adviser to many such firms, not least because the scrap value of their ships is much less than the cost of new ones. For that, blame over-production of steel by China. The scrap value per long ton of ship fell from \$450 in 2014 to \$271 last year. Banks have preferred to restructure loans on unprofitable vessels rather than scrap them at a fraction of the value of the debt owed on them.

Breaking firms are becoming more cautious, too—particularly the beaching yards in India, Pakistan and Bangladesh that account for two-thirds of ship-scrapping globally. Last year several in India got into trouble when they bought vessels during a short-lived steel-price spike and then had to sell the scrap at a big loss.

Some yard owners also complain about the cost of compliance with the Hong Kong International Convention of 2009, which sets minimum environmental and worker standards for ship recycling. Although India, Pakistan and Bangladesh have not ratified it, some facilities, such as India's Shree Ram yard in Alang, try to adhere to the convention. Others do not. Falls this year in the number of bulk carriers and tankers being sent for scrap may be bad news for the shipping industry. For the environment, there is a silver lining. ■



货物航运

仍于苦海中沉浮

航运业饱受运力过剩的困扰，为何船只报废率仍如此之低

新船太多，旧船报废太少。金融危机以来，贸易增长放缓，衡量散货运价的波罗的海干散货指数（Baltic Dry Index）已下降93%。在某些航线上，集装箱运费也有相同的降幅。2008年，将一个20英尺集装箱从中国运至巴西的费用为2000美元，现在只要50美元。航运业普遍陷入赤字苦海。去年8月，位列世界第七的韩国韩进海运（Hanjin Shipping）破产，即使是业内成本最低的马士基航运公司也在2016年亏损了3.67亿美元。

不过，2月底在布鲁塞尔召开的行业盛会欧洲航运周（European Shipping Week）上出现了一些乐观的情绪。大型航运公司的老板们认为最坏的情况已经过去。德国航运公司赫伯罗特（Hapag Lloyd）的CEO罗尔夫·哈本·詹森（Rolf Habben Jansen）认为，提高报废率将会减少过剩运力。德鲁里航运咨询公司（Drewry）的拉胡尔·卡普尔（Rahul Kapoor）预测该行业今年有望实现盈亏平衡。

但是，许多船东仍不愿把他们的旧船送进废铁堆。在集装箱航运业务上，这个问题表现得很明显。去年，各航运公司共报废了194艘船，占全球船舶总吨位的3%——创历史高位。但今年的新船将增加8%的运力，净增长超过预计需求增长的两倍。

造船量激增最初始于马士基在2011年订购的20艘3E级巨轮。这些船只让马士基跟竞争对手相比降低了成本，而这些对手则订购了自己的超大船只予以回应。起初，行业还能通过降低三分之一的航速来掩盖这些额外运力，但这个策略的效力已达极限。

大型航运企业的高管们希望，自家节能高效的新船会迫使独立的小公司报废老旧船只。然而，为多家此类小公司提供咨询的巴兹尔·卡拉察斯（Basil Karatzas）指出，这些公司往往是家族企业，并没有这样的打算，

尤其是因为它们船只的废料价值远低于新船的成本。这就要怪中国钢铁业的生产过剩了。每长吨报废船体的价格由2014年的450美元下跌至去年的271美元。银行更愿意重组不盈利船只的贷款，而不是把它们报废然后只收回一小部分欠债。

拆船企业也变得越来越谨慎，尤其是那些在印度、巴基斯坦和孟加拉进行冲滩拆船的公司——全球三分之二的船只报废都在那里进行。去年，印度几家公司遇到了麻烦。它们在钢铁价格短暂暴涨时购进报废船只，然后却不得不大亏本出售拆解出来的废铁。

一些拆船厂业主还抱怨2009年通过的《香港公约》的合规成本，该公约为船舶回收设定了最低环境和劳工标准。尽管印度、巴基斯坦和孟加拉尚未批准该公约，但也有一些拆船厂，比如位于印度阿郎港的Shree Ram，已在尽量遵守公约。其他拆船厂则没有照做。今年散货船和油轮报废的数量有所下降，这对于航运业或许是坏消息，但对于环境来说，却是黑暗中的一线光亮。■



The semiconductor industry

Silicon crumble

How the rise of artificial intelligence is creating new variety in the global chip market, and trouble for Intel

“WE ALMOST went out of business several times.” Usually founders don’t talk about their company’s near-death experiences. But Jen-Hsun Huang, the boss of Nvidia, has no reason to be coy. His firm, which develops microprocessors and related software, is on a winning streak. In the past quarter its revenues increased by 55%, reaching \$2.2bn, and in the past 12 months its share price has almost quadrupled.

A big part of Nvidia’s success is because demand is growing quickly for its chips, called graphics processing units (GPUs), which turn personal computers into fast gaming devices. But the GPUs also have new destinations: notably data centres where artificial-intelligence (AI) programmes gobble up the vast quantities of computing power that they generate.

Soaring sales of these chips (see chart) are the clearest sign yet of a secular shift in information technology. The architecture of computing is fragmenting because of the slowing of Moore’s law, which until recently guaranteed that the power of computing would double roughly every two years, and because of the rapid rise of cloud computing and AI. The implications for the semiconductor industry and for Intel, its dominant company, are profound.

Things were straightforward when Moore’s law, named after Gordon Moore, a founder of Intel, was still in full swing. Whether in PCs or in servers (souped-up computers in data centres), one kind of microprocessor, known as a “central processing unit” (CPU), could deal with most “workloads”, as

classes of computing tasks are called. Because Intel made the most powerful CPUs, it came to rule not only the market for PC processors (it has a market share of about 80%) but the one for servers, where it has an almost complete monopoly. In 2016 it had revenues of nearly \$60bn.

This unipolar world is starting to crumble. Processors are no longer improving quickly enough to be able to handle, for instance, machine learning and other AI applications, which require huge amounts of data and hence consume more number-crunching power than entire data centres did just a few years ago. Intel's customers, such as Google and Microsoft together with other operators of big data centres, are opting for more and more specialised processors from other companies and are designing their own to boot.

Nvidia's GPUs are one example. They were created to carry out the massive, complex computations required by interactive video games. GPUs have hundreds of specialised "cores" (the "brains" of a processor), all working in parallel, whereas CPUs have only a few powerful ones that tackle computing tasks sequentially. Nvidia's latest processors boast 3,584 cores; Intel's server CPUs have a maximum of 28.

The company's lucky break came in the midst of one of its near-death experiences during the 2008-09 global financial crisis. It discovered that hedge funds and research institutes were using its chips for new purposes, such as calculating complex investment and climate models. It developed a coding language, called CUDA, that helps its customers program its processors for different tasks. When cloud computing, big data and AI gathered momentum a few years ago, Nvidia's chips were just what was needed.

Every online giant uses Nvidia GPUs to give their AI services the capability to ingest reams of data from material ranging from medical images to

human speech. The firm's revenues from selling chips to data-centre operators trebled in the past financial year, to \$296m.

And GPUs are only one sort of "accelerator", as such specialised processors are known. The range is expanding as cloud-computing firms mix and match chips to make their operations more efficient and stay ahead of the competition. "Finding the right tool for the right job", is how Urs Hölzle, in charge of technical infrastructure at Google, describes balancing the factors of flexibility, speed and cost.

At one end of the range are ASICs, an acronym for "application-specific integrated circuits". As the term suggests, they are hard-wired for one purpose and are the fastest on the menu as well as the most energy-efficient. Dozens of startups are developing such chips with AI algorithms already built in. Google has built an ASIC called "Tensor Processing Unit" for speech recognition.

The other extreme is field-programmable gate arrays (FPGAs). These can be programmed, meaning greater flexibility, which is why even though they are tricky to handle, Microsoft has added them to many of its servers, for instance those underlying Bing, its online-search service. "We now have more FPGAs than any other organisation in the world," says Mark Russinovich, chief technology officer at Azure, the firm's computing cloud.

| *Time to be paranoid*

Instead of making ASICs or FPGAs, Intel focused in recent years on making its CPU processors ever more powerful. Nobody expects conventional processors to lose their jobs anytime soon: every server needs them and countless applications have been written to run on them. Intel's sales from the chips are still growing. Yet the quickening rise of accelerators appears to be bad news for the company, says Alan Priestley of Gartner, an IT consultancy. The more computing happens on them, the less is done on

CPUs.

One answer is to catch up by making acquisitions. In 2015 Intel bought Altera, a maker of FPGAs, for a whopping \$16.7bn. In August it paid more than \$400m for Nervana, a three-year-old startup that is developing specialised AI systems ranging from software to chips. The firm says it sees specialised processors as an opportunity, not a threat. New computing workloads have often started out being handled on specialised processors, explains Diane Bryant, who runs Intel's data-centre business, only to be "pulled into the CPU" later. Encryption, for instance, used to happen on separate semiconductors, but is now a simple instruction on the Intel CPUs which run almost all computers and servers globally. Keeping new types of workload, such as AI, on accelerators would mean extra cost and complexity.

If such integration occurs, Intel has already invested to take advantage. In the summer it will start selling a new processor, code-named Knights Mill, to compete with Nvidia. Intel is also working on another chip, Knights Crest, which will come with Nervana technology. At some point, Intel is expected also to combine its CPU's with Altera's FPGAs.

Predictably, competitors see the future differently. Nvidia reckons it has already established its own computing platform. Many firms have written AI applications that run on its chips, and it has created the software infrastructure for other kinds of programmes, which, for instance, enable visualisations and virtual reality. One decades-old computing giant, IBM, is also trying to make Intel's life harder. Taking a page from open-source software, the firm in 2013 "opened" its processor architecture, which is called Power, turning it into a semiconductor commons of sorts. Makers of specialised chips can more easily combine their wares with Power CPUs, and they get a say in how the platform develops.

Much will depend on how AI develops, says Matthew Eastwood of IDC, a market researcher. If it turns out not to be the revolution that many people expect, and ushers in change for just a few years, Intel's chances are good, he says. But if AI continues to ripple through business for a decade or more, other kinds of processor will have more of a chance to establish themselves. Given how widely AI techniques can be applied, the latter seems likely. Certainly, the age of the big, hulking CPU which handles every workload, no matter how big or complex, is over. It suffered, a bit like Humpty Dumpty, a big fall. And all of Intel's horses and all of Intel's men cannot put it together again. ■



半导体行业 芯片碎裂

人工智能的崛起正在全球芯片市场创造新产品，英特尔有麻烦了

“有几次我们差点就倒闭了。”公司创始人通常都不会谈论自己公司濒临破产的经历，不过英伟达（Nvidia）的老板黄仁勋没什么理由要避忌。他的公司近来捷报频传。过去一个季度，这家开发微处理器和相关软件的公司收益增长了55%，达22亿美元，股价在过去12个月几乎翻了两番。

英伟达的成功有很大一部分原因是人们对其生产的芯片需求增长很快。这种名为图形处理器（GPU）的芯片能让个人电脑成为快速游戏设备。不过GPU还有了新的用武之地，特别是为数据中心提供人工智能程序耗费的大量计算能力。

这些芯片飞涨的销量（见图表）是迄今为止信息技术长期转型最显著的标志。摩尔定律放慢了脚步（不久之前这个定律还保证计算能力大约每两年会翻一番），加之云计算和AI的快速崛起，计算的体系正趋于碎片化。这对半导体行业及业内主导企业英特尔有着深远的影响。

摩尔定律以英特尔创始人之一戈登·摩尔（Gordon Moore）的名字命名。在该定律完全应验之时，情况很简单。无论是在个人电脑（PC）还是服务器（数据心里性能更强劲的计算机）中，名为“中央处理单元”（CPU）的一类微处理器都可处理大多数“工作负载”（各类计算任务的总称）。英特尔制造的CPU性能最为强大，因此这家公司不仅在PC处理器市场一家独大（占据约80%的市场份额），还几乎完全垄断了服务器的处理器市场。2016年，英特尔的收入接近600亿美元。

如今这个单极世界已开始崩溃。处理器性能提升的速度并不足以满足例如机器学习以及其他AI应用程序的需求。这些应用都需要大量的数据，消耗的数字运算能力比几年前所有数据中心加起来还要多。英特尔的客户，如谷歌、微软和其他大数据中心运营商，正在选择来自其他公司越来越专门

化的处理器，而且还开始设计自己的处理器。

英伟达的GPU就是一个例子。这些GPU最初是设计用来运行交互式视频游戏所需的大量复杂计算。GPU有数百个专用“核心”（处理器的“大脑”）并行工作，而CPU只有几个强大的核心来按顺序处理计算任务。英伟达最新的处理器拥有3584个核心，而英特尔的服务器CPU最多只有28个。

英伟达上次濒临倒闭是在2008至2009年全球金融危机期间，不过它也是在那时时来运转。它发现自家芯片在对冲基金和研究机构那里有了新用途，例如用来计算复杂的投资和气候模型。英伟达开发了一种被称为CUDA的编程语言，帮助其客户就不同任务为处理器编程。当云计算、大数据和AI在几年前势头渐劲时，能够满足这些需求的正是英伟达芯片。

每个互联网巨头都在使用英伟达的GPU，以令它们的AI服务能够从医学图像和人类语音等各类材料中吸收大量数据。上一个财年，英伟达面向数据中心运营商的芯片销售额增长了两倍，达到2.96亿美元。

不过，GPU只是这些被称为“加速器”的专用处理器中的一种。为了提高运营效率并在竞争中保持领先，云计算公司会混用和搭配芯片，因此专用处理器的范围也在扩大。负责谷歌技术基础设施的乌尔斯·霍尔泽（Urs Hölzle）这样描述在灵活性、速度和成本因素之间取得平衡：“要为合适的工作找到合适的工具。”

专用处理器的一种极端形式是专用集成电路（ASIC）。顾名思义，这种电路为单一目的而搭建。相较于其他芯片，它们速度最快，能效也最高。数十个创业公司都正在开发这种已内置AI算法的芯片。谷歌已打造了一个叫作“张量处理单元”（TPU）的ASIC，用于语音识别。

另一个方向的极端是现场可编程门阵列（FPGA）。这种芯片可以编程，灵活性也就更大，因此尽管这种芯片不易驾驭，微软还是把它加入到许多服务器中，比如微软的在线搜索必应（Bing）的服务器里就有它们。微软的云计算平台Azure的首席技术官马克·拉希诺维奇（Mark Russinovich）说：“我们现在有世界上最多的FPGA。”

| 该提心吊胆了

近年来，英特尔没有制造ASICs或FPGA，而是致力于制造更为强劲的CPU。没有人认为传统处理器很快就要失去用武之地：每个服务器都需要这些处理器，无数的应用程序也都在其上运行。英特尔的芯片销量仍在增长。不过IT咨询公司高德纳（Gartner）的艾伦·普里斯特利（Alan Priestley）说，加速器正在加速的增长对英特尔来说似乎是个坏消息。加速器上进行的计算越多，留给CPU的就越少。

一种对策就是通过收购来赶上加速器的发展。2015年，英特尔以167亿美元的天价收购了FPGA制造商Altera；去年8月，它又以4亿多美元买下Nervana——这家创业公司刚成立三年，正在开发从软件到芯片的专用AI系统。英特尔自称视专用处理器为机遇而非威胁。主管英特尔数据中心业务的黛安·布莱恩特（Diane Bryant）解释说，新的计算工作负载往往先在专用处理器上进行，到头来还是会被“拉入CPU”。例如，加密计算以前在单独的半导体上进行，但现在只是英特尔CPU上的一个简单指令，全球几乎所有计算机和服务器的上都在运行。在加速器上运行AI等新型工作负载意味着成本增加、复杂性更高。

这样的整合一旦发生，英特尔已经进行了投资以占领先机。今年夏天，英特尔将开始销售代号为Knights Mill的新处理器，与英伟达一争高下。英特尔还在利用Nervana的技术开发另一款代号为Knights Crest的芯片。到某个时候，英特尔还会将其CPU与Altera的FPGA整合在一起。

可以预见，竞争对手对未来有着不同的看法。英伟达认为它已搭建了自己的计算平台。许多公司已经编写了AI应用程序在英伟达的芯片上运行，并且英伟达还为其他类型的程序创建了软件基础设施，用于实现可视化和虚拟现实等功能。几十岁高龄的计算巨头IBM也在试着抢英特尔的生意。IBM学习开源软件的做法，在2013年“开源”了其Power处理器的架构，把它变成了半导体业的一种共有资源。专用芯片制造商可以更轻松地将它们的产品与Power CPU整合，并且对平台如何发展有了发言权。

未来很大程度上将取决于AI的发展，市场研究公司IDC的马修·伊斯特伍

德（Matthew Eastwood）说。他认为如果AI最终没有带来许多人所期待的革命，而只是在几年内带来了变革，英特尔还是有机会的。但是，如果AI在未来十年或更长时间内继续影响芯片行业，其他种类的处理器将有更多的机会攻占市场。鉴于AI技术应用之广泛，第二种情况的可能性似乎可大。当然，运算任务无论多大多复杂一概由又大又笨的CPU处理的时代已经结束了。CPU的坠落就像童谣中的蛋头先生摔下墙头变成碎片那样，英特尔的兵马再怎么努力也无法将它复原了。■



Statistics

Nullius in verba

A crash course in understanding numbers

PEOPLE take in five times as much information each day as they did in the mid-1980s. With all these data sloshing around it is easy to feel lost. One politician uses a statistic to back up her argument; a newspaper uses another fact to refute it; an economist uses a third to prove them both wrong. In “A Field Guide to Lies and Statistics” Daniel Levitin, an American neuroscientist, shows the reader how to find a way through all this numerical confusion.

A book about statistics can easily be boring. Fortunately, Mr Levitin is the perfect guide. Before becoming an academic he used to work as a stand-up comedian. Drawing on those skills Mr Levitin peppers his book with wisecracks. He uses the phrase “on average, humans have one testicle” to make the point that the mean can be a misleading description of a population. He goes off on interesting tangents, granting the reader some light relief from detailed analysis of sampling and probabilities. Only occasionally is his hokey style annoying.

Using plenty of examples, Mr Levitin shows how easily statistics can lead people astray. Take the following assertion, which on a quick skim might seem perfectly reasonable: “In the 35 years since marijuana laws stopped being enforced in California, the number of marijuana smokers has doubled every year.” One will soon realise that this must be nonsense; even with only one smoker to begin with, after doubling every year for 35 years there would be more than 17bn of them. Mr Levitin repeatedly throws these statistical curveballs at his readers, training them to adopt a take-nobody’s-word-for-it attitude. It is an effective pedagogical technique.

Some statistics turn out to be plain wrong, but more commonly they mislead. Yet this is hard to spot: numbers appear objective and apolitical. A favourite of academics and journalists, when analysing trends, is to “rebase” their figures to 100 so as to back up the argument that they wish to make. For instance, starting a chart of American GDP growth in 2009, when the country was in recession, tricks the reader into thinking that over the long term the economy is stronger than it really is. “[K]eep in mind that experts can be biased without even realising it,” Mr Levitin reminds people.

A basic understanding of statistical theory helps the reader cope with the onslaught of information. Mr Levitin patiently explains the difference between a percentage change and a percentage-point change, a common source of confusion. When a journalist describes a statistical result as “significant”, this rarely carries the same meaning as when a statistician says it. The journalist may mean that the fact is interesting. The statistician usually means that there is a 95% probability that the result has not occurred by chance. (Whether it is interesting or not is another matter.)

Some readers may find Mr Levitin’s book worthy but naive. The problem with certain populist politicians is not that they mislabel an x-axis here or fail to specify a control group there. Rather they deliberately promulgate blatant lies which play to voters’ irrationalities and insecurities. Yet if everyone could adopt the level of healthy statistical scepticism that Mr Levitin would like, political debate would be in much better shape. This book is an indispensable trainer. ■



统计学

谁的话也别盲信

一堂教你理解数字的速成课

如今，人们每天吸收的信息量是上世纪80年代中期的五倍。置身于如此纷繁奔涌的数据之中，很容易就会茫然无措。一名政客用一个统计数字来支撑自己的论调，一家报纸随后用另一个事实驳斥了她，一位经济学家再用第三个证据证明这二人都错了。在《关于谎言与统计数字的实地指南》（A Field Guide to Lies and Statistics）一书中，美国神经科学家丹尼尔·列维京（Daniel Levitin）向读者展示了如何在这些数字迷阵中探寻出一条道路。

统计学方面的书很容易就让人觉得无趣，幸好有列维京这样的完美向导。在投身学术之前，他从事过脱口秀喜剧表演。有了这方面的技巧，他在书中处处都写下了妙趣横生的语句。比如，他用这样一句话来点明用平均值来描述一个群体会多么有误导性：“人类平均每人有一颗睾丸。”他时不时会突然离题讲些趣事，令读者跳脱出关于抽样和概率的详细分析而得到些许轻松。偶尔，他这种略嫌造作的风格也会让人腻烦。

列维京运用大量实例来证明统计数据轻易就能让人们偏离真相。例如，粗看之下，下面这个言之凿凿的说法似乎十分合理：“自从加州停止实施大麻管理法以来，35年间吸食大麻的人每年都翻一倍。”听者很快就会意识到，这一定是在胡说。就算吸大麻人的一开始只有一个，每年翻一番，35年后也会有超过170亿人吸食大麻。列维京屡屡出其不意地向读者抛出这类统计学难题，训练他们养成这样一种态度：任何人的话都不照单全收。这是一种行之有效的教学技巧。

有些统计数字到头来完全就是错的，不过它们误导人的情形要更为常见。然而，要辨认看似客观且无关政治的数字并不容易。在分析趋势的时候，学者和新闻记者们最喜欢做的一件事就是将所获数字的基数“重定”在100，好支撑自己想要说明的论点。举个例子，将美国GDP增长图表的起

始时间定在该国陷入衰退的2009年，读者就会被蒙蔽，得出长期而言经济强健的印象，而这一印象会好于真实情况。列维京提醒人们，“记住，专家也会有偏见，而且还毫不自知。”

对统计学理论有了基本的了解，读者就能更好地应对海量信息的冲击。人们常常都会混淆百分比变化与百分点变化，列维京耐心地解释了二者的区别。当一名新闻记者用“显著的”（significant）来描述一个统计结果时，表达的意思很少会和统计学家在使用这个词时所指的意思相同。记者想表达的也许是这个事实很有趣，而统计学家指的通常都是该结果有95%的概率不是随机发生。（至于有趣与否就是另外一码事了。）

有些读者也许会认为列维京的这本书虽值得一读，但未免天真。某些民粹主义政客的问题并不在于他们在这里误标了x轴、在那里没有明确列出控制组，而是故意散布赤裸裸的谎言，迎合选民的非理性和不安情绪。不过，如果每个人都能对统计数字采取列维京所推崇的那种明智的怀疑态度，政治辩论的状况定会大有改观。这本书是一位不可或缺的教练员。■



Oil prices

Full tank

Why is so much oil sitting in storage?

IT SOUNDS like a scene from “The Big Short”, a film about financial speculation. Light aircraft fly photographers close to America’s oil-storage facilities, using infra-red imaging and photographs to gauge the rise and fall of levels of crude in 2,100 storage tanks, in an attempt to work out whether oil futures are overvalued or not.

In fact, it is less mischievous than that. The intelligence-gatherers work for a company, Genscape, that sells the information to traders everywhere, giving them a few days’ jump before storage surveys are published by the government.

These data are particularly useful at a time when near-record levels of oil inventories in America are weighing on oil prices and frustrating attempts by OPEC, the producers’ cartel, to prop up the market. The high level of inventories is vital to an understanding of why crude prices suddenly plummeted this month, according to the International Energy Agency (IEA), a forecaster. West Texas Intermediate is back below \$50 a barrel, its level before OPEC in November agreed to cut output (see chart).

Three reasons explain why the tanks are so full. Firstly, OPEC’s agreement with non-members such as Russia to cut production from January 1st set off a flurry of hedge-fund buying, pushing oil prices higher. American shale producers were quick to take advantage of higher prices by pumping more oil. The number of American oil rigs has risen to 617 from 386 a year ago, producing 400,000 barrels a day more than at the lows in September. Much of that has gone to storage terminals like Cushing, Oklahoma.

Second, OPEC has been hoisted by its own petard. In the months before it started cutting output, it sharply raised production and exports. After weeks of trans-Atlantic travel, this oil is showing up in higher American imports, put into storage when refineries were idled for maintenance.

The third factor is the shape of the curve of futures prices, which is closely related to the level of inventories. When OPEC orchestrated the January cut, it hoped to rebalance supply and demand by mid-year, and push the futures market into “backwardation”, meaning prices in the long term were at a discount to short-term prices. Backwardation reflects the market’s willingness to buy oil and use it rather than storing it. The strategy worked for a while.

But since the release of bearish American inventory data on March 8th, the market slipped back into “contango”, the name for the discount at which near-term prices trade to longer-term ones. Contango makes it more worthwhile to buy oil and store it. Hillary Stevenson of Genscape notes that the storage costs in tanks in Cushing are about 41 cents per barrel of oil per month, compared with a one-month contango of about 65 cents.

Contango can be a self-fulfilling prophecy, because the more oil is stored, the lower short-term prices go. So OPEC’s challenge is to try and break the loop, possibly by promising to extend its output cuts beyond June. But in that case, the shale drillers are likely to add yet more wells. And so the merry-go-round will continue. ■



油价

油罐满满

为何油罐里存储了这么多石油？

这听起来就像关于金融投机的电影《大空头》（The Big Short）中的场景。摄影师乘坐轻型飞机靠近美国的储油设施，利用红外成像和照片来测量2100个储罐中原油储量的升降变化，试图以此算出石油期货是否被高估。

实际的情形并不像电影里那样离谱。这些收集情报的人服务于Genscape公司，该公司把信息卖给各地的交易者，让他们在政府发布原油库存调查报告之前能有几天时间快速调整。

眼下这些数据尤其有用。美国原油库存接近纪录水平，以致油价受到打压，石油生产商的卡特尔欧佩克提振市场的努力受挫。预测机构国际能源署（IEA）认为，要了解原油价格本月突然暴跌的原因，高库存水平至关重要。WTI原油价格回落至每桶50美元以下，即去年11月欧佩克同意减产之前的水平（见图表）。

三个原因解释了为何油罐如此充盈。首先，欧佩克与俄罗斯等非成员国达成协议，从1月1日起减产，引发了一系列对冲基金购入，推高了油价。美国页岩油生产商抓住油价上涨的机会，迅速开采出更多的石油。美国石油钻机的数量从一年前的386台增加到现在的617台，石油日产量比去年9月的低点多出40万桶。其中大部分石油已经运到俄克拉荷马州的库欣（Cushing）等存储仓库。

第二，欧佩克搬起石头砸了自己的脚。在开始减产之前的几个月里，它大幅度提高了产量和出口。这些石油历经数周时间横跨大西洋，成为美国新增进口的一部分，在炼油厂因维修而停产时被储存入库。

第三个因素是期货价格曲线的走势，这与库存水平密切相关。欧佩克在谋

划1月的减产时，它希望到年中供求将重归平衡，并推动期货市场进入“贴水”状态，即远期价格低于近期价格。期货贴水反映了市场有意购买并使用而不是储存石油。这个策略在一段时间里发挥了作用。

但自从3月8日美国库存的利空数据发布以来，市场重新陷入“期货升水”，即近期价格低于远期价格。期货升水使购买和存储石油更为划算。

Genscape的希拉里·史蒂文森（Hillary Stevenson）指出，库欣油罐的存储成本每月每桶约41为美分，而1个月的原油期货升水大概65美分。

期货升水可以是一个自证预言，因为石油储存越多，近期价格就越低。因此，欧佩克面临的挑战是试图打破循环，可能的途径是承诺把减产延长至6月之后。但在这种情况下，页岩油开采商可能会增开更多油井。因此，这种循环将继续下去。 ■



Microsoft

Head in the cloud

The world's biggest software firm has overhauled its culture. But getting cloud computing right is hard

A DECADE ago, visiting Microsoft's headquarters near Seattle was like a trip into enemy territory. Executives would not so much talk with visitors as fire words at them (one of this newspaper's correspondents has yet to recover from two harrowing days spent in the company of a Microsoft "brand evangelist"). If challenged on the corporate message, their body language would betray what they were thinking and what Bill Gates, the firm's founder, used often to say: "That's the stupidest fucking thing I've ever heard."

Today the mood at Microsoft's campus, a sprawling collection of more than 100 buildings, is strikingly different. The word-count per minute is much lower. Questions, however ignorant or critical, are answered patiently. The firm's boss, Satya Nadella (pictured), strikes a different and gentler tone from Mr Gates and Steve Ballmer, his immediate predecessor (although he, too, has a highly competitive side).

Both these descriptions are caricatures. But they point to an underlying truth: how radically the world's biggest software firm has changed in the short time since Mr Nadella took charge in early 2014. Back then everything at Microsoft revolved around Windows, the operating system that powered most computers. It was a franchise the company believed needed to be extended and defended at almost any price.

Windows has since retreated into a supporting role; sometimes it is little more than a loss-leader to push other products. At the heart of the new Microsoft is Azure, a global computing cloud. It is formed of more than 100

data centres around the world, dishing up web-based applications, bringing mobile devices to life and crunching data for artificial-intelligence (AI) services. Along with this shift in strategy has come a less abrasive, more open culture.

Microsoft's transformation is far from complete. Windows, Office—the once equally dominant package of applications for personal computers—and other PC-related products together still generate about two-fifths of its revenues and three-quarters of its profits. But even those who have watched Mr Nadella's actions with a high degree of scepticism reckon the firm is moving on from its cash-cows.

The firm's transformation did not begin with Mr Nadella. It launched Azure and started to rewrite its software for the cloud under Mr Ballmer. But Mr Nadella has given Microsoft a new *Gestalt*, or personality, that investors appear to like. The firm's share price has nearly doubled since he took over (see chart).

Dethroning Windows was the first task. Previously, new products were held back or shorn of certain features if these were thought to hurt the program (something known internally as the “strategy tax”). One of Mr Nadella's early decisions was to allow Office to run on mobile devices that use competing operating systems. He went so far as to use a slide that read “Microsoft loves Linux”. Mr Ballmer had called the open-source operating system a “cancer”.

The downgrading of Windows made it easier for Mr Nadella to change the firm's culture—which is so important, he believes (along with Peter Drucker), that it “eats strategy for breakfast”. Technologies come and go, he says, so “we need a culture that allows you to constantly renew yourself”. Whereas Mr Ballmer was known for running across the stage and yelling “I love this company”, Mr Nadella can often be seen sitting in the audience,

listening. When, in 2016, internet trolls manipulated Tay, one of Microsoft's AI-powered online bots, into spewing racist comments, people waited for heads to roll. Mr Nadella sent around an e-mail saying "Keep pushing, and know that I am with you...(the) key is to keep learning and improving."

Employees are no longer assessed on a curve, with those ending up at the lower end often getting no bonus or promotion. For the firm's annual executive retreat in 2015, Mr Nadella included the heads of companies Microsoft had recently acquired, such as Mojang, the maker of Minecraft, a video game, and Acomplia, an e-mail app, breaking with the tradition that only longtime executives can attend.

| *The book of Nadella*

Sending such signals matters more than ever in the tech industry. Well-regarded firms find it easier to recruit top-notch talent, which is highly mobile and has its pick of employers. A reputation for aggression can attract the attention of regulators and lead to a public backlash, as Microsoft itself knows from experience and Uber, a ride-hailing unicorn, is finding out.

Mr Nadella has changed the firm's organisation as well as its culture. It is now more of a vertically integrated technology firm—"full stack", in the jargon. It not only writes all kinds of software, but builds its own data centres and designs its own hardware. Mr Nadella points out that it now even develops some of the chips for its data centres.

His imprint can be seen on three businesses in particular: the cloud, hardware and AI. Microsoft does not break out by how much it has increased investment in the cloud, but building data centres is expensive and its capital expenditure is soon expected nearly to double, to \$9bn a year, from when Mr Nadella took over. If you take only basic services, such as data storage and computing, Microsoft's cloud is much smaller than

Amazon Web Services, the leader in cloud computing, which is owned by Amazon, an e-commerce giant. But if you add Microsoft's web-based services, such as Office 365 and other business applications, which are only a negligible part of AWS's portfolio, the two firms are of comparable size. Both AWS's and Microsoft's cloud businesses boast an annual run rate (the latest quarterly revenues multiplied by four) of \$14bn. Microsoft hopes to reach \$20bn by its 2018 financial year, a fifth of total expected revenues.

In terms of scale, then, there has been much progress. Yet in stark contrast to AWS, which supplies the bulk of Amazon's profits, Azure is still loss-making. Some analysts are optimistic that this could change. Mark Moerdler of Sanford C. Bernstein, a research firm, thinks that once Microsoft tapers its investments in data centres and their utilisation goes up, it could approach the margins enjoyed by AWS, which reached more than 30% in the last quarter.

Scott Guthrie, who heads Azure, admits that the margins for cloud-based services will probably be lower than for conventional software. But when applications are delivered online, he points out, Microsoft can capture a bigger slice of the overall pie. As well as offering its existing software as services in the cloud, it also takes care of components of IT systems, such as storage and networking, that used to be provided by other vendors. The firm's addressable market is far bigger, he says.

Perhaps. But however well Microsoft performs, life in the cloud will always be far tougher than it was in the realm of personal computers, argues David Mitchell Smith of Gartner, a consultancy. Microsoft will not only have to compete with Amazon, but with Google, which intends to go after business customers.

Although the cloud is the core of the new Microsoft, hardware is another important bet. The firm has shed its ailing mobile-phone division, which it

had bought from Nokia, but on its campus in Redmond hundreds of employees are busy developing new devices. Its prototyping lab offers all that a designer of mobile gadgets could want, such as 3D printers to churn out overnight new models of a hinge, for example, or machines to cut the housing of a new laptop from a block of aluminium.

“Failing faster” is the purpose of the new equipment, says Panos Panay, who is in charge of Microsoft’s hardware business. Designers can test ideas more quickly in pursuit of the firm’s goal to develop new categories of product. Hardware, software and online services are meant to be bundled into a single product to create what the firm gratingly calls an “experience”.

One example is the Surface Book, a high-end laptop. It features a detachable screen which doubles as a computing tablet—a combination that has already found a following, and according to some, offers better value than comparable laptops from Apple. More daring still is HoloLens, an augmented-reality device in the form of a wireless head-mounted display. It is capable of mixing “real” and virtual reality for business purposes—for example, by projecting new parts on a motorcycle frame so a designer can easily see what works. (It is currently only available for developers.)

HoloLens, its designers hope, will also be a device where people use artificial-intelligence services—Mr Nadella’s third big bet. In September Microsoft formed a new AI unit, combining all its efforts in the field, including its basic-research group of more than 1,000 people and the engineering team behind Bing, its search engine.

Every single business application is going to be disrupted by AI, says Harry Shum, who is in charge of the new unit. Algorithms trained by reams of data could tell sales staff which leads to spend most time on, and help identify risky deals where, for instance, the customer might not fulfil contract terms. This, he explains, is also a big reason why Microsoft spent a

whopping \$26bn to buy LinkedIn, a professional social network that has 467m users. The deal adds to the data the firm needs to train its new AI applications.

AI is a growing part of Azure, too. In recent months Microsoft has introduced two dozen “cognitive services” to Azure. Some understand language and can identify individual speakers, others recognise faces and can tap into academic knowledge. The idea is for other firms to be able to use these offerings to make their own products smarter, thus “democratising AI”. Schneider Electric, which makes gear to manage energy systems, for instance, uses some of Microsoft’s AI services to monitor its equipment.

It is easy to be impressed by what Mr Nadella has achieved in only three years. But it is far from certain that his technology bets will play out as planned. To run a computing cloud profitably you need hyper-efficient operations; something that Amazon, in contrast to Microsoft, has grown up with. Although Microsoft has expertise in AI, others, such as Google and IBM, got a far earlier start. Nor is designing integrated devices part of Microsoft’s DNA in the way it is for Apple. Augmented reality is an extremely promising field but HoloLens may turn out to be no more than an expensive toy for developers.

Success or failure in the new areas will of course continue to be cushioned for some time by the revenues and profits from Windows and Office. Yet there, too, lie risks. If the PC market, whose secular decline has slowed since last year, take another turn for the worse, the company’s finances would suffer badly, warns John DiFucci of Jefferies, an investment bank.

Mr Nadella doesn’t seem to be worried by such unknowns, which are to be expected in a fast-changing industry. Instead, he frets about too much success. “When you have a core that’s growing at more than 20%, that is

when the rot really sets in,” he says. It remains to be seen whether or not the firm can ever again achieve such velocity. For now, though, its share price is showing plenty of speed. ■



微软

云里雾里

世界上最大的软件公司已经彻底变革了企业文化，但要做好云计算并不容易

十年前，拜访微软位于西雅图附近的总部仿佛深入敌境。该公司的高管在接待访客时不是在交流，而更像是训话（本刊一名记者曾与微软一位“品牌传教士”相处两日而备受折磨，至今尚未恢复）。如果公司的主张受到挑战，这些高管们的肢体语言会立刻泄露他们心中所想，以及公司创始人比尔·盖茨过去常说的：“这他妈是我听过的最蠢的话。”

如今，建筑物过百的庞大微软园区里气氛已迥然不同。高管的语速慢了许多，无论多无知或多有批评性的问题他们都能耐心回答。公司老板萨蒂亚·纳德拉（Satya Nadella，如图）谈吐温和，与盖茨或上一任的史蒂夫·鲍尔默（Steve Ballmer）口气完全不同（虽然他也有争强好胜的一面）。

以上两种描述用了漫画手法，略有夸张，但都指出了一个基本事实：2014年初纳德拉接任以来，微软这个世界最大的软件公司发生了巨大的变化。那时微软的一切都围绕着安装在大多数计算机上的操作系统Windows进行。公司认为需要不惜一切代价来扩大和保护这一产品。

而Windows在2014年后已经退居配角，有时仅仅是用来推销其他产品的促销品。新微软的核心是全球性的计算云Azure，由遍布全球的100多个数据中心组成。Azure创造出基于网络的应用程序，让移动设备焕发生机，并为人工智能（AI）服务处理数据。随着微软战略的转变，其文化也变得更加开放，不再那么生硬。

然而微软的转型远未完成。Windows以及同样曾占主导地位的个人电脑应用程序套装Office，还有其他个人电脑相关产品仍共同贡献了微软约五分之一的收入和四分之三的利润。但即便是那些一直对纳德拉的举措持高度怀疑态度的人也认为，微软正在另立发展目标，以摆脱对这些现金牛的依赖。

微软的转型并不是从纳德拉开始的。公司在鲍尔默执掌时便发布了 Azure，并开始为了云计算而重写其软件。但纳德拉赋予了微软一个新的“格式塔（Gestalt）”——或曰个性，看起来很受投资者欢迎。公司的股价自纳德拉上任以来几乎翻了一番（见图表）。

让 Windows 走下王座是第一项任务。以前，如果认为新产品有损 Windows，公司就会将它束之高阁或者削减某些功能（内部称之为“战略税”）。纳德拉上任之初所做的决定之一就是允许 Office 在使用竞争操作系统的移动设备上运行，他甚至还用过一张写着“微软爱 Linux”的幻灯片。而在此之前，鲍尔默曾将开源操作系统称为“毒瘤”。

降级 Windows 让纳德拉更容易改变公司的文化。他（和彼得·德鲁克一样）认为文化非常重要，在文化面前，战略就是“小巫见大巫”。他说技术变化迅速，所以“我们需要一种能让我们不断重塑自我的文化”。人们对鲍尔默的印象是他会跑过讲台，大喊“我爱这家公司”，而纳德拉通常都是坐在观众席中静静聆听。2016年，微软的人工智能在线机器人之一 Tay 被网络喷子“教坏”，竟大放种族主义厥词。大家都以为有人会因此而饭碗不保，纳德拉却发了一封电子邮件说，“继续努力，要明白我是支持你们的……关键是要不断学习和改进。”

微软也不再用曲线评估员工。在以前，评分在曲线低端的人往往没有奖金或得不到晋升。在公司2015年的年度高管务虚会上，纳德拉打破了只有资深高管才可以参加的传统，邀请了微软近期所收购公司的负责人，如视频游戏《我的世界》（Minecraft）的开发商 Mojang 和电子邮件应用 Acompli。

| 纳德拉的下注账本

在技术行业，释放这样的信号比以往任何时候都重要。受人尊敬的公司更容易招聘顶尖人才，这些人才流动性高，且有资本挑老板。一个公司太过咄咄逼人的名声传播出去会招致监管机构的注意，还会遭到公众抵制。微软在这方面经验不少，网约车独角兽公司优步也正深有体会。

纳德拉不仅改变了公司的文化，还改变了组织架构。微软现在更像是一个垂直整合的科技公司，行话叫做“全栈”。它不仅编写各种软件，还打造自己的数据中心、设计自己的硬件。纳德拉指出，微软现在甚至还为自己的数据中心开发部分芯片。

在三个业务领域尤其可以看到纳德拉的印记：云计算、硬件和人工智能。微软并没有公布它在云计算方面增加了多少投资，但是建设数据中心成本很高，公司资本支出预计很快将比纳德拉接任时的水平翻近一番，达到每年90亿美元。如果只看如数据存储和计算这样的基本服务，微软的云计算业务远远小于电子商务巨头亚马逊旗下的领先云计算平台Amazon Web Services（AWS）。但如果加上微软基于网络的服务，例如Office 365及其他商业应用程序（这类应用程序在AWS的产品组合中占比微不足道），那么二者云计算业务的规模旗鼓相当。AWS和微软的云计算业务的年化营收（最近一季度的收入乘以四）均为140亿美元，微软希望这一收入在2018财年能达到200亿美元，占预期总收入的五分之一。

这样说来，微软在规模上已取得长足进步。然而与为亚马逊贡献大部分利润的AWS形成鲜明对比的是，Azure仍在亏损。一些分析人士乐观地认为这可能会有所改变。研究公司盛博（Sanford C. Bernstein）的马克·莫德勒（Mark Moerdler）认为，等微软逐渐减少了对数据中心的投资、数据中心利用率提高之后，就有可能实现AWS的利润率水平（上个季度超过30%）。

Azure的负责人斯科特·格思里（Scott Guthrie）承认，云服务的利润率可能会低于传统软件。但他指出，在各种应用程序于云端发布后，微软在整个市场上能够分得更大一杯羹。除了提供现有软件作为云服务外，微软还提供存储和联网等IT系统组件，而这些以往都是由其他供应商提供的。格思里说微软的潜在市场要比现在大得多。

也许如此。但咨询公司高德纳（Gartner）的大卫·米歇尔·史密斯（David Mitchell Smith）认为，无论微软的表现有多好，它在云端的日子始终都会比在个人电脑领域难过得多。微软的竞争对手不仅仅是亚马逊，

还有意在争夺商业客户的谷歌。

虽然云服务是新微软的核心，硬件也是该公司另一个重要的赌注。先前从诺基亚手中购买的手机部门经营惨淡，已遭微软抛弃。不过在其雷德蒙德（Redmond）的园区里，数百名员工正忙于研发新设备。微软原型实验室提供了移动设备设计师想要的一切东西，例如一晚上就可以打印出多种新型号转轴的3D打印机，或是能从一整块铝上切割出新款笔记本电脑外壳的机器。

负责微软硬件业务的帕诺思·佩内（Panos Panay）说提供这些设备是为了“加快失败的脚步”。公司志在研发新的产品种类，为这一目标而努力的设计师们可以更快地测试创意。硬件、软件和在线服务被打包成为单一产品，以创造出微软总挂在嘴边的那种“体验”。

高端笔记本电脑Surface Book就是个例子，它的屏幕可拆分，能兼作平板电脑。这种组合已经为人所效仿，有些人认为Surface Book的性价比要比苹果同类笔记本电脑更高。更为大胆的尝试是全息眼镜HoloLens。这是一款无线头戴显示器形式的增强现实设备。它能够混合“现实”和虚拟现实来实现商业目的，比如将新部件投影在摩托车车架上，这样设计师就可以很容易地看到哪个部件合适。（目前仅供开发人员使用。）

HoloLens的设计师也希望人们能借助它来使用人工智能服务，而人工智能正是纳德拉的第三大赌注。去年9月，微软组建了一个新的AI部门，整合了微软在该领域的所有资源，包括超过1000人的基础研究团队和搜索引擎必应的工程团队。

负责新部门的沈向洋说，每一个商业应用程序都将被AI颠覆。由大量数据训练出来的算法可以告诉销售人员应该在哪些商机上花费主要精力，并帮助他们识别高风险交易，例如客户可能不会履约。沈向洋解释道，这也是微软斥资260亿美元收购拥有4.67亿用户的专业社交网络LinkedIn的重要原因，这笔交易增加了微软培训新AI应用程序所需的数据。

AI也是Azure中越来越重要的一部分。近几个月来，微软已在Azure中推出

了20多项“认知服务”。有些服务理解语言，可以识别不同的说话者，另外一些则能识别面孔，也可以利用学术知识。这样做是为了让其他公司能够利用这些服务让自己的产品更智能化，从而“使AI大众化”。例如，生产能源系统管理设备的施耐德电气（Schneider Electric）就利用一些微软的AI服务来监控其设备。

纳德拉经过仅仅三年就取得如此成就，这很容易让人感到钦佩，但还远不能确定他的技术赌注是否能按计划发展。要运行有利可图的计算云需要超高效的运营，而这是亚马逊从发展之初就一直拥有的，而微软则不然。虽然微软在AI方面很专业，但谷歌和IBM等其他公司起步更早。不像苹果，微软骨子里也没有设计集成设备的DNA。增强现实是一个非常有前途的领域，但HoloLens有可能最终只沦为开发者的一个昂贵玩具。

当然，无论在新领域里是成功还是失败，Windows和Office的收入及利润都可以提供一段时间的缓冲。然而这其中也有风险。投资银行杰富瑞（Jefferies）的约翰·迪福西（John DiFucci）警告说，虽然PC市场的长期衰退自去年以来已经放缓，但如果再次出现恶化，微软的财务状况将受到重挫。

纳德拉似乎并不因为这些未知数而担忧，不确定性在快速变化的行业中也是预料之中的。相反，他对成功太多倒是颇感不安。他说：“当你的核心业务增长速度超过20%，那便是麻烦真正开始的时候。”微软是否能够再次实现这样的发展速度尚待分晓。不过，至少现在，它的股价上涨很快。





Corporate ambitions

Amazon's empire

The world's most remarkable firm may eventually be threatened by its own success

AMAZON is an extraordinary company. The former bookseller accounts for more than half of every new dollar spent online in America. It is the world's leading provider of cloud computing. This year Amazon will probably spend twice as much on television as HBO, a cable channel. Its own-brand physical products include batteries, almonds, suits and speakers linked to a virtual voice-activated assistant that can control, among other things, your lamps and sprinkler.

Yet Amazon's shareholders are working on the premise that it is just getting started. Since the beginning of 2015 its share price has jumped by 173%, seven times quicker than in the two previous years (and 12 times faster than the S&P 500 index). With a market capitalisation of some \$400bn, it is the fifth-most-valuable firm in the world. Never before has a company been worth so much for so long while making so little money: 92% of its value is due to profits expected after 2020.

That is because investors anticipate both an extraordinary rise in revenue, from sales of \$136bn last year to half a trillion over the next decade, and a jump in profits. The hopes invested in it imply that it will probably become more profitable than any other firm in America. Ground for scepticism does not come much more fertile than this: Amazon will have to grow faster than almost any big company in modern history to justify its valuation. Can it possibly do so?

It is easy to tick off some of the pitfalls. Rivals will not stand still. Microsoft has cloud-computing ambitions; Walmart already has revenues nudging \$500bn and is beefing up online. If anything happened to Jeff Bezos,

Amazon's founder and boss, the gap would be exceptionally hard to fill. But the striking thing about the company is how much of a chance it has of achieving such unprecedented goals.

| *A new sort of basket-case*

This is largely due to the firm's unusual approach to two dimensions of corporate life. The first of these is time. In an era when executives routinely whinge about pressure to produce short-term results, Amazon is resolutely focused on the distant horizon. Mr Bezos emphasises continual investment to propel its two principal businesses, e-commerce and Amazon Web Services (AWS), its cloud-computing arm.

In e-commerce, the more shoppers Amazon lures, the more retailers and manufacturers want to sell their goods on Amazon. That gives Amazon more cash for new services—such as two-hour shipping and streaming video and music—which entice more shoppers. Similarly, the more customers use AWS, the more Amazon can invest in new services, which attract more customers. A third virtuous circle is starting to whirl around Alexa, the firm's voice-activated assistant: as developers build services for Alexa, it becomes more useful to consumers, giving developers reason to create yet more services.

So long as shareholders retain their faith in this model, Amazon's heady valuation resembles a self-fulfilling prophecy. The company will be able to keep spending, and its spending will keep making it more powerful. Their faith is sustained by Amazon's record. It has had its failures—its attempt to make a smartphone was a debacle. But the business is starting to crank out cash. Last year cashflow (before investment) was \$16bn, more than quadruple the level five years ago.

If Amazon's approach to time-frames is unusual, so too is the sheer breadth of its activities. The company's list of current and possible competitors, as

described in its annual filings, includes logistics firms, search engines, social networks, food manufacturers and producers of “physical, digital and interactive media of all types”. A wingspan this large is more reminiscent of a conglomerate than a retailer, which makes Amazon’s share price seem even more bloated: stockmarkets typically apply a “conglomerate discount” to reflect their inefficiencies.

Many of these services support Amazon’s own expansion and that of other companies. The obvious example is AWS, which powers Amazon’s operations as well as those of other firms. But Amazon also rents warehouse space to other sellers. It is building a \$1.5bn air-freight hub in Kentucky. It is testing technology in stores to let consumers skip the cash register altogether, and experimenting with drone deliveries to the home. Such tools could presumably serve other customers, too. Some think that Amazon could become a new kind of utility: one that provides the infrastructure of commerce, from computing power to payments to logistics.

| *A giant cannot hide*

And here lies the real problem with the expectations surrounding Amazon. If it gets anywhere close to fulfilling them, it will attract the attention of regulators. For now, Amazon is unlikely to trigger antitrust action. It is not yet the biggest retailer in America, its most mature market. America’s antitrust enforcers look mainly at a firm’s effect on consumers and pricing. Seen through this lens, Amazon appears pristine. Consumers applaud it; it is the most well-regarded company in America, according to a Harris poll. (AWS is a boon to startups, too.)

But as it grows, so will concerns about its power. Even on standard antitrust grounds, that may pose a problem: if it makes as much money as investors hope, a rough calculation suggests its earnings could be worth the equivalent of 25% of the combined profits of listed Western retail and

media firms. But regulators are also changing the way they think about technology. In Europe, Google stands accused of using its clout as a search engine to extend its power to adjacent businesses. The comparative immunity from legal liability of digital platforms—for the posting of inflammatory content on Facebook, say, or the vetting of drivers on Uber—is being chipped away.

Amazon's business model will also encourage regulators to think differently. Investors value Amazon's growth over profits; that makes predatory pricing more tempting. In future, firms could increasingly depend on tools provided by their biggest rival. If Amazon does become a utility for commerce, the calls will grow for it to be regulated as one. Shareholders are right to believe in Amazon's potential. But success will bring it into conflict with an even stronger beast: government. ■



企业雄心

亚马逊帝国

世界上最卓越的公司最终也许会被自己的成功威胁

亚马逊是一家不同寻常的公司。美国在线消费每增加一美元，就有一多半给了这家曾经的图书销售公司。它是世界领先的云计算供应商。今年亚马逊在电视上的花费可能会是有线电视频道HBO的两倍。公司自有品牌的实体产品包括电池、杏仁、西装以及音箱。这种音箱与虚拟语音助手相连接，可以控制你的台灯、洒水器等装置。

不过亚马逊的股东们对其估值的假设是这家公司才刚刚起步。自2015年初至今，它的股票价格已经上涨了173%，比之前两年快了7倍（比标准普尔500指数快了12倍）。它的市值约4000亿美元，位列全球第五。以前从来没有哪家公司能维持这么高的市值这么久却只赚很少的钱：它的市值有92%来自于2020年以后的预期盈利。

这是因为投资人既盼望其收入猛增，销售额能从去年的1360亿美元涨至十年后的5000亿美元，也期待着利润飙升。寄托在它身上的希望暗示着亚马逊可能会变得比美国任何一家公司都更赚钱。对这些期盼的怀疑最有力的依据是：为了证明它的市值合理，亚马逊的增长将必须快过现代历史上几乎所有的大公司。它能做到吗？

要列出几个隐患来非常容易。对手不会坐以待毙。微软在云计算上野心勃勃；沃尔玛的营收已经逼近5000亿美元，并且正在加强在线业务。如果亚马逊的创始人和老板杰夫·贝索斯（Jeff Bezos）遇到什么不测，要填补这一空缺将格外困难。然而这家公司引人注目的一点就是它有多大可能达成这些前所未有的目标。

| 新型的“包罗万象”

这主要是因为该公司对企业生命的两大方面有着非同寻常的态度。其一是时间。在这个时代，高管们一贯都会抱怨要创造短期业绩的压力太大，而

亚马逊却毅然着眼于长远的未来。贝索斯重视持续投资以推动其两大主要业务——电子商务和它的云计算部门Amazon Web Services（AWS）。

在电子商务方面，亚马逊吸引的顾客越多，就会有越多的零售商和制造商想在亚马逊上销售它们的产品。这给了亚马逊更多的现金去提供新服务，例如两小时送达以及流媒体视频和音乐，而这又吸引了更多顾客。与此类似，越多客户使用AWS，亚马逊就能在新服务上投入越多，进而吸引更多客户。第三个良性循环则是围绕该公司的语音助手Alexa展开：有了开发者为Alexa设计服务，它对消费者来说就越来越有用，开发者继而就有理由去创造更多的服务。

只要股东们对这一模式保持信心，亚马逊令人兴奋的估值就会像一个自我应验的预言。公司将可以一直花钱，而它的支出也会不断让它变得更强大。支撑股东信心的是亚马逊的业绩。它曾经失败过，制造智能手机的尝试便是个灾难。但是公司正开始大量产生现金。去年的现金流（投资前）为160亿美元，比五年前的四倍还多。

如果说亚马逊对投资时间期限的态度非同寻常，那么它对公司经营的广度也是如此。如其年报所述，公司目前以及未来可能的竞争对手包括物流公司、搜索引擎、社交网络、食品制造商和“各种各样的实体、数字和交互式媒体”的制作商。如此之广的跨度更像是一个企业集团而不是一个零售商，这愈加让亚马逊的股价看起来虚高：股市通常会对股价打一个“企业集团折扣”来反映它们的低效。

这些服务中的很多都有助于亚马逊自身和其他公司的扩张。一个明显的例子是AWS，它既为亚马逊也为其他公司的运营提供动力。不过亚马逊还向其他卖家出租仓库。它正在肯塔基州建造一个价值15亿美元的空运中心。它正在门店测试新技术，让消费者完全跳过到收银台结账的环节，它还在尝试用无人机送货到家。这些工具也很可能会服务于其他客户。有些人认为亚马逊也许会成为一种新型的公用事业，提供从云计算能力、支付到物流的商务基础设施。

| 巨人无处躲藏

对于围绕着亚马逊的期望而言，真正的问题如下。一旦真的接近这些目标，它就会招来监管部门的注意。目前来看它还不大可能会触发反垄断行动。在其最成熟的市场美国，亚马逊还不是最大的零售商。美国的反垄断执法机构考量的主要是一家公司对消费者的影响力及其定价。从这一角度来看，亚马逊还很质朴。消费者为它拍手叫好；Harris的一项调查显示，它是美国声誉最好的公司（AWS对于创业公司来说也是一大福音）。

但随着亚马逊的发展，对它影响力的担忧也在增长。即便是从通常的反垄断角度来看，这也会是一个问题：如果它像投资人所希望的那样赚得盆满钵满，粗略算下来，它的盈利将相当于西方所有上市零售公司和媒体公司总盈利的25%。但监管机构同时还在改变它们对科技的看法。在欧洲，谷歌遭到指控，有人认为它利用自己作为搜索引擎的影响力来扩展其他业务。数字平台原本相对而言享有更多的法律责任豁免——比如在Facebook上发布煽动性内容或是审核优步司机这类事件上，但这种特权如今也在逐渐削弱。

亚马逊的商业模式也会促使监管机构转换思路。投资者看重亚马逊的增长更甚于盈利，这让掠夺性定价愈发具有诱惑力。在未来，企业可能会越来越依赖其最大竞争对手所提供的工具。如果亚马逊真的成为一个商务公用事业，将其作为这样一种事物来进行监管的呼声就会加强。股东相信亚马逊的潜力，这一点没错。但成功会把它推向与另一头更强大的猛兽对抗：政府。■



Mass entertainment

Winner takes all

Technology has given billions of people access to a vast range of entertainment. Gady Epstein explains why they still go mostly for the big hits

ONE OF THE axioms of technological progress is that it democratises entertainment, distributing delights to the masses that were once reserved for the elites. More high-quality entertainment is available to more people on the planet than ever before. At the same time individuals across the globe can find an audience much more easily than was previously possible. The ability to access whatever entertainment people want digitally and on demand has transformed diversions in societies both rich and poor, changing the lives of billions.

Even more remarkably, mass entertainment today can be tailor-made, not one-size-fits-all. There is something for everyone and at any time that suits. At the beginning of the day in New York the dreary subway ride to work is filled with music. In Tokyo the journey home from the office is a time to devour manga on a mobile phone. In the evening in a rustbelt city outside Beijing, workers who cannot afford a night out may tune into broadcasts live-streamed by their fellow citizens. Billions of people can choose from a large range of mobile games at any time.

In his book “The Long Tail”, published in 2006, Chris Anderson, a technology writer who used to work for this newspaper, observed that the internet has opened up potential markets for any niche product, no matter how quirky. A decade on, any star on YouTube can attest to that. From a child unboxing toys to the delight of toddlers around the world to a puckish Swedish gamer with millions of teenage fans, running one’s own virtual TV channel online can be worth tens of millions of dollars to a lucky few.

And yet as a business, entertainment has in some ways become less democratic, not more. Technology is making the rich richer, skewing people's consumption of entertainment towards the biggest hits and the most powerful platforms. This world is dominated by an oligarchy of giants, including Facebook, Google, Amazon, Netflix and Disney (as well as Alibaba and Tencent within China's walled ecosystem). Those lacking sufficient scale barely get noticed. Paradoxically, enabling every individual and product on the planet to find a market has made it next to impossible for the market to find them. Consumers generally favour whatever they find on their mobile screens or at the top of their search results. The tail is indeed long, but it is very skinny.

Being able to produce a blockbuster hit has become even more valuable than it used to be. It turns out that everyone wants hits—the more familiar the better, says Derek Thompson, author of a book entitled “Hit Makers”. Despite the availability of entertainment specially tailored for each individual, people still crave experiences they can share with others. What they want most is what everyone else wants.

The same technological tools that have atomised entertainment have also made it easier to aggregate audiences. Rankings of the most popular downloads or streams are self-reinforcing. Recommendation algorithms steer people to what others like them have also watched or listened to. The social-media impact of the biggest hit in any genre is dramatically greater than that of any lesser hit, thanks to network effects. It seems clear now that the future of mass entertainment is not “selling less of more”, as Mr Anderson put it, but selling a lot more of less.

The film business illustrates the point. Of the thousands of films released worldwide in 2016 (including well over 700 in America alone), the top five performers at the box office were all made by Disney. The 13 films the company released last year, plus remaining business from “Star Wars: The

Force Awakens”, accounted for one-fifth of total film revenue worldwide. Disney has focused on big-event films with iconic characters and storylines that have global appeal (and that fuel its unparalleled businesses in consumer-product licensing and theme parks). Only a few years ago the big studios would typically aim for 20-25 films apiece to provide a margin for error. Some still do, but Disney’s more focused approach, investing almost exclusively in blockbusters, is paying off with a much higher rate of return.

When Bob Iger took over as CEO in 2005, he felt sure that, in an era of proliferating content, big brands would become more valuable—the bigger the better. The company went on to spend \$15.5bn to amass an arsenal of content brands that became the envy of the media world: Pixar Animation Studios, Marvel Entertainment and, in 2012, Lucasfilm, maker of “Star Wars”. “We saw in each one of those a brand that would matter in a new world order,” says Mr Iger.

The blockbuster effect has been even more striking on the digital platforms that were supposed to demonstrate the benefits of the long tail. On iTunes or Amazon, the marginal cost of “stocking” another item is essentially zero, so supply has grown. But the rewards of this model have become increasingly skewed towards the hits. Anita Elberse, of the Harvard Business School, working with data from Nielsen, notes that in 2007, 91% of the 3.9m different music tracks sold in America notched up fewer than 100 sales, and 24% only one each. Just 36 best-selling tracks accounted for 7% of all sales. By last year the tail had become yet longer but even thinner: of 8.7m different tracks that sold at least one copy, 96% sold fewer than 100 copies and 40%—3.5m songs—were purchased just once. And that does not include the many songs on offer that have never sold a single copy. Spotify said in 2013 that of its 20m-strong song catalogue at the time, 80% had been played—in other words, the remaining 4m songs had generated no interest at all.

Music-streaming services have not been around for long enough to allow a definitive assessment of their market impact, but as they attract more casual music fans (as opposed to deeply knowledgeable nerds), the hits can be expected to benefit. In 2015 the top 1,000 songs were streamed 57bn times in America, accounting for 18.8% of the total volume of streams, according to BuzzAngle Music; last year the top 1,000 songs accounted for 92bn streams, or 23% of the total.

The economics of blockbuster films, which are shown in cinemas, might seem different from those of blockbuster music and TV streaming, but in the digital age they and other entertainment products have much in common. There is almost no limit to the supply of entertainment choices in every category, but people's awareness of these products and their ability to find them is constrained by the time and attention they can spare. Overwhelmed by the abundance of choice, they will generally buy what they are most aware of. The algorithms used to make recommendations, offered by many sites, reinforce this trend: they push consumers to what is popular rather than send them off to explore obscure parts of the tail. This helps explain why Netflix, which specialises in supplying film and video on demand, has repeatedly bet big on event television, from its hit "The House of Cards" to the lavish production of "The Crown", about Britain's royal family. It has also spent hundreds of millions of dollars to secure the rights to Disney films. It still views itself as a long-tail company, but although it spends billions of dollars to serve lots of different market niches, especially geographical ones, subscribers generally make a beeline for the top 50 or so.

At the same time a lot of entertainment has been commoditised as the barriers to production and distribution have come down. An item further down the long tail may rarely be chosen, but is not "scarce" in the sense that it can command a premium; on the contrary, a relatively obscure item is worth very little. One reason is that the internet leads consumers to

expect most things to be free, especially content without a brand name. Second, consumers believe (rightly) that there is not much difference between most of the obscure items on offer. And third, they reckon (also usually correctly) that those items have cost hardly anything to produce, so they are almost worthless. Conversely, consumers will pay a premium for famous brand names.

This is partly to do with the way search engines and social platforms work. Facebook, YouTube and Snapchat readily deliver huge amounts of entertainment free. At the same time they offer individual performers, artists and writers a greatly increased chance of finding some sort of audience, be it next door or halfway across the world. On average, 60% of the viewers of an individual creator's YouTube channel live outside the country where the artist is based. This may be a fairer way of achieving stardom than in the pre-internet era, when traditional media companies picked winners and pushed them to the public via narrow distribution channels. Likewise, the 710m people online in China have discovered another independent path to fame, which is likely to spread to other parts of the world. Live-streaming has helped millions of Chinese internet users, many of them in rural villages or dreary industrial towns, personalise mass entertainment for each other. In such ways, with lower barriers to finding an audience (whether of one or many), millions of people around the world are using the internet as a lottery ticket to stardom. It is still a very long shot, but in theory the opportunity is now available to everyone.

That translates into more entertainment of all kinds being produced and consumed than ever before. On the whole, though, the rewards of the digital economy accrue mostly to the big platforms and media companies. Eric Schmidt, the executive chairman of Alphabet, Google's parent, has said that his company's thinking has been greatly influenced by the long tail; but he has also acknowledged that most of the money is to be made in the head.

The enduring dominance of the blockbuster has implications for the way consumers will be entertained for decades to come. Global competition for their attention, and their wallets, will bring about more mega-mergers like the one proposed between AT&T, a telecoms and pay-TV firm, and Time Warner, one of Hollywood's greatest content creators. The \$109bn offer indicated that AT&T felt the need to own great content to differentiate itself in the market. Likewise, it hinted at an uncertain future for content companies that cannot make sure they have an audience. For now, the competition among studios and video programmers is delivering more high-quality television for everyone than ever before, but it is also stoking fears of a collapse to come. This report will examine the proposition that the world may be getting close to peak TV.

The best time to gain (or lose) audience—and to challenge the dominance of an established platform—is when technology makes a leap. That is why media, gaming and tech companies are investing billions in virtual reality and augmented reality. Such technologies can change the way that people experience storytelling and persuade them to suspend disbelief. James Cameron showed with his superb 3D imagery in “Avatar” how a leap in visual technology can create an outsized blockbuster. Now Disney is racing with other studios and tech giants to come up with the next leap, alternative realities. This report will argue that the most promising of these technologies are still far from ready, though many people will take to lesser, cheaper forms of them, such as those they can experience on their smartphones.

| *I was there*

Between the avalanche of digital entertainment and the still-distant promise of alternative realities, there is still a huge market for experiencing something real in person. The few hits that have captured the public imagination command a hefty premium. From “Hamilton” on Broadway to

the mixed-martial arts combatants in the Ultimate Fighting Championship, people will pay thousands of dollars for the privilege of being there, even though they can experience the same thing or at least hear the same songs in digital form for a small fraction of the price.

For the majority who must consume entertainment remotely, most of the battles are still about screens, be they the size of a smartphone or half a wall, and about minutes of attention within particular apps. But although consumers seem to have a dizzying array of choices, most of them do not take full advantage of them. What they pick is increasingly determined by the algorithms driving this competition, and those algorithms mostly send them straight to what everyone else is consuming. Blockbusters are the safe bet. ■



大众娱乐

赢家通吃

技术让数十亿人获得了形式广泛的娱乐内容。加迪·爱普斯泰因解释为何在多数时候人们仍对热门大作一拥而上

技术进步的一个公认的作用是使娱乐大众化，让普通人也能够享受到曾是精英专享的乐趣。越来越多的人能享受到越来越多高品质的娱乐内容。与此同时，世界各地的人们也比以前更容易找到观众。如今利用数字技术，人们可以按需获得任何娱乐内容，这同时转变了富人和穷人的娱乐方式，改变了数十亿人的生活。

更令人惊叹的是，今天的大众娱乐可以量身定制，而不再是只提供“均码”的内容，人人都能在任何时候找到满足自己需要的东西。在纽约，人们清晨搭乘地铁上班的沉闷旅程充满了音乐。在东京，人们在下班回家的路上用手机如饥似渴地看漫画。晚上，在邻近北京的一个没落工业城市里，没钱出去过夜生活的工人可以收看自己国人的网络直播。全球数十亿人随时都可以玩林林总总的手游。

在2006年出版的《长尾理论》（The Long Tail）一书中，曾为本刊工作的科技作家克里斯·安德森（Chris Anderson）评论道，互联网为任何利基产品都开辟了潜在市场，无论这个产品有多古怪。十年过去了，YouTube上的任何一个明星都可以证明这一点。从一个打开玩具包装的孩子，到世界各地表情可爱的幼儿，再到瑞典拥有数百万青少年粉丝的搞怪游戏主播，运行自己的在线虚拟电视频道可以为少数幸运儿带来数千万美元的收入。

但作为一个行业，娱乐在某些方面的大众化程度不进反退。技术让富者愈富，把人们的娱乐消费集中在最热门的作品和最强大的平台上。娱乐世界主要是由Facebook、谷歌、亚马逊、Netflix和迪士尼（以及中国封闭生态系统里的阿里巴巴和腾讯）等巨擘寡头称霸，那些规模不够的企业几乎无人留意。矛盾的是，让地球上的每个人和产品都能找到市场也意味着市场

几乎不可能找到他们。消费者通常都喜欢能在移动设备屏幕上或搜索结果的最前列找到的内容。长尾很长，但也非常之细。

能制作大热作品变得比以往更有价值。《热门炮制者》（Hit Makers）一书的作者德里克·汤普森（Derek Thompson）说，事实上每个人都想要大热作品，认知度越高越好。尽管每个人都可以获得为其特别定制的娱乐内容，但人们仍然渴望能与他人分享的娱乐体验。大家都想要的就是他们最想要的。

让娱乐分散化的那些技术工具同样也让聚集观众变得更容易。下载或观看排名具有自我强化效应。推荐算法引导消费者选择那些与自己相像的人观看或收听的内容。由于网络效应，在任何类型的娱乐作品中，最热门者对社交媒体的影响远大于不那么热门的内容。现在有一点似乎已经很清楚：大众娱乐的未来并不会如安德森所说的那样“品类更多，销量更少”，而是品类更少，销量更多。

电影业的情况正说明了这一点。2016年全球发行的数千部电影中（仅在美国就发行了700多部），票房前五名都是由迪士尼制作。迪士尼去年发行了13部电影，加上《星球大战：原力觉醒》（2015年底发行）在2016年的票房收入，这些影片共占去年全球电影总收入的五分之一。迪士尼专注制作大片，其标志性的角色和故事情节对全球观众都极具吸引力，这也推动了它在商品授权和主题公园领域里无可比肩的业务。仅在几年前，大型电影公司通常给自己设定的目标是允许每年有20至25部电影亏本，有些公司仍是如此。但迪士尼更加专注，几乎仅投资大片，获得了更高得多的回报率。

鲍勃·伊格尔（Bob Iger）2005年接任迪士尼CEO，他笃信在内容层出不穷的时代，大品牌会变得更更有价值，而且还越大越好。迪士尼随后斥资155亿美元收购了一系列在媒体世界里人人称羡的内容品牌，包括皮克斯动画工作室、漫威娱乐，并在2012年把制作《星球大战》的卢卡斯影业收归麾下。伊格尔说：“我们认为每一个品牌在新的世界秩序中都将各领风骚。”

在理应展现长尾好处的数字平台上，大片效应更加突出。在iTunes或亚马逊，增加一项“存货”的边际成本基本上为零，供应因此增加。但这种模式的回报越来越集中于热门产品。哈佛商学院的安妮塔·埃尔贝斯（Anita Elberse）在分析尼尔森的数据后指出，2007年在美国销售的390万首不同音乐曲目中，91%的乐曲累计销售数低于100笔，24%的乐曲只有一笔销售。仅36首最畅销曲目就占了总销售数的7%。到了去年，音乐行业的尾巴变得更长，但也更细了：在870万首销售数为一笔或以上的不同曲目中，96%的销售数少于100笔，40%（即350万首歌曲）只售出了一笔，这还不包括许多在售但却从来没人买过的曲目。Spotify在2013年表示，当时在其收录的2000多万首曲目中，80%已经播放——换言之，剩下的400万首完全无人问津。

音乐流媒体服务出现的时间不长，还不足以对它们的市场影响力做出明确的评估，但这些服务吸引到的更多是普通音乐爱好者（而非发烧级乐迷），因此热门音乐可望受益。BuzzAngle Music的数据显示，2015年在美国，流媒体播放量排名前1000位的歌曲共计播放570亿次，占播放总量的18.8%；去年排名前1000的歌曲播放次数为920亿次，占播放总量的23%。

在电影院放映的大片可能看起来和那些热门音乐及电视流媒体不同，但在数字时代，它们和其他娱乐产品有着很多共同点。每个娱乐类别中都有几乎无限供应的选择，但人们对这些产品的认知和找到它们的能力受时间和注意力的限制。由于选择过多，人们通常会购买他们最耳熟能详的产品。许多网站上用于提供建议的算法强化了这一趋势：它们将消费者推向受欢迎的产品，而不是让他们去探索不知名的尾部产品。这可以解释专门提供电影和视频点播服务的Netflix公司为什么会反复下重注在热门节目上（如自制热播剧《纸牌屋》和关于英国王室的豪华巨作《王冠》等）。它还斥资数亿美元来获得迪士尼电影的播放权。Netflix仍然认为自己是一个长尾公司，但是，尽管它斥资数十亿美元来服务大量不同的利基市场，特别是不同地域的利基市场，其用户通常还是直奔前50名左右的节目而去。

同时，由于制作和发行的门槛已经下降，许多娱乐都已被商品化。靠近长

尾末端的作品可能鲜有人问津，但又算不上是人们愿意高价购买的“稀缺品”。相反，一个相对无名的作品价值无几。原因之一是互联网的发展让消费者期望大多数网上资源都是免费的，特别是没有品牌的内容。第二，消费者（正确地）认为，网上大多数无名作品之间并无太大的区别。第三，他们估计（通常也正确）这些作品的制作几乎所费无几，所以也几乎毫无价值。相反，消费者愿意为知名品牌多掏腰包。

这种情况与搜索引擎和社交平台的运作方式有一定关系。Facebook、YouTube和Snapchat随时提供大量免费娱乐内容。同时，它们使得个人表演者、艺术家和作家找到自己观众的机会大增，无论观众是隔壁邻居还是住在地球另一边的人。收看个人创作者YouTube直播的观众平均有60%都和这位创作者生活在不同的国家。这种成名方法可能比互联网之前的时代更为公平，那时还要由传统媒体公司来挑选优胜者，并通过狭窄的分销渠道把他们推向公众。同样，中国的7.1亿网民在网上发现了另一条独立成名之路，而且还可能声名远播到世界各地。网络直播已帮助数百万中国网民（其中许多身处农村或沉闷的工业城镇）为彼此制作个性化的大众娱乐内容。这种方式找到观众的门槛较低（无论是找到一个观众还是许多），因而世界各地的亿万网民正在把互联网当做彩票，一旦中奖便功成名就。尽管出名的机率仍然很低，但在理论上，现在人人都有机会了。

这样，就会有比以往更多的各式娱乐内容被制作出来并消费掉。不过总的来说，数字经济的回报主要还是集中在大型平台和媒体公司。谷歌母公司Alphabet的执行董事长埃里克·施密特（Eric Schmidt）表示，谷歌的理念受长尾理论影响很大，但他也承认，赚钱大部分还得靠主流产品。

大片持久的主导地位将影响未来几十年消费者的娱乐方式。全世界都在争夺消费者的关注以及他们的钱包，这将带来更多的大型合并，比如电信和付费电视公司AT&T与好莱坞最伟大的内容创作公司之一时代华纳计划进行的合并。1090亿美元的收购报价表明AT&T认为需要拥有优秀的自有内容才能在市场上脱颖而出。同样，此合并案也暗示，那些不能确保会拥有观众的内容制作公司未来将充满不确定性。现在，各家影视公司和视频制作公司之间的竞争为大家提供了比以往任何时候都要多的高品质电视节

目，但也引发了对崩溃的恐惧。本报道将分析全球电视发展可能将要触顶的观点。

赢得（或失去）观众并且挑战权威平台主导地位的最佳时机是技术实现飞跃之时。因此，媒体、游戏和科技公司都在投资数十亿美元研发虚拟现实和增强现实技术。这些技术可以改变人们体验故事的方式，说服他们搁置怀疑。在电影《阿凡达》中，詹姆斯·卡梅隆（James Cameron）借助他精湛的3D影像向人们展示了视觉技术的飞跃如何能创造出一部超级大片。现在迪士尼正在与其他影视公司和技术巨头竞争，看谁能率先实现下一个飞跃——另类现实。本报道将阐述，这些技术中最有前途的还远未就位，尽管许多人会先接受这些技术较粗略、便宜的形式，比如在智能手机上就能体验的那些。

| 身临其境

在纷至沓来的数字娱乐和仍遥遥无期的另类现实之间，还有一个亲历真实情境的巨大市场。引发公众遐想的几部“大作”价格不菲，从百老汇的音乐剧《汉密尔顿》（Hamilton）到UFC终极格斗锦标赛中的综合格斗选手，人们为了能亲临现场不惜花费数千美元，尽管他们只要花一个零头就能在网上观看到同样的内容或至少听到相同的歌曲。

对于大多数必须远程消费娱乐的人来说，无论是用智能手机屏幕还是半面墙大小的屏幕，大多数的格斗比赛仍然是通过某些应用在屏幕上收看几分钟而已。然而，虽然消费者面临的选择似乎多得让人眼花缭乱，但大多数人并没有充分利用这些选择。他们最终的选择越来越多地由推动竞争的算法所决定，而这些算法大多把他们推向了大家都在消费的内容。热门大作稳赚不赔。■



Rise of the micro-multinational Chinese and overseas

A new breed of startup is entering foreign markets early on

ON THE outskirts of Guangzhou, a city in southern China, lies an abandoned park filled with crumbling replicas of the wonders of the world. To the right are fading golden spires that are meant to represent Angkor Wat, a temple in Cambodia. On the left, a row of dusty Egyptian statues towers over a desolate Greek amphitheatre. Adding to the surrealism, the tops of the trees have been lopped off and a buzzing noise fills the night air.

This strange place is the testing ground for EHang, a Chinese startup that makes drones. (The treetops were chopped off, an employee explains, because drones kept crashing into them.) Hu Huazhi, EHang's founder, is beaming. His firm has just set a world record for a drone-swarm light show in Guangzhou, where it flew a thousand small drones in perfect unison. Next it plans to launch an autonomous flying-taxi service with a giant drone big enough to take a person (pictured). Dubai has just signed a deal with EHang to launch drone taxis this summer.

EHang is an example of a new kind of Chinese firm, labelled “micro-multinationals” by some. In the past, Chinese consumer-goods firms focused on the home market; startups were particularly inward-looking. The rare exceptions to this rule—firms like Lenovo, Haier and Huawei—were giant technology companies with deep pockets. That made sense: the mainland economy was growing at double-digit rates and China's rising middle classes were eager for new products. Marketing and distribution were easier to get right on the mainland than overseas.

But times are changing: more Chinese startups want to go global from the start. Often founders are mainlanders who have worked or studied abroad.

In some cases, says Benjamin Joffe of Hax, a hardware “accelerator” in Shenzhen, the startups may have little choice but to widen their horizons. Their products may simply be too innovative and expensive for China’s frugal consumers.

One such firm is Makeblock, a startup based in Shenzhen that sells do-it-yourself robot kits. Jasen Wang, its founder, says he went “global” from day one. His firm has quickly entered developed markets. Foreign sales (including to such big retailers as America’s Radio Shack) make up nearly three-quarters of the firm’s total revenues.

The fact that the mobile internet is particularly advanced in China means the mainland can throw up truly inventive new business models, says Shi Yi, a serial entrepreneur. DotC United, his company, looks for models on the mainland and then adapts them for foreign markets. “We are like Rocket Internet, but in reverse,” he declares, referring to a German e-commerce conglomerate that takes business models from advanced markets and adapts them for developing ones. For example, Wifi Master Key is a Chinese sharing-economy app that lists details of private and public wifi networks around the world. Swift WiFi, Mr Shi’s homage to it, now has over 150m users in 50 countries.

Musical.ly is another micro-multinational. Valued at about \$500m, it is one of the most fashionable apps among Western youngsters. More than 100m teenagers use it to share short videos of themselves lip-synching to popular songs. Teens and parents alike may be surprised to discover that this trendy app is run by Chinese engineers, working round the clock in an open-plan office in Shanghai in the company of the firm’s mascot, a small white dog named Mu Mu.

Alex Zhu, Musical.ly’s co-founder, reckons his firm can become “Instagram for music videos”. Unlike other micro-multinationals, Musical.ly did give

the local market a go but has flopped at home. Mr Zhu notes that Chinese schoolchildren typically have hours of homework and tutoring after school. They did not use his firm's app. In contrast, he observes, "American kids have lots of free time to play and experiment with social media after 3pm."

In the past, fear of getting sued over intellectual property (IP) kept many Chinese firms at home. The new micro-multinationals are tackling the issue head-on. Ninebot, a Beijing-based firm, makes better versions of the clunky, self-balancing scooters that were invented by America's Segway. Confronted with an IP lawsuit from the latter firm, Ninebot simply bought Segway. Now, argues Mr Joffe, it innovates "on top of Segway", which was stagnating, and the combined firm's strategy will be global.

Neil Shen of Sequoia, an American venture-capital firm, reckons this all adds up to a trend. Slowing growth in China means the domestic market is less attractive than it used to be. A younger generation of founders unafraid of going global is in charge. David Cogman of McKinsey, a consultancy, who works with many Chinese entrepreneurs, recalls that a decade ago it was almost unheard of for small, consumer-oriented firms to look abroad. When he advises companies today, it is "a regular conversation". ■



微型跨国公司的兴起

中国与海外

一种新型创业公司从成立之初就开始进入海外市场

在中国南方城市广州郊区一个废弃的公园里，到处是东倒西歪的世界奇观微缩复制品。右边褪了色的金黄尖塔原本代表的是柬埔寨寺庙吴哥窟。左边屹立着一排落满尘土的埃及雕像，旁边是一个破败的希腊露天剧场。树梢被砍掉了，夜空中充斥着一种嗡嗡的噪音，更增添了超现实主义的氛围。

这个奇怪的地方是制造无人机的中国创业公司亿航的试飞场地（一名员工解释说，砍掉树梢是因为无人机总是撞上去）。亿航的创始人胡华智面露喜色。他的公司刚刚在广州创下了无人机灯光秀的世界纪录：一千架小型无人机上演了完美的编队表演。接下来，亿航计划推出可搭载一名乘客的大型无人机（如图），提供自动飞行的无人机的士服务。迪拜刚刚与亿航签署了一项协议，将在今年夏天推出无人机的士。

亿航代表了一类新型的中国公司，一些人称之为“微型跨国公司”。过去，中国消费品公司专注于国内市场，创业公司尤其注重国内发展。联想、海尔和华为这些为数不多的特例都是财力雄厚的大型科技公司。这种选择不无道理：那时中国大陆的经济每年以两位数的速度增长，崛起的中产阶级渴望获得新产品，在中国大陆营销和分销要比在国外更易获得成功。

然而时移世易：如今更多的中国创业企业刚起步便想走出去。这些企业的创始人通常都是曾在海外工作或学习的大陆人士。深圳的硬件创业“加速器”Hax公司的本杰明·约菲（Benjamin Joffe）说，有时创业公司可能别无选择，只能扩大视野。对中国节俭的消费者来说，它们的产品可能太过超前也太过昂贵了。

深圳销售DIY机器人套装的创业公司Makeblock就属于这种情况，创始人王建军说他从第一天起就“走出去”了。他的公司已迅速进入发达市场，海

外销售（包括对美国的Radio Shack等大型零售商的销售）占了公司总收入的近四分之三。

多次创业的企业家石一说，移动互联网在中国特别发达，这意味着中国大陆可以推出真正有创造性的新型商业模式。石一的公司DotC United在大陆寻找商业模式，调整之后应用于海外市场。“我们就像‘火箭网络（Rocket Internet）’，但做法刚好和它相反。”石一提到的这家德国电子商务集团从先进市场汲取商业模式，加以调整后用于发展中国家市场。Wifi万能钥匙是一个中国的共享经济应用，列出了世界各地私人 and 公共WiFi网络的详细信息。石一推出了这款应用的“致敬作品”：Swift WiFi，现在在50个国家拥有超过1.5亿个用户。

Musical.ly是另一家微型跨国公司，估值约5亿美元，是西方青少年中最流行的应用之一，有超过1亿的青少年用它来分享自己跟着流行歌曲对口型的视频短片。这些青少年和家长们可能不会想到，这么潮的应用竟是由中国工程师运营的，他们就在上海一家开放式办公室里通宵达旦地工作着，陪伴他们的是公司的吉祥物——一只名叫Mu Mu的小白狗。

Musical.ly的联合创始人朱骏认为他的公司可以成为“音乐视频界的Instagram”。与其他微型跨国公司不同，Musical.ly也在本地市场做过尝试，但却在主场失利了。朱骏指出，中国学生通常在放学后要花几个小时做作业和上辅导课，不会去玩他公司的应用。相比之下，他注意到，“美国孩子下午3点后有大量的空闲时间在社交媒体上玩乐，做各种各样的尝试。”

在过去，由于担心因知识产权问题被起诉，许多中国公司只在本土经营。新的微型跨国公司正在正面迎击这个问题。北京公司纳恩博在美国赛格威（Segway）公司发明的笨重平衡车的基础上推出了改进的产品。面对来自赛格威的知识产权诉讼，纳恩博干脆收购了赛格威。约菲认为纳恩博如今是“站在赛格威的肩膀上”进行创新，在此之前赛格威已经停滞不前，合并后公司的战略将面向全球。

美国风险投资公司红杉资本（Sequoia）的沈南鹏认为这一切都促成了一种趋势。中国增长放缓意味着国内市场的吸引力不如以往。不惧怕走出国门的年轻一代创始人成为企业掌舵人。咨询公司麦肯锡的岑名彦（David Cogman）与许多中国企业家都有合作关系。他回忆道，十年前，面向消费者的小型公司寻求海外市场的案例几乎闻所未闻。如今在他为公司提供咨询服务时，走出去已成为“常见的话题”。■



Oceanography

Fruits de mer

Plucking minerals from the seabed is back on the agenda

IN THE 1960s and 1970s, amid worries about dwindling natural resources, several big companies looked into the idea of mining the ocean floor. They proved the principle by collecting hundreds of tonnes of manganese nodules—potato-sized mineral agglomerations that litter vast tracts of Davy Jones's locker. At first sight, these nodules are attractive targets for mining because, besides manganese, they are rich in cobalt, copper and nickel. As a commercial proposition, though, the idea never caught on. Working underwater proved too expensive and prospectors discovered new mines on dry land. Worries about shortages went away, and ocean mining returned whence it had come, to the pages of science-fiction novels.

Now it is back. As Mark Hannington of the GEOMAR-Helmholtz Centre for Ocean Research, in Germany, explained to the AAAS, prototype mining machines are already being tested, exploration rights divvied up between interested parties, and the legal framework put in place. Next week the International Seabed Authority, which looks after those parts of the ocean floor beyond coastal countries' 200 nautical-mile exclusive economic zones, is issuing guidelines for the exploitation of submarine minerals. In Dr Hannington's view, a gold rush is starting. And he was speaking only partly metaphorically.

One of the most advanced projects is that of Nautilus Minerals, a Canadian firm. In January 2016 Nautilus took delivery of three giant mining machines (two rock-cutters and an ore-collector) that move around the seabed on tracks, like tanks. It plans to start testing these this year. If all goes well the machines could then start operating commercially in Nautilus's concession off the coast of Papua New Guinea, which

prospecting shows contains ore with a copper concentration of 7%. (The average for terrestrially mined ore is 0.6%.) This ore also contains other valuable metals, including gold.

This approach (which is also that taken by firms such as Neptune Minerals, of Florida, and a Japanese consortium led by Mitsubishi Heavy Industries) is different from earlier efforts. It involves mining not manganese nodules, but rather a type of geological formation unknown at the time people were looking into those nodules—submarine hydrothermal vents. These rocky towers, the first of which was discovered in 1977, form in places where jets of superheated, mineral-rich water shoot out from beneath the sea floor. They are found near undersea volcanoes and along the ocean ridges that mark the boundaries between Earth's tectonic plates. They generally lie in shallower waters than manganese nodules, and often contain more valuable substances, gold among them.

They are not, though, as abundant as manganese nodules, so if and when the technology for underwater mining is proved, it is to nodules that people are likely to turn eventually. These really are there in enormous numbers. According to Dr Hannington, the Clarion-Clipperton fracture zone, a nodule field that stretches from the west coast of Mexico almost to Hawaii, contains by itself enough nickel and copper to meet global demand for several decades, and enough cobalt to last a century.

Mining, whether on land or underwater, does come at an environmental cost, though. This was the subject of a presentation by Stace Beaulieu of the Woods Hole Oceanographic Institution, in Massachusetts. The nature of that cost depends on the ecosystem. The deep-sea plains which host nodule fields tend not to be home to big animals, said Dr Beaulieu, but the sediments the nodules are found in play host to microscopic critters that would be most upset by the process of trawling that is needed to bring the nodules to the surface. They might take decades to recover from it.

Hydrothermal vents are an even more peculiar environment than nodule fields. Unlike almost every other ecosystem, they are based not on energy from the sun, but on chemicals—particularly hydrogen sulphide—dissolved in the ejected water that are used by specialised bacteria to power their metabolisms. This, and their isolation from one another in the manner of small oceanic islands, means vents are host to many distinct and rare species. Conservationists therefore care about them a lot.

That said, as Dr Beaulieu pointed out, vent life may be more robust than many people assume. One of the hazards of dwelling near an undersea volcano is that an eruption can destroy your home in an instant. The creatures that live around vents seem able to bounce back from such catastrophes fairly quickly, so a visit from a mining machine might not be such a disaster after all. ■



海洋研究

海中珍宝

海底采矿重回议程

上世纪六七十年代，人们担忧自然资源行将枯竭，几家大公司开始研究开采海底资源的设想。它们采集到了数百吨锰结核——散布在广阔海床中的马铃薯大小的矿物团块，证实了相关原理。乍看之下，这些结核是很有吸引力的采矿目标，因为除了锰，它们还富含钴、铜和镍。但作为商业项目，这种方法却并未流行开来。水下作业的成本太高，而且勘探人员在陆地找到了新的矿藏。资源短缺的忧虑消散，“海底采矿”也重回其发源地——科幻小说之中。

如今，“海底采矿”卷土重来。正如德国GEOMAR亥姆霍兹海洋研究中心（GEOMAR-Helmholtz Centre for Ocean Research）的马克·汉宁顿（Mark Hannington）向美国科学促进会（AAAS）解释的那样，采矿机原型已在测试中，利益相关方分配好了勘探权，法律框架也已落实到位。沿海国家享有200海里的专属经济区，这个范围之外的洋底则是由国际海底管理局（International Seabed Authority）负责管理。下周该机构将发布有关开采海底矿物的指导原则。在汉宁顿看来，一轮淘金热正在开启。他说的可不完全是比喻。

最领先的项目之一是由加拿大的鹦鹉螺矿业公司（Nautilus Minerals）开展的。2016年1月，该公司购买的三台巨型采矿机交付，其中两台是岩石切割机，一台是矿石采集机，都能像坦克那样靠履带在海床上移动。该公司计划于今年开始测试这些机器。假如一切顺利，它们之后便可在该公司位于巴布亚新几内亚沿海已获得采矿权的海域启动商业运作。据勘探，该区域有含铜量为7%的矿石（陆上开采的矿石一般含铜量为0.6%），而且这种矿石还含有黄金等贵金属。

这种方法有别于之前的尝试（佛罗里达的海王星矿业公司、以三菱重工为首的一家日本财团等公司也采用这种方法）。它开采的并非锰结核，而是

当初大家并不知晓的一种地质构造——深海热泉。这些石质的突出喷口在1977年首次被发现，因富含矿物质的过热液体从海底喷出而形成，位于海底火山附近及地球板块边界的洋脊上。相比锰结核，这些喷口一般位于较浅的海域，而且往往含有更具价值的成分，包括黄金。

但它们的数量不像锰结核那样多。因此，如果海底开采技术经证实可行，人们可能最终还是会去开采锰结核，因其储量的确庞大。据汉宁顿称，从墨西哥西海岸几乎延伸至夏威夷的克拉里昂-克利珀顿断裂带（Clarion-Clipperton fracture zone）正是富含矿物结核的区域，其镍和铜的储量足够满足全球几十年的需求，钴储量则可满足我们一世纪之需。

然而采矿无论是在陆地还是水下进行，都会导致对环境的破坏。美国马萨诸塞州伍兹霍尔海洋研究所（Woods Hole Oceanographic Institution）的学者斯泰斯·比利（Stace Beaulieu）曾就此主题做过演讲。环境破坏的性质取决于所涉及的生态系统。比利表示，结核分布区所在的深海平原一般并非大型动物的家园，但结核所处的沉积层却是微小生物的栖息地，而把结核运上海面的拖网过程对这些生物的影响最大。它们可能需要几十年才能恢复过来。

深海热泉是比结核区更特别的环境。不同于几乎其他所有生态系统，这一系统并非基于太阳能量，而是依靠溶解在喷出热液中的化学物质尤其是硫化氢，专门有一些细菌使用这些物质来推动新陈代谢。再加上海底热泉就像洋中小岛般彼此隔离，使得热液喷口成为许多独特稀有物种的栖息地。生态环境保护者对此非常关注。

尽管如此，热液喷口的生物也许就像比利所指出的那样，比很多人想象的要更顽强。在海底火山附近栖息的一大风险是火山一旦爆发家园便瞬间荡然无存。在热泉喷口附近生活的生物似乎能很快从这类灾难中恢复过来，所以采矿机到访一回或许算不上什么祸害。■



Grab v Uber

Road warriors

A South-East Asian startup must contend with Uber on home soil

SCOOTER-DRIVERS in bright green helmets enliven the dusk of rush hour in Ho Chi Minh City, Vietnam's commercial centre. This conspicuous fleet is carrying round clients of Grab, a South-East Asian ride-hailing firm. Its operations, connecting travellers with taxis, private cars and motorbike taxis in six countries, straddle a region that is twice as populous as America and swiftly urbanising. Its future seems assured, if it can compete with Uber, a deep-pocketed American competitor.

Grab started life at Harvard Business School, where its 34-year-old boss, Anthony Tan, met his co-founder, Hooi Ling Tan (the pair are unrelated). Its headquarters are in Singapore. Anthony's father runs Tan Chong Motors, a car assembler and distributor which is among Malaysia's largest companies, but he does not have funding from the family outfit.

Mr Tan denies that he is building South-East Asia's answer to Uber, and says he is more inspired by Chinese technology firms such as Tencent, an online-gaming and social-media firm that owns WeChat, a fantastically popular mobile-messaging service, and Alibaba Group, an e-commerce giant. In particular, Grab aims to emulate WeChat's success in popularising mobile payments through smartphones.

A big chunk of the \$1bn of cash that Grab holds for investing purposes will be ploughed into its digital-payments system, "GrabPay", which started operating in January 2016. In November 2016 Grab updated GrabPay, turning it from a digital-payments processor which was mostly of use to people who already had credit and debit cards, to a digital wallet which South-East Asians can top up with credit by making cash payments at

banks and some convenience stores. At present people mainly use GrabPay to pay for Grab rides, but the aim is that customers will eventually use it to buy all manner of daily items.

But such dreams depend on Grab seeing off local rivals and defending its business from Uber, which is roughly 20 times as valuable. Grab's investors include Temasek, Singapore's state investment firm, and China Investment Corporation, a Chinese one. In September, SoftBank, a Japanese telecoms and technology firm that is owned by Masayoshi Son (who last year announced a \$100bn tech-investment fund in partnership with Saudi Arabia and other investors), led a group that put \$750m into Grab, valuing it at more than \$3bn.

Uber operates in all the same countries—Indonesia, Vietnam, the Philippines, Thailand, Malaysia and Singapore—but in 20 cities compared with Grab's 34. The American firm last year suffered a setback which, paradoxically, makes it a stronger rival: in August it abandoned its costly efforts to crack China, and sold its business there to Didi Chuxing, a local competitor which is also an investor in Grab. The deal freed up resources which Uber is now using to push deeper into Grab's territories.

Fierce discounting of rides has been one result. Uber's chances of dominance in South-East Asia have increased in the past 12 months or so, says Florian Hoppe of Bain, a consulting firm, because it has been improving its local strategy—from having relatively few people on the ground and a narrow range of services to selling the same broad products as Grab: taxis, private cars and two-wheeler ride-hailing.

Grab still claims to have services that are better suited to South-East Asians. Mr Tan points to its GrabHitch offering, for example. Many people in Jakarta, Indonesia's capital, live in suburban developments many miles from the central business district, and make long journeys on their scooters

into work every day. GrabHitch allows them to advertise the route and time of their trip in the hope of finding someone who wants to hitch a lift on the back of their scooter, paying a nominal sum to cover petrol and bike-maintenance costs. Uber doesn't offer anything as informal or low-priced.

Indonesia is a key battleground: its population of 257m accounts for more than one-third of the region's people. Since launching its motorbike taxis in Jakarta in May 2015, Grab has gradually overhauled the lead formerly enjoyed by Go-Jek, a local ride-hailing business, and seems to be drawing ahead. Uber, which came late to the market, is now in third place. On February 2nd Grab said it will invest \$700m into Indonesia over the next four years. For Grab, South-East Asia's traffic-clogged mega-cities are not "just another" market, says Mr Tan. "This is our home." ■



Grab对阵优步

马路勇士

一家东南亚的创业公司必须要在本国市场与优步一争高下

傍晚时分，在越南的商业中心胡志明市，头戴亮绿色头盔的摩托车司机为此刻的交通高峰时段带来了活力。这些醒目的车辆正在运送东南亚网约车公司Grab的客户。在这个横跨六个国家、人口相当于美国两倍并正在迅速城市化的区域里，该公司将出租车、私家车以及摩的和乘客连接起来。如果Grab能与财大气粗的美国竞争对手优步相抗衡，那么它的未来似乎便一片光明了。

Grab诞生于哈佛商学院，在那里，它34岁的老板陈炳耀（Anthony Tan）遇见了他的联合创始人陈慧玲（Hooi Ling Tan）（两人并非亲属关系）。公司总部设在新加坡。陈炳耀父亲经营的汽车装配和经销企业陈唱汽车（Tan Chong Motors）是马来西亚最大的公司之一，但他并没有动用家族企业的资金。

陈炳耀否认他正在缔造东南亚版的优步，并称自己更多是受到中国科技企业的启发，例如在线游戏和社交媒体公司腾讯（它旗下的微信是一款非常流行的移动讯息服务），以及电子商务巨头阿里巴巴集团。Grab尤其想复制微信在利用智能手机推广移动支付上所取得的成功。

Grab持有10亿美元用于投资，其中有相当一部分将投入到数字支付系统GrabPay（已于2016年1月投入运营）。去年11月，Grab升级了GrabPay，将它从数字支付处理系统（主要对已有信用卡和借记卡的人适用）变成了数字钱包（东南亚人可以在银行和一些便利店用现金来向其中充值）。目前，人们主要用GrabPay来支付Grab车费，但公司的目标是客户最终会用它来购买各种日用品。

但能否实现这个梦想取决于Grab能否打败当地的竞争对手，并保护其业务不受优步（估值约为它的20倍）竞争的冲击。Grab的投资者包括新加坡的

国有投资企业淡马锡以及中国的国有投资企业中投公司。去年9月，孙正义拥有的日本电信和科技公司软银（SoftBank）牵头向Grab投资7.5亿美元，对该公司的估值超过30亿美元。（孙正义去年宣布与沙特阿拉伯和其他投资者合作设立一只1000亿美元的高科技投资基金。）

在Grab覆盖的国家（印尼、越南、菲律宾、泰国、马来西亚和新加坡），优步都已开展业务，但只进入了20个城市。相比之下，Grab的业务则遍布34个城市。优步在去年遭受了挫折，但这反而使它成为了一个更强大的对手：去年8月，它放弃了征服中国的昂贵努力，将那里的业务卖给了当地竞争对手滴滴出行（同时也是Grab的投资者之一）。这笔交易腾出了资源，优步目前正运用这些资源更深入地向Grab的地盘推进。

其结果之一就是大幅的乘车优惠。咨询公司贝恩（Bain）的弗洛里安·霍普（Florian Hoppe）表示，优步在东南亚称雄的可能性在过去12个月左右的时间里已经增加，因为它一直在改进当地战略——从当地人员相对较少、服务范围较窄转变为和Grab一样产品范围广泛，提供出租车、私家车和两轮车的网约服务。

Grab仍然声称自己提供了更适合东南亚人的服务。陈炳耀以GrabHitch服务为例来说明这一点。在印尼首都雅加达，很多人住在远离中心商务区的新建郊区，每天骑摩托车长途行驶去上班。GrabHitch让他们能把自己的行驶路线和时间广而告之，好找到想搭顺风摩托车的人，并象征性地向搭车人收一些钱来支付汽油费和车辆维护的花销。优步则没有提供任何这般非正式或低价的服务。

印尼是一个关键战场：那里有2.57亿人口，占这一地区人口的三分之一还多。自从2015年5月在雅加达推出摩的以来，Grab便逐渐赶超了原本领先的当地网约车公司Go-Jek，而且似乎还在拉大差距。优步进入这个市场较晚，目前位居第三。2月2日，Grab表示未来四年将在印尼投资七亿美元。对于Grab而言，东南亚交通堵塞的大城市“不仅仅是另一个”市场而已，陈炳耀说，“这里是我们的根据地。”■



Global property prices

Searching for sanctuary

Bolthole money pushes prices up for local and foreigner alike

MANY Americans were taken aback when news broke in January that Peter Thiel, an internet billionaire and adviser to Donald Trump, had New Zealand citizenship. For five years this backer of an “America first” president had kept his Kiwi passport quiet. Then the government released details of his \$10m-lakeside estate.

A growing horde of rich foreigners see New Zealand as a safe haven. In 2016 overseas investors bought just 3% of all properties. But their purchases were concentrated at the expensive end of the market, which is growing fast: sales involving homes worth more than NZ\$1m (\$690,000) increased by 21%. That helped push prices in the country up by 13% over the past year, to lead *The Economist's* latest tally of global house-price inflation (see table).

New Zealand is one of several countries where the impact of foreign money on housing is under scrutiny. Prices have also risen rapidly in Australia and Canada. Central bankers fret about the dangers fickle capital flows pose to financial stability. London's mayor has ordered a study on foreign ownership in the capital after property prices rose by 54% in four years.

Foreign capital also makes itself felt in America, where house prices have recovered to a new nominal high. Canadians once dominated; now they are outnumbered by Chinese citizens spending some of the \$1.3trn that has left the country since autumn 2014. The National Association of Realtors estimates that Chinese investors bought 29,000 American homes for a total of \$27bn in the year to March 2016. Foreign buyers focus on a handful of cities: San Francisco, Seattle, New York and Miami.

In some places, foreign investment has led to a construction boom. In Miami apartments are being built in numbers not seen since the financial crisis, financed in part by Venezuelan money. Australia lets foreigners invest only in new-build properties, and they do: 26,000 new flats are due on the market in Sydney and Melbourne over the next 18 months. In London 45,000 homes have been built since 2014—the highest rate in ten years—but locals grumble many are pads for footloose foreigners.

In many of these countries affordability looks stretched. *The Economist* gauges house prices against two measures: rents and income. If, over the long run, prices rise faster than the revenue a property might generate or the household earnings that service a mortgage, they may be unsustainable. By these measures house prices in Australia, Canada and New Zealand look high. In America as a whole, housing is fairly valued, but in San Francisco and Seattle it is 20% overpriced.

Haven investors may disregard affordability measures. Property can either be a bolthole or earn an income; in many supply-constrained cities its value may rise rapidly; even if not, the risks may be lower than at home. Investment from China has gone up as its own property market has become stretched, fears of devaluation have risen and a crackdown on corruption continues. A study in 2016 found that increased political risk in places such as Greece and Syria explained 8% of the variation in London's house prices since 1998.

Policymakers may well scratch their heads. It is difficult both to make housing more affordable for a country's own citizens and to encourage foreigners to buy. Britain has in fact tried to curb foreign enthusiasm with higher taxes, and by publishing a registry of 100,000 British homes owned by foreign companies—a potential embarrassment for some.

But unintended consequences lurk. After a 15% levy on purchases from

abroad was introduced in the Canadian city of Vancouver last August, the number of foreign buyers dropped by 80%. That helped dampen house-price inflation there but pushed up demand in nearby Victoria. It also deterred highly skilled immigrants. The levy will soon be amended to exclude foreigners on skilled-work visas.

Some foreigners will stump up even if costs rise. More Americans are house-hunting abroad, for example. By one measure, interest in boltholes in New Zealand has tripled since Mr Trump's election. ■



全球房价

寻找避难所

寻求避风港的资金推高房价，对本地人和外国人都是如此

今年1月，互联网亿万富翁、唐纳德·特朗普的顾问彼得·泰尔（Peter Thiel）拥有新西兰国籍的新闻爆出，令许多美国人大吃一惊。他支持那位主张“美国优先”的总统，五年来却将自己持有新西兰护照一事暗藏于袖，直到政府公布了他在新西兰价值千万美元的湖畔物业的详情。

越来越多富有的外国人把新西兰视为安全的避风港。2016年，海外投资者购买的房产仅占总量的3%，但他们购置的房产主要集中在快速增长的高端市场：价值超过100万新西兰元（69万美元）的房屋销售上升了21%。过去一年里，这种趋势推动新西兰房价上涨了13%，在《经济学人》近期对全球房价上涨的调查中居于首位（见图表）。

新西兰是仔细探究外国资金对住房有何影响的几个国家之一。澳大利亚和加拿大的房价也迅速上涨。各国央行官员担心不稳定的资本流动会危害金融稳定。伦敦房价四年内上涨了54%，之后该市市长下令调研外国人拥有房产的情况。

美国也受到了外国资本的影响。美国的房价已经回升，名义价格创下新高。之前在美国置业的外国人主要是加拿大人，如今在数量上已被中国人超越。自2014年秋天以来中国有1.3万亿美元流出境外，其中一部分进入了美国房地产市场。美国房地产经纪人协会（National Association of Realtors）估计，在截至2016年3月的一年间，中国投资者购买了2.9万套美国住宅，总价值为270亿美元。外国买家集中在旧金山、西雅图、纽约和迈阿密等少数几个城市。

在一些地方，外国投资带来了建筑热潮。在迈阿密，新建公寓的数量之多为金融危机之后所未见，其中一部分卖给了委内瑞拉人。澳大利亚只允许外国人投资新建房产，而外国人也的确在这样做：未来18个月里，在悉尼

和墨尔本将有2.6万套新公寓开售。在伦敦，2014年以来已建成4.5万套住宅，是十年来最快的增长，但当地人抱怨很多房子都卖给了来去自由的外国人。

在许多这类国家，居民对房价的负担能力看来已经吃紧。《经济学人》用租金和收入这两个指标来衡量房价。从长远来看，如果房价上涨快于房地产可能产生的收入或用来偿还房贷的家庭收入，上涨或许不可持续。从这两个指标来看，澳大利亚、加拿大和新西兰的房价看起来很高。整体而言，美国住房估值合理，但旧金山和西雅图的房价高估了20%。

寻求避风港的投资者可能不会关注负担能力指标。房地产要么可以避险，要么能够赚取收入。在很多供应受限的城市，房价可能会迅速上涨；即使不上涨，风险可能也低于国内。在中国国内房地产市场过度、对人民币贬值的担忧增加、反腐行动持续推进之际，来自中国的投资已然增加。2016年的一项研究发现，1998年后伦敦房价的变化有8%与希腊和叙利亚等地政治风险的增加有关。

政策制定者很有可能会挠头。既要让国人买得起房，又要鼓励外国人买房，这难以两全。事实上为了遏制外国人的购房热情，英国已增加税收，并公布了10万套外国公司持有英国房产的记录——这对一些公司来说可能是件难堪的事。

不过这也潜藏着意想不到的后果。去年8月，在加拿大温哥华市对外国人购房征税15%之后，外国买家的数量下降了80%。这帮助抑制了当地的房价上涨，但推高了附近维多利亚市的购房需求。这也让高技术移民望而却步。这项税收很快会修改，把持有技术工作签证的外国人排除在外。

即使成本上升，一些外国人也会掏钱。例如，更多的美国人正在海外寻找房产。一项估测显示，自特朗普当选以来，美国人对新西兰避风港房产的兴趣已上升了两倍。■



The world economy

On the rise

A synchronised global upturn is under way. Thank stimulus, not the populists

ECONOMIC and political cycles have a habit of being out of sync. Just ask George Bush senior, who lost the presidential election in 1992 because voters blamed him for the recent recession. Or Chancellor Gerhard Schröder, booted out by German voters in 2005 after imposing painful reforms, only to see Angela Merkel reap the rewards.

Today, almost ten years after the most severe financial crisis since the Depression, a broad-based economic upswing is at last under way. In America, Europe, Asia and the emerging markets, for the first time since a brief rebound in 2010, all the burners are firing at once.

But the political mood is sour. A populist rebellion, nurtured by years of sluggish growth, is still spreading. Globalisation is out of favour. An economic nationalist sits in the White House. This week all eyes were on Dutch elections featuring Geert Wilders, a Dutch Islamophobic ideologue, just one of many European malcontents.

This dissonance is dangerous. If populist politicians win credit for a more buoyant economy, their policies will gain credence, with potentially devastating effects. As a long-awaited upswing lifts spirits and spreads confidence, the big question is: what lies behind it?

| *All together now*

The past decade has been marked by false dawns, in which optimism at the start of a year has been undone—whether by the euro crisis, wobbles in emerging markets, the collapse of the oil price or fears of a meltdown in China. America's economy has kept growing, but always into a headwind. A

year ago, the Federal Reserve had expected to raise interest rates four times in 2016. Global frailties put paid to that.—

Now things are different. This week the Fed raised rates for the second time in three months—thanks partly to the vigour of the American economy, but also because of growth everywhere else. Fears about Chinese overcapacity, and of a yuan devaluation, have receded. In February factory-gate inflation was close to a nine-year high. In Japan in the fourth quarter capital expenditure grew at its fastest rate in three years. The euro area has been gathering speed since 2015. The European Commission's economic-sentiment index is at its highest since 2011; euro-zone unemployment is at its lowest since 2009.

The bellwethers of global activity look sprightly, too. In February South Korea, a proxy for world trade, notched up export growth above 20%. Taiwanese manufacturers have posted 12 consecutive months of expansion. Even in places inured to recession the worst is over. The Brazilian economy has been shrinking for eight quarters but, with inflation expectations tamed, interest rates are now falling. Brazil and Russia are likely to add to global GDP this year, not subtract from it. The Institute of International Finance reckons that in January the developing world hit its fastest monthly rate of growth since 2011.

This is not to say the world economy is back to normal. Oil prices fell by 10% in the week to March 15th on renewed fears of oversupply; a sustained fall would hurt the economies of producers more than it would benefit consumers. China's build-up of debt is of enduring concern. Productivity growth in the rich world remains weak. Outside America, wages are still growing slowly. And in America, surging business confidence has yet to translate into surging investment.

Entrenching the recovery calls for a delicate balancing-act. As inflation

expectations rise, central banks will have to weigh the pressure to tighten policy against the risk that, if they go too fast, bond markets and borrowers will suffer. Europe is especially vulnerable, because the European Central Bank is reaching the legal limits of the bond-buying programme it has used to keep money cheap in weak economies.

The biggest risk, though, is the lessons politicians draw. Donald Trump is singing his own praises after good job and confidence numbers. It is true that the stockmarket and business sentiment have been fired up by promises of deregulation and a fiscal boost. But Mr Trump's claims to have magically jump-started job creation are sheer braggadocio. The American economy has added jobs for 77 months in a row.

| *No Keynes, no gains*

Most important, the upswing has nothing to do with Mr Trump's "America First" economic nationalism. If anything, the global upswing vindicates the experts that today's populists often decry. Economists have long argued that recoveries from financial crashes take a long time: research into 100 banking crises by Carmen Reinhart and Kenneth Rogoff of Harvard University suggests that, on average, incomes get back to pre-crisis levels only after eight long years. Most economists also argue that the best way to recover after a debt crisis is to clean up balance-sheets quickly, keep monetary policy loose and apply fiscal stimulus wherever prudently possible.

Today's recovery validates that prescription. The Fed pinned interest rates to the floor until full employment was in sight. The ECB's bond-buying programme has kept borrowing costs in crisis-prone countries tolerable, though Europe's misplaced emphasis on austerity, recently relaxed, made the job harder. In Japan rises in VAT have scuppered previous recoveries; this time the government wisely deferred an increase until at least 2019.

The tussle over who created the recovery is about more than bragging rights. An endorsement for populist economics would favour insurgent parties in countries like France, where the far-right Marine Le Pen is standing for president. It would also favour the wrong policies. Mr Trump's proposed tax cuts would pump up the economy that now least needs support—and complicate the Fed's task. Fortified by misplaced belief in their own world view, the administration's protectionists might urge Mr Trump to rip up the infrastructure of globalisation (bypassing the World Trade Organisation in pursuing grievances against China, say), risking a trade war. A fiscal splurge at home and a stronger dollar would widen America's trade deficit, which may strengthen their hand. Populists deserve no credit for the upsurge. But they could yet snuff it out. ■



世界经济

蒸蒸日上

全球经济正在同步上扬，要感谢的是刺激政策而非民粹主义

经济和政治的周期往往并不同步。看看老布什，1992年他输掉了总统竞选，因为选民把当时的经济衰退怪在他的头上。再看看施罗德，在实施了痛苦的改革后，他在2005年被德国选民撵下台，眼睁睁看着默克尔坐享其成。

今天，大萧条之后最严重的金融危机已过去近十年，一场大范围的经济增长终于到来。经历2010年的短暂反弹之后，美国、欧洲、亚洲和新兴市场第一次一起开动马力。

但是政治气氛却令人失望。因多年经济增长缓慢而滋生的民粹主义反叛仍在蔓延。全球化不受待见。主政白宫的是一位经济民族主义者。本周，所有人都盯着荷兰大选，主角是荷兰的反穆斯林倡导者海尔特·维尔德斯（Geert Wilders），而他仅仅是欧洲众多对现实不满者之一。

这样的错位非常危险。如果将更繁荣的经济归功于民粹政治家，那么他们的政策就将赢得民众信任，这可能会有毁灭性的影响。人们期盼已久的经济增长振奋了精神、传播了信心，现在的重要问题是：究竟是什么推动了增长？

| 大家一起来

过去十年曾经呈现出多次虚假的曙光。由于欧元危机、新兴市场动荡、油价暴跌或是对中国经济崩溃的担忧等种种原因，一年之初鼓起的乐观情绪最后总是烟消云散。美国的经济在持续增长，但始终遭遇逆风。一年前，美联储原本预计在2016年加息四次。全球经济虚弱让这一计划落空。

现在的情况则不同。本周美联储三个月来第二次加息，部分原因是美国经济的活力，但也多亏了全球各地的增长。对中国产能过剩以及人民币贬值

的担忧已经消退。2月，中国工业品出厂价格涨幅已接近九年来最高点。日本第四季度资本支出的增长达到三年来最快速度。欧元区自2015年以来逐渐提速。欧盟委员会的经济景气指数（economic-sentiment index）达到2011年以来的最高点；欧元区失业率则为2009年以来最低。

全球经济活动的风向标看起来也很有活力。作为全球贸易的风向标，韩国2月出口增长超过20%。台湾制造企业已经连续12个月扩大生产。即便是深陷衰退的地方，最坏的境况也已过去。巴西经济已持续八个季度萎缩，但随着通胀预期降低，利率如今正在下跌。巴西和俄罗斯有望为今年全球GDP增长做出贡献，而不再是拖后腿。据国际金融研究所（The Institute of International Finance）估算，1月发展中国家的月增长率已达2011年来的最快水平。

这并不意味着全球经济已恢复正常。因为再度担心供大于求，到3月15日的一周内油价下跌了10%；如果油价持续下跌，对产油国经济的损害会比消费者获得的益处更大。中国债务的积累始终令人担忧。富裕世界的生产力增长仍然疲软。美国以外，工资增长仍然缓慢。而在美国国内，汹涌而来的商业信心尚未转化为澎湃的投资。

巩固经济复苏需要精巧的平衡之道。随着通胀预期上升，央行将不得不仔细斟酌采取紧缩政策，以免通胀过快，令证券市场和借款人蒙受损失。欧洲尤其脆弱，因为欧洲央行已接近债券购买计划的法律上限，欧洲央行一直利用这一计划令疲软经济体的货币保持低位。

不过，最大的风险是政客们从中得出的经验。特朗普在就业数字可喜、信心指数上涨之后正自吹自擂。的确，股票市场和商业行情在放松管制和财政刺激的承诺下看涨。但特朗普宣称自己神奇地快速创造了就业是彻头彻尾的吹牛。美国经济的就业岗位已经连续77个月增加了。

| 没有凯恩斯，没有收获

最重要的是，经济上涨与特朗普“美国第一”的经济民族主义没有任何关系。如果有，只能说全球经济上涨证明了当下民粹主义者常常谴责的那些

专家是正确的。经济学家长久以来都认为从金融危机中复苏需要很长时间：哈佛大学的卡门·莱因哈特（Carmen Reinhart）和肯尼斯·罗格夫（Kenneth Rogoff）研究了一百次银行业危机。他们指出，平均而言，只有经过长达八年后工资才能恢复到危机前的水平。大部分经济学家还认为债务危机后最好的复苏方法是迅速清理资产负债表、维持宽松的货币政策，并且在尽可能谨慎的前提下，实施财政刺激。

今日的复苏验证了这一良方。美联储将利率维持在低位，直至充分就业来临。欧洲央行的债券购买计划让易发危机的国家能够负担得起贷款成本，尽管欧洲错误地强调紧缩（最近有所松动），让就业更加困难。日本过去上调消费税令之前的复苏付之东流；这一次政府明智地将加税延后到最早在2019年才实施。

争论是谁成功让经济复苏不只是争夺夸耀的权利。对民粹主义经济学的认可会有利于一些国家的反叛党派，比如法国极右翼的玛丽娜·勒庞（Marine Le Pen）正在参加总统竞选。这也会有利于错误的政策。特朗普提出的减税会让经济升温，而此刻的经济最不需要支持，减税政策还会让美联储的工作变得更复杂。这届政府的贸易保护主义者会因他们自己世界观的错误信仰而更加坚定，可能会敦促特朗普破坏全球化的基础架构（例如，绕过世贸组织来发泄对中国的不满），从而可能引发贸易战。国内的财政刺激和强劲美元会扩大美国的贸易赤字，这有可能增强他们的力量。民粹主义者对于经济上涨毫无功劳可言，反而可能会扼杀这一切。





Schumpeter

A trip to the shrink

Three sanity tests for whether tech firms are living in a bubble

IS THE technology industry in La La Land? There are alarming signs. House prices in San Francisco have risen by 66% more than in New York over the past five years. Even at the height of the dotcom bubble in 2001, the gap was lower, at 58%. Shares of technology firms trade on their highest ratio to sales since the turn of the century. Four of the world's most valuable firms are tech companies: Apple, Alphabet, Microsoft and Amazon. Snap, a tiddler with \$400m of sales and \$700m of cash losses in 2016, listed shares on March 2nd that gave it a valuation of over \$20bn.

For companies and investors in any industry, it is hard to work out if you are living in a bubble. To help, Schumpeter has created three sanity tests for global tech firms. These examine their cashflow, whether investors differentiate between companies, and whether forecasts of their future earnings suffer from a fallacy of composition. The exercise suggests that tech valuations are frothy, but not bubbling.

The first test is cashflow, and the industry passes it with flying colours. In 2001 about half of all listed tech firms were unable to convert their sales into hard dollars. Times have changed. In the past 12 months the biggest 150 technology companies generated a mighty \$350bn of cashflow after capital expenditures—higher than the total cashflow over the same period of all the non-financial companies listed in Japan, for instance.

In a bubble, investors bid up the value of assets regardless of their quality. The prices of good and bad tulips soared alike in 17th-century Holland, and in 2008 subprime debt was almost as valuable as Treasury bonds. So the second test is whether buyers are differentiating clearly between tech

firms, of which there are three broad types. Some, such as Samsung and Apple, are mature and profitable. At other firms, including Alibaba, Tencent, Facebook and Alphabet, sales are growing at an annual rate of over 20%, with high margins. Then there are “blue-sky” firms that are unprofitable but have explosive sales growth. Uber and Snap are examples.

One way to gauge whether investors are sensibly valuing each category differently is to calculate companies’ duration, or how much of their current market worth is expected to be realised soon and how much relies on pots of gold being found far into the future (see chart). Schumpeter has crunched the numbers for the world’s ten biggest tech firms and for three rising stars, splitting their market value into three parts: value which has already been realised in the form of net cash held, the present value of expected earnings in the next four years, and the value attributable to what happens after 2020. Samsung and Apple are not growing much but are low-risk: over 40% of their value can be explained by cash and near-term profits. The raciest firms, such as Tesla, are expected to generate over 90% of their value after 2020. These firms could well crash and burn. The good news is that investors are placing their most eye-watering valuations on a fringe of smallish companies that are growing very fast indeed.

The third test is whether there is a fallacy of composition. In a bubble the bullish claims of individual companies aren’t plausible once you add them all up. In the dotcom era the market-share targets of internet-service providers added up to well over 100%. In the subprime crisis every bank claimed that it had offloaded its risks onto other banks. The technology industry is less vulnerable to criticism on this front. The aggregate profits of the top five tech firms are expected to rise from 6% of American corporate earnings last year, to 10% by 2025: bold, but not implausible. Managers are not anticipating the same profit stream twice. For example, Facebook is not expected to become a force in search, while Google is not expected to conquer social media.

Although the lunatics have not taken over the asylum, there are, however, pockets of excess. Even though their valuations are now starting to deflate, there are still too many privately held technology firms with stretched valuations of \$1bn-10bn. Worldwide, such companies have a total worth of \$350bn. When it comes to facing up to failure, too, the industry's record is bad. Twitter's sales may shrink by 14% this quarter compared with a year earlier, and it is losing money. Past company failures in the tech business suggest that once decline sets in, it takes only two years or so for a firm to lose a quarter or more of its sales. Yet Twitter is sticking to its line that rapid growth will soon return.

| *Truly amazing*

Another worry is Amazon. It is one of the most optimistically valued firms, with 92% of its current worth justified by profits after 2020. Outside investors have a lot at stake because it is huge, with a market value of \$410bn. About a third of this value is justified by its profitable cloud-computing arm, AWS. But the rest of the firm, which straddles e-commerce, television and films, as well as logistics, barely makes money despite generating large sales. Nor is it growing particularly fast for its industry. To justify its valuation you need to believe that it becomes a sort of giant utility for e-commerce which by 2025 cranks out profits of around \$55bn a year, or probably more than any other firm in America.

The final worry is that technology firms are flouting the laws of corporate finance, which hold that there is a relationship between a company's market value, its profits and the sums it has invested. New entrants should be attracted by the fact that companies are winning huge valuations from tiny investments, in turn dragging profits and valuations back down. As a group, the biggest ten technology firms have \$8 of market value for every dollar they have sunk in net fixed physical and intangible assets. For Snap the figure is \$36, and for Tencent it is \$53. If new competitors do not, or

cannot, emerge, then competition authorities are likely to intervene more than they do now. It sounds odd, but the main valuation risk for many of the world's tech giants is that they rake in too much money. ■



熊彼特

消泡之旅

科技公司是否身处泡沫之中？三个心智测试来检验

科技产业是否正处在虚幻之国？这不乏警示信号。过去五年旧金山房价的涨幅超出纽约66%。即使在互联网泡沫最大的2001年，这一差距也只有58%。科技公司股票市销率已升至世纪之交以来的新高。全球市值最大的四家公司均为科技公司：苹果、Alphabet、微软、亚马逊。在2016年销售额为四亿美元而现金损失达七亿美元的小公司Snap在3月2日上市，估值超过200亿美元。

任何行业的公司和投资者都很难搞清自己是否处于泡沫之中。为此，熊彼特为全球科技公司设计了三个心智测试来帮助判断。这些测试审视公司的现金流状况，看投资者对各公司有无加以区分，并检验这些公司未来收益预测是否存在合成谬误。测试显示，科技公司的估值正在起沫，但还没有构成虚高。

第一个测试针对现金流，科技行业在这方面表现出色。2001年，约半数上市科技公司无法将销售转化为真金白银。时移势易。在过去一年，最大的150家科技公司在扣除资本支出后现金流达3500亿美元之巨，比同期在日本上市的所有非金融公司的总现金流还高。

在泡沫时期，投资者无视资产质量而盲目推高其价值。在17世纪的荷兰，郁金香不论优劣，价格一律飙升。2008年，次级债成为几乎同美国国债一样抢手的香饽饽。所以，第二个测试是看买家对三大类科技公司有否清楚区分。有一类科技公司，如三星和苹果，发展成熟，盈利可观。而包括阿里巴巴、腾讯、Facebook、Alphabet在内的其他一些科技公司则是年销售增速超过20%，利润很高。还有一些是虽未盈利但销售呈爆炸性增长的“蓝天”公司，优步和Snap便是例子。

衡量投资者是否明智地对各类科技公司做区别性估值的一个办法是计算这

些公司的股票久期，即其市场估值有多少能于近期实现，多少要依靠在未来发掘的价值（见图表）。熊彼特计算了全球最大的十家科技公司及三大后起科技公司的数据，将其市值分为三部分：已经以留存净现金的形式实现的价值、未来四年预期收益的现值、2020年后实现的价值。三星和苹果的增长不大，但风险低：其价值中超过40%为现金和近期利润。而特斯拉等最独特而有活力的公司90%的估值要在2020年后才会实现。这些公司很可能撑不到那个时候。好消息是，投资者给出最大胆估值的那群小公司确实增长迅猛。

第三个测试检查是否存在合成谬误。存在泡沫时，只要把各家公司的豪言汇总，就会发现它们各自的说辞并不合理。在互联网泡沫时期，网络服务供应商的市场份额目标加起来远超过100%。在次贷危机中，每家银行都说自己已把风险转移到其他银行身上。在这方面科技行业的可指摘之处较少。到2025年，前五大科技公司的总利润在美国企业盈利的占比预计将从去年的6%上升至10%——这是一个大胆的预测，但并不离谱。高管们没有预期通过复制别人的业务带来利润流，例如，他们并不期望Facebook成为搜索巨头，也没想让谷歌称霸社交媒体。

虽然情况尚未失控，但确有虚浮之象。尽管这些科技公司的估值开始下降，仍有太多私有科技公司估值过高（在10亿至100亿美元之间）。在全球，这些公司总值达3500亿美元。而说到应对挫折，科技业过往的表现也不妙。推特本季度的销售额可能比去年同期下降14%，而且正在亏损。业界记录显示，科技公司一旦遭遇衰退，只消两年左右，其销售额便会蒸发四分之一或更多。然而，推特仍坚持既定路线，认为快速增长会很快恢复。

| 确实惊人

另一个忧虑的焦点是亚马逊。作为估值最乐观的公司之一，其当前价值的92%需依赖2020年后实现的利润。外部投资者的风险很大，因为这是一个市值高达4100亿美元的巨无霸。其中约三分之一的估值是基于它的一个盈利部门——AWS云计算服务平台。而该公司横跨电子商务、影视、物流领域的其余部门尽管销售额巨大，却盈利甚微。按科技行业的标准来看，亚

亚马逊目前的增长也不是非常快。如果认为其估值合理，你需要相信，到2025年，亚马逊将成为年利润约达550亿美元（很可能超越美国任何其他公司）的巨型电子商务平台。

最后的一个忧虑是，科技公司无视企业融资的规律。这些规律认定公司的市值、利润及投资总额之间要保持一定关系。新进入者应该会留意到，在位公司从微小的投资获得巨大的估值，从而吸引它们进入这一领域，如此一来就会把利润和估值都压下来。整体来说，最大的十家科技公司每投入一美元到固定和无形净资产，便可获得八美元的市场价值。对Snap来说，这一数字为36美元，腾讯则为53美元。假如新的竞争对手没有或无法出现，竞争监管机构很可能比现在介入更多。听来奇怪，但对世界许多科技巨头而言，估值的主要风险是它们敛财太过。■



Artificial intelligence

Neighbourhood watch

Millions of street-level images give insights into America's demography

“WOULD it not be of great satisfaction to the king to know, at a designated moment every year, the number of his subjects?” A military engineer by the name of Sébastien le Prestre de Vauban posed this question to Louis XIV in 1686, pitching him the idea of a census. All France’s resources, the wealth and poverty of its towns and the disposition of its nobles would be counted, so that the king could control them better.

These days, such surveys are common. But they involve a lot of shoe-leather, and that makes them expensive. America, for instance, spends hundreds of millions of dollars every year on a socioeconomic investigation called the American Community Survey; the results can take half a decade to become available. Now, though, a team of researchers, led by Timnit Gebru of Stanford University in California, have come up with a cheaper, quicker method. Using powerful computers, machine-learning algorithms and mountains of data collected by Google, the team carried out a crude, probabilistic census of America’s cities in just two weeks.

First, the researchers trained their machine-learning model to recognise the make, model and year of many different types of cars. To do that they used a labelled data set, downloaded from automotive websites like Edmunds and Cars.com. Once the algorithm had learned to identify cars, it was turned loose on 50m images from 200 cities around America, all collected by Google’s Streetview vehicles, which provide imagery for the firm’s mapping applications. Streetview has photographed most of the public streets in America, and in among them the researchers spotted 22m different cars—around 8% of the number on America’s roads.

The computer classified those cars into one of 2,657 categories it had learned from studying the Edmunds and Cars.com data. The researchers then took data from the traditional census, and split them in half. One half was fed to the machine-learning algorithm, so it could hunt for correlations between the cars it saw on the roads in those neighbourhoods and such things as income levels, race and voting intentions. Once that was done, the algorithm was tested on the other half of the census data, to see if these correlations held true for neighbourhoods it had never seen before. They did. The sorts of cars you see in an area, in other words, turn out to be a reliable proxy for all sorts of other things, from education levels to political leanings. Seeing more sedans than pickup trucks, for instance, strongly suggests that a neighbourhood tends to vote for the Democrats.

The system has limitations: unlike a census, it generates predictions, not facts, and the more fine-grained those predictions are the less certain they become. The researchers reckon their system is accurate to the level of a precinct, an American political division that contains about 1,000 people. And because those predictions rely on the specific, accurate data generated by traditional surveys, it seems unlikely ever to replace them.

On the other hand, it is much cheaper and much faster. Dr Gebru's system ran on a couple of hundred processors, a modest amount of hardware by the standards of artificial-intelligence research. It nevertheless managed to crunch through its 50m images in two weeks. A human, even one who could classify all the cars in an image in just ten seconds, would take 15 years to do the same.

The other advantage of the AI approach is that it can be re-run whenever new data become available. As Dr Gebru points out, Streetview is not the only source of information out there. Self-driving cars, assuming they catch on, will use cameras, radar and the like to keep track of their surroundings. They should, therefore, produce even bigger data sets. (Vehicles made by

Tesla, an electric-car firm, are capturing such information even now.) Other kinds of data, such as those from Earth-imaging satellites, which Google also uses to refresh its maps, could be fed into the models, too. De Vauban's "designated moment" could soon become a constantly updated one. ■



人工智能

社区瞭望

利用数百万街道图像了解美国人口状况

“若陛下每年都可在指定时刻了解子民数量，岂不称心满意？”1686年，法国军事工程师塞巴斯蒂安·勒普雷斯特雷·德·沃邦（Sébastien Le Prestre de Vauban）向路易十四力荐人口普查这一概念。法国所有的资源、城镇的富庶与匮乏程度，以及贵族们的财产配置都将被清点计算，以便国王更好地掌控这一切。

今时今日，这类普查已很常见，但因耗时费力而代价不菲。例如，美国一项名为“美国社区普查”的社会经济调查每年要花费数亿美元，且需五年时间才能得出结果。但现在，由加州斯坦福大学的蒂姆尼特·盖布鲁（Timnit Gebru）率领的研究小组找到了一个相对低廉快捷的方法。该小组运用强大的计算机、机器学习算法以及谷歌收集的海量数据，在短短两周时间内便对美国各城市做了一次粗略的概率性普查。

首先，研究人员训练其机器学习模型识别众多不同类型汽车的品牌、型号和出厂年份。为此，他们利用了从Edmunds和Cars.com这类汽车网站下载的带标注数据集。机器算法学会分辨汽车后，便开始自行分析从美国200个城市收集到的5000万张图片。这些图片全部由为谷歌的地图应用提供图像的谷歌街景车收集而来。“谷歌街景”拍摄了美国大部分公共街道，研究人员从中发现了2200万辆不同的汽车，约占美国汽车保有量的8%。

计算机通过学习Edmunds和Cars.com上的数据建立了2657个类别，进而据此将所发现的汽车分门别类。接着研究人员从传统的人口普查中提取数据，将其一分为二，一半输入到机器学习算法中，让算法寻找社区路上所见汽车与收入水平、种族及投票意向等方面的相关性。这项工作完成后，再用另一半数据来测试算法，看看在这些算法没有接触到的社区里，这些相关性是否成立。结果是肯定的。换句话说，在某一地区见到的汽车类型确实是了解从教育水平到政治倾向性等各方面信息的可靠指标。比如在一

个社区内见到的轿车比皮卡多的话，则表明区内民众很可能倾向投票给民主党。

该系统存在局限性：与人口普查不同，系统生成的是预测，而非实情，并且预测范围越细，结果就越不准确。研究人员认为其系统可以精确到选区（美国的政治分区，每个选区约有1000人）。而因为机器预测依赖由传统普查产生的具体而准确的数据，所以似乎不太可能取代传统普查。

而另一方面，这一系统相对要便宜快捷得多。盖布鲁的系统运用了两三百个处理器，按人工智能研究的标准来看，这样的硬件数量并不算多。但系统在两周内处理了5000万张图片。若换人来做，即使一个人能在十秒内把一张图片中的所有汽车做好分类，也需要15年才能完成同样的工作量。

这一人工智能手段的另一优点是，每当有新数据可用时，系统可以再次运算。正如盖布鲁指出的，“谷歌街景”并非唯一的信息来源。无人驾驶汽车会运用摄像头、雷达之类的设备来追踪周围环境，如果它们流行起来，就可以生成更大的数据集。电动汽车公司特斯拉制造的车辆如今已在捕捉这类信息。其他类型的数据，例如地球成像卫星拍摄的图像（谷歌也在用这类卫星来更新其地图），也可以输入该人工智能模型。这样，德·沃邦的“指定时刻”也许很快就会变为“无时无刻”了。■



Red tape in America

Doing deregulation right

America needs regulatory reform, not a crude cull of environmental rules

WHAT does the Republican Party, led by Donald Trump, agree on? In addition to an enthusiasm for power, two things unite the conservatism of Stephen Bannon, the president's consigliere, with the conservatism of Mitch McConnell and Paul Ryan, the Republican leaders in Congress. One is tax cuts, on which he has thus far been vague. The other is deregulation, which matters more to Republicans now than debt or deficits.

The president promised "a historic effort to massively reduce job-crushing regulations" when he spoke to a joint session of Congress on February 28th. Mr Bannon has announced nothing less than "the deconstruction of the administrative state". That project began with an executive order requiring federal agencies to get rid of two regulations for every new one they issue. It continued in early March when the White House proposed slashing the budgets of many federal agencies. Under Barack Obama, CEOs grumbled constantly about burdensome new regulation and more zealous enforcement of existing rules. Stockmarkets have soared, possibly on a belief that undoing all this will bring much faster growth.

Something has indeed dampened America's economic dynamism. Startups are rarer, labour is less mobile and fewer people switch jobs than they did three decades ago. Regulation has shot up the list of small firms' concerns since 2008. Yet there is a right way and a wrong way to deregulate. Markets need clear rules, enforced predictably. Less regulation is not always better: the freedom to dump toxic sludge into rivers will not improve Americans' living standards. Republicans must ensure that they do the right sort of deregulation. There is little to be gained from crudely hacking at Mr Obama's handiwork, while ignoring systemic problems that have led to a

proliferation of rules, whoever is in charge.

| *Don't just blame the bureaucrats*

By one estimate, the number of federal edicts has risen steadily for almost four decades, from about 400,000 in 1970 to 1.1m. One reason for this proliferation is that bureaucrats much prefer writing new rules to rubbing out old ones. They scrutinise policy rigorously, but usually only in advance, when little is known about its impact. Little effort is made to analyse whether a rule's benefits still justify its costs once implemented. Instead, politicians rely on gut instinct to tell them whether firms' complaints about over-regulation are reasonable.

Political gridlock is another reason for regulatory sprawl. When a president is blocked by a hostile Congress, as Mr Obama was for most of his time in office, the temptation is to exercise power by issuing rules through the federal bureaucracy. But even when Washington is unified, as it is now, Congress and the executive branch find it much easier to issue new edicts than to undo old ones. The same is true at the state level.

The result is a proliferation of rules at all levels of government—rules that can slow innovation, but which also impede straightforward tasks, such as fixing bridges. When Mr Obama tried to finance “shovel-ready” infrastructure projects after the recession, he found that many lacked the long list of permits and approvals necessary to start building. Any infrastructure push by Mr Trump will run up against the same roadblocks.

Fixing this requires substantial change. Mr Obama made a modest start by directing agencies to evaluate old regulations. Mr Trump's demand that agencies must abolish old rules before writing new ones sounds crude, but provides a welcome incentive for bureaucrats to look again at old rulings. The strategy has had some success in Britain and Canada.

The White House should bolster the office that scrutinises proposed rules. It has seen its staff fall by half over three decades, while regulations have proliferated. Congress should appoint experts to scrutinise regulation on its behalf, as it has done for budgetary matters. This new body could review old rules as a matter of course. If these edicts do not pass a cost-benefit analysis, they should expire automatically.

Unfortunately, the approach many Republicans favour is to make it harder for the executive branch to do anything at all. Some want to subject every new rule to a congressional vote. Yet few politicians are equipped to scrutinise, say, arcane financial rules. Such votes are more likely to create feeding opportunities for lobbyists—and, in turn, more of the exemptions that increase regulatory complexity and harm competition.

The Republicans are right that America's regulatory sprawl needs tackling. A well-executed drive to cut red tape will doubtless bring economic gains. But it will be painstaking work, a far cry from the slash-and-burn approach the Trump team has in mind. Crude rule-cutting and budget-slashing will simply leave America dirtier and less safe. ■



美国的繁文缛节

放松监管 行之有道

美国需要监管改革，而不是粗暴地废除环保法规

以特朗普为首的共和党人在什么方面能达成一致？除了对权力的热情，还有两件事让总统高级顾问史蒂芬·班农（Stephen Bannon）的保守主义与美国国会共和党领袖明奇·麦康奈尔（Mitch McConnell）和保罗·瑞安（Paul Ryan）的保守主义团结一心。第一是减税，这一点到目前为止特朗普仍含糊其辞。第二是放松监管，如今这一点对共和党而言比债务或赤字更重要。

2月28日，特朗普在国会联席会议上发表演说时承诺，“会做出历史性的努力，大量减少损害就业的监管。”班农宣布的计划无异于“对行政国家的解构”。它以一道行政命令开头，要求联邦机构每发布一项新法规，就要废除两项法规。3月初该计划仍在延续：白宫提出削减多个联邦机构的预算。奥巴马执政时，CEO们不停抱怨繁重的新法规以及对现行法规愈加狂热的执行力度。股市已经狂飙，原因可能是市场相信消除这一切能带来快得多的增长。

美国的经济活力的确受到了抑制。创业公司减少，劳动力流动性减弱，换工作的人也比30年前要少。自2008年来，监管已经让小公司的担忧越来越多。但是放松监管的方法有对有错。市场需要清晰的规则，并以可预见的方式执行。监管不一定总是越少越好：向河里倾倒有毒污泥的自由并不能提升美国人的生活水平。共和党人必须确保他们放松监管的方式是正确的。粗鲁地砍掉奥巴马的作品，却忽略那些无论谁掌权都会导致繁文缛节滋生的系统性问题，这么做毫无益处。

| 别只怪官僚

据估算，联邦法令的数量近40年来一直稳步增加，从1970年的约40万条增至110万条。法令激增的原因之一是比起废除旧法规，官僚们更愿意去制定新法规。他们一丝不苟地审查政策，但通常都只是在发布之前，而此时

他们对政策可能产生的影响知之甚少。他们极少会去分析某项法规一旦实施，其益处是否仍能抵得上成本。相反，政客们是靠直觉来判断公司对过度监管的抱怨是否合理。

政治僵局是法规蔓生的另一个原因。如果总统受到敌对的国会掣肘，正如奥巴马执政期的大部分时间那样，那么通过联邦官僚机构发布法规来行使权力就成了一种诱惑。但是即便华府像现在这样团结统一，国会和行政部门也觉得发布新法令比废除旧的容易得多。在各州层面也是一样。

结果就是各级政府的法规层出不穷，这些法规不但会延缓创新，也阻碍了开展简单直接的任务，例如修桥。奥巴马在经济衰退后想资助一些“万事俱备，只待开工”的基建项目时，却发现很多项目都缺少开工必需的一长串许可和批准。特朗普推进的任何基建项目也会遭遇同样的障碍。

矫正这一点需要实质性的改变。奥巴马开了个温和的头，要求各机构评估旧法规。特朗普命令各机构在起草新法规前先废除旧的，这听起来粗暴，但为官僚们提供了一个颇受欢迎的动机，让他们再去看看旧的法规。这一策略在英国和加拿大都曾起到一些效果。

白宫应该支持审查法规提案的办公室。30年来它眼见着自己的员工减少了一半，而法规却已激增。国会应当指定专家来代表它审核法规，就像它在预算事宜上所做的那样。理所当然地，这个新主体也能审查旧法规。如果旧法令没有通过成本效益评估，则应当自动废止。

不幸的是，很多共和党人喜欢的方式是让行政部门难有任何作为。有些人希望每项新法规都要通过国会投票。但极少有政客能胜任复杂法规的审核，比如晦涩难懂的金融法规。这样的投票更有可能为游说者提供生财的机会，进而会产生更多的豁免。这会增加法规的复杂性并损害竞争。

美国庞杂的监管需要处理，这一点上共和党是对的。砍掉繁文缛节如果执行妥当，无疑会带来经济收益。但这是项艰苦的工作，与特朗普团队有意采用的大刀阔斧的方式相去甚远。粗暴地砍掉法规、削减预算只会让美国的环境更糟糕、更不安全。■



Brexit and financial centres

Picking up the pieces

European cities hope to scoop business from London. The size of the prize is far from clear

“WHEN the vote took place,” says Valérie Pécresse, “it was an opportunity for us to promote Île de France”, the region around Paris of which she is the elected head. Two advertising campaigns were prepared, depending on the result of Britain’s referendum last June on leaving the European Union. The unused copy ran: “You made one good decision. Make another. Choose Paris region.”

Brexit has made Paris bolder. Once Britain leaves Europe’s single market, the many international banks and other firms that have made London their EU home will lose the “passports” that allow them to serve clients in the other 27 states. Possibly, mutual recognition by Britain and the EU of each other’s regulatory regimes will persist. But no one can rely on the transition to Brexit being smooth, rather than a feared “cliff edge”. Best to assume the worst.

Britain is expected to start the two-year process of withdrawal in March. Given the time needed to get approval from regulators, find offices and move (or hire) staff, financial firms have long been weighing their options. London will remain Europe’s leading centre, but other cities are keen to take what they can.

The Parisians are pushing hardest, pitching their city as London’s partner and peer. “I don’t see the relationship with London as a rivalry,” says Ms Pécresse. “The rivalry is not with London but with Dublin, Amsterdam, Luxembourg and Frankfurt.” Especially, it seems, Frankfurt. Paris has more big local banks, more big companies and more international schools than

its German rival. London apart, say the French team, it is Europe's only "global city". When, they smirk, did you last take your partner to Frankfurt for the weekend?

In February the Parisians were in London, briefing 80 executives from banks, asset managers, private-equity firms and fintech companies. They are keen to dispel France's image as an interventionist, high-tax, work-shy place. The headline corporate-tax rate is 33.3% but due to fall to 28% by 2020. A scheme giving income-tax breaks to high earners who have lived outside France for at least five years will now apply for eight years after arrival or return, not five. The Socialists, who run the city itself, and Ms Péresse's Republicans are joined in a business-friendly "sacred union", says Gérard Mestrallet, president of Paris Europlace, which promotes the financial centre. Ms Péresse and others play down the risk that Marine Le Pen, of the far-right, Eurosceptic National Front will win the presidential election this spring.

More quietly, Hubertus Vöth of Frankfurt Main Finance (the counterpart of Paris Europlace) is "pretty confident" about his city's ability to attract more bankers. To Mr Vöth, the big prize is the clearing of trades in euros, which London dominates but which both Frankfurt and Paris hope to snaffle. The European Central Bank once tried to force clearing to move from London to inside the euro zone, but was thwarted in 2015 when EU judges ruled it lacked the necessary authority. After Brexit, it may try again.

Nicolas Mackel of Luxembourg for Finance, the grand duchy's development agency, is relatively "laid back". All are welcome, Mr Mackel says, but no taxes or regulations have been changed, nor applications fast-tracked. Business has been brisk anyway, because of the duchy's expertise with fund managers. China's big banks use Luxembourg as a continental hub.

After a slow start, the Dutch too are trying to gain from any "Brexodus". The

foreign-investment agency has expanded its (small) office in London. The Netherlands offers a high quality of life and almost everyone speaks English. But Amsterdam's financial centre lacks the scale of Frankfurt or Paris, and is short of housing and schools. A cap of 20% of salaries on bankers' bonuses is also off-putting, although the finance ministry says global banks may be exempt under certain conditions.

Dublin is keen to attract more asset managers. Irish central bankers are worried about whether they have the right expertise to regulate, say, complex trading. Some would be relieved if the hordes do not materialise. The city is already short of office space, housing, roads and international-school places.

The size of the prize is hard to gauge. Much depends on the post-Brexit agreement between Britain and the EU, and what regulators demand in capital and personnel. Banks may also shift some work out of Europe, to New York, or even Hong Kong or Singapore. Some services, warns a banker, may not be provided at all. Mr Vãth thinks that, with euro clearing, Frankfurt could see an extra 10,000 jobs or more. Arnaud de Bresson of Europlace estimates that Paris stands to gain 10,000 "direct" posts in finance and fintech, plus 10,000-20,000 in law, accountancy and so on. Europlace hasn't tried to quantify the number tied to clearing.

Different institutions have their own priorities. HSBC, a big British bank, has already said that it expects to move around 1,000 jobs to Paris, where it already has a subsidiary; some other banks still sound wary of the place, despite the best efforts of the French. Switzerland's UBS, which also says around 1,000 London jobs are at risk, set up shop in Frankfurt last year: that seems a natural base, although its bosses have also mentioned Madrid. Fund managers not already in Dublin or Luxembourg are likely to head there. Lloyd's of London, an insurance market, and Blackstone and Carlyle, two American private-equity giants, reportedly favour Luxembourg for

their EU home.

The continental European financial centres all say they have acres of space for new arrivals. There should be more than enough, at least for now.

“We’re not talking about banks moving lock, stock and barrel,” says Lee Elliott, head of commercial research at Knight Frank, a property consultancy. All banks have bases in all the main centres and after the downsizing of recent years, they still have vacant space. James Maddock of Cushman & Wakefield, another property-services firm, says that since 2008, banks in Europe have shifted 34,000 back- and mid-office jobs to eastern Europe, a further 5,050 to Ireland and 14,200 to British cities outside London. Brexit will involve fewer (if better-paid) people.

But in all the cities vying for post-Brexit trade, a common refrain is heard: we wish it wasn’t happening. In Luxembourg too, Mr Mackel says, an ad was planned for the day after the referendum: “We would have missed you.” It didn’t appear. ■



脱欧与金融中心

捡漏

欧洲城市希望能从伦敦拾得些业务，但收获多少远未明朗

“英国脱欧公投之际，”法国巴黎大区议会主席瓦莱里·佩克莱斯（Valérie Pécresse）说，“正是我们推广法兰西岛的好时机。”法兰西岛为法国首都圈，又称巴黎大区。该议会当时拟定了两套宣传活动，准备视去年6月英国脱欧公投的结果做选择。那个未被采用的文案写道：“这个决定做得好。再做一个吧，来选择巴黎大区。”

英国脱欧令巴黎更为大胆。一旦英国离开欧洲单一市场，许多以伦敦为其欧洲总部的国际银行和公司就将失去在其他27个欧盟成员国内为客户服务的“通行证”。英国和欧盟可能还会继续承认对方的监管制度，但谁也不能指望向脱欧的过渡一定是平缓的，而不是人们害怕的“断崖式”的。最好还是做好最坏的打算。

英国预计于3月启动为期两年的脱欧程序。由于监管机构审批过程长，寻觅办公地址及转移（或聘用）员工也需要时间，金融公司早已开始权衡手头的选择。伦敦仍将是欧洲领先的金融中心，但其他城市也跃跃欲试，想要分得一杯羹。

其中属巴黎最为积极，它将自己定位为伦敦的合作伙伴和同侪。“我不认为巴黎与伦敦是竞争对手的关系，”佩克莱斯说道。“我们要抗衡的并非伦敦，而是都柏林、阿姆斯特丹、卢森堡和法兰克福。”目前看来，它的头号竞争对手是法兰克福。相比这一德国对手，巴黎拥有更多大型本地银行、大公司及国际学校。佩克莱斯的团队表示，除伦敦之外，巴黎是欧洲唯一的“全球性城市”。他们得意地揶揄道，你上次带伴侣到法兰克福度周末已经是多久前的事了？

2月，这一巴黎团队来到伦敦，向银行、资产管理公司、私募股权和金融科技公司的80名高管作简要推介。法国展现出的形象是奉行干涉主义、高

税率、人们好逸恶劳，佩克莱斯的团队急切地想要消除这些成见。法国目前的企业所得税基准税率为33.3%，但到2020年将下降至28%。法国对在境外居住至少五年的高收入人士提供所得税优惠，该优惠的享受期限将从入境或回到法国起五年延长至八年。推广该市金融中心地位的巴黎欧洲金融市场协会（Paris Eurolace）主席杰拉德·梅斯特雷（Gérard Mestrallet）表示，巴黎市议会中占多数席位的社会党及佩克莱斯的共和党联手组成了主张商业友好的“神圣联盟”。对于反欧盟极右翼政党“国民阵线”的玛丽娜·勒庞（Marine Le Pen）可能在今春法国大选中胜出，佩克莱斯等人则淡化了这一风险。

法兰克福金融合作促进会（Frankfurt Main Finance，相当于巴黎欧洲金融市场协会）主席胡贝图斯·菲特（Hubertus Vath）要低调些。他对自己的城市能吸引更多银行人士“非常有信心”。对菲特来说，“大奖”在于欧元清算交易。目前伦敦在这方面占主导地位，但法兰克福和巴黎均希望能抢得控制权。欧洲央行曾试图强制将欧元清算从伦敦迁至欧元区内，但2015年欧盟法官裁定欧洲央行无权作此决定，这一努力因而受阻。英国脱欧后，欧洲央行也许将再作尝试。

卢森堡金融推广署（LFF，卢森堡大公国的推广机构）的马可宁（Nicolas Mackel）相对“淡然”。马可宁说，我们欢迎所有人，但我们并没有改变税制或法规，也没为任何申请提供“快速通道”。尽管如此，这里的业务一直都很兴隆，因为卢森堡有吸引基金管理公司的专长。中国的大型银行还利用卢森堡作为自己在欧洲大陆拓展的枢纽。

荷兰人虽然起步慢，但也正试图从这次“脱欧大撤退”（Brexodus）中有所斩获。荷兰外商投资局（NFIA）已扩大其在伦敦的（小）办事处。荷兰的优势是生活品质高，而且几乎人人都能说英语。但阿姆斯特丹作为金融中心的规模不如法兰克福或巴黎，住房及学校也很短缺。银行从业人员的奖金不得高于其年收入20%的限制也是一个不利因素。但荷兰财政部称，全球性银行或许可在某些条件下获得豁免。

都柏林渴望吸引更多资产管理公司。爱尔兰央行官员担心自己是否具备相

应的专业监管能力，例如对复杂交易的监管。假如预期的“蜂拥而至”没实现，部分人将松一口气。都柏林的办公空间、住房、道路及国际学校名额已出现短缺。

收获多少难以衡量，而且很大程度上要取决于英国和欧盟之间的“后脱欧”协议，以及监管机构对于资本和人员的要求。银行也可能会把部分工作转移到欧洲以外，比如纽约，甚至香港或新加坡。有银行家警告，一些服务可能会被完全取消。菲特认为，随着欧元清算业务的涌入，法兰克福可能新增一万个或更多的职位。巴黎欧洲金融市场协会的亚诺·德布雷松（Arnaud de Bresson）估计，巴黎将在金融和金融科技领域获得一万个“直接”职位，在法律和会计等领域还将另增一两万个职位。巴黎欧洲金融市场协会尚未尝试算出清算业务方面的新增职位数量。

不同的机构各有优先考虑的事项。英国大型银行汇丰在巴黎已拥有一家子公司，并表示预计将向巴黎转移约1000个职位；尽管法国推广团队努力再三，其他一些银行对巴黎的态度似乎仍有所保留。瑞士瑞银（UBS）也表示约有1000个在伦敦的职位面临转移风险。它去年已在法兰克福设立分支：这似乎是不二之选，不过其高层也曾考虑过马德里。外地基金管理公司很可能会到都柏林或卢森堡落户。据称，伦敦的保险交易市场劳合社（Lloyd's of London）以及美国私募股权巨头黑石（Blackstone）和凯雷（Carlyle）更愿意选择卢森堡为其欧盟基地。

欧洲大陆的金融中心均表示拥有大量空间接纳新来者。至少目前来说，空间应该是绰绰有余。“我们说的不是银行把一切都迁走了。”房地产咨询公司莱坊（Knight Frank）的商业物业研究部主管李·艾略特（Lee Elliott）说道。所有银行在各大金融中心都设有基地，近年缩减规模后，仍有空间。另一物业服务公司戴德梁行（Cushman & Wakefield）的詹姆士·马多克（James Maddock）表示，自2008年以来，欧洲的银行已把34,000份中后台职位转移到东欧，另有5050份和14,200份这类职位分别转移到了爱尔兰及伦敦以外的英国城市。英国脱欧涉及的人员流动会少些（不过这些人薪酬也更高）。

然而，在争抢后脱欧交易的所有城市中，总能听到同一调门：我们希望英国脱欧并没有发生。卢森堡也一样。马可宁说，该市原本准备了一句广告语，准备在公投后第二天推出：“我们差点就得想念你了。”但它最终并没派上用场。■



Augmented reality

Better than real

Replacing the actual world with a virtual one is a neat trick. Combining the two could be more useful

SCIENCE fiction both predicts the future and influences the scientists and technologists who work to bring that future about. Mobile phones, to take a famous example, are essentially real-life versions of the hand-held communicators wielded by Captain Kirk and his crewmates in the original series of “Star Trek”. The clamshell models of the mid-2000s even take design cues directly from those fictional devices.

If companies ranging from giants like Microsoft and Google to newcomers like Magic Leap and Meta have their way, the next thing to leap from fiction to fact will be augmented reality (AR). AR is a sci-fi staple, from Arnold Schwarzenegger’s heads-up display in the “Terminator” films to the holographic computer screens that Tom Cruise slings around as a futuristic policeman in “Minority Report”.

AR is a close cousin to virtual reality (VR). There is, though, a crucial difference between them: the near-opposite meanings they ascribe to the term “reality”. VR aims to drop users into a convincing, but artificial, world. AR, by contrast, supplements the real world by laying useful or entertaining computer-generated data over it. Such an overlay might be a map annotated with directions, or a reminder about a meeting, or even a virtual alien with a ray gun, ripe for blasting. Despite the hype and prominence given recently to VR, people tend to spend more time in real realities than computer-generated ones. AR thus has techies licking their lips in anticipation of a giant new market. Digi-Capital, a firm of analysts in California, reckons that of the \$108 billion a year which it predicts will be spent by 2021 on VR and AR combined, AR will take three-quarters.

| *Improving on the world*

Like many science-fictional technologies, AR is in fact already here—just unevenly distributed. An early version was the heads-up displays that began to be fitted to jet fighters in the 1950s. These projected information such as compass headings, altitude and banking angles onto the cockpit canopy. Such displays occasionally turn up in cars, too. But only now, as computers have shrunk enough and become sufficiently powerful, has it become possible to give people a similar sort of experience as they go about their daily lives.

Last year, for instance, the world was briefly entranced by an AR smartphone game called Pokémon Go. Players had to wander the world collecting virtual monsters that were, thanks to their phones' cameras, drawn over a phone's-eye view of a building's lobby or a stand of trees. Apps such as Snapchat, which features image filters that permit users to take pictures of themselves and others wearing computer-generated rabbit ears or elaborate virtual make-up, are another example.

There are less frivolous uses, too. Google's Translate app employs computer vision, automatic translation and a smartphone's camera to show an image of the world that has text, such as items on menus and street signs, interpreted into any of several dozen languages.

Apps like Snapchat and Translate rely on machine-vision algorithms to work their magic. Snapchat is designed to detect faces. This works well enough, but means that the bunny ears can be applied only to heads. Translate, similarly, looks for text in the world upon which to work its magic. But smartphone-makers have bigger plans.

At the end of last year Google and Lenovo, a Chinese hardware manufacturer, unveiled the Phab 2 Pro, the first phone to implement a piece of Google technology called Tango. The idea is that, by giving the

phone an extra set of sensors, it can detect the shape of the world around it. Using information from infra-red detectors, a wide-angle lens and a “time-of-flight” camera (which measures how long pulses of light take to reflect off the phone’s surroundings) Tango is able to build up a three-dimensional image of those surroundings. Armed with all this, a Tango-enabled phone can model a house, an office or any other space, and then use that model as a canvas upon which to draw things.

To give an idea of what is possible, Google has written apps that would be impossible on Tango-less phones. “Measure”, for instance, overlays a virtual tape measure on the phone’s screen. Point it at a door, and it will tell you how wide and high that portal is. Point it at a bed, and you get the bed’s dimensions—letting you work out whether it will fit through the door. Another Tango app is the oddly spelled “Woorld”, which lets users fill their living rooms with virtual flowers, houses and rocket ships, all of which will interact appropriately with the scenery. Place the rocket behind a television, for instance, and the set will block your view of it.

| *Through a pair of glasses, virtually*

The effect Tango gives is impressive, but the technology is still in its early stages. Building 3D models of the world is computationally demanding, and quickly drains even the Phab 2 Pro’s beefy battery. The models themselves quickly use up the phone’s data-storage capacity. And the touchscreen of a phone is a clumsy way of communicating with the software. Some enthusiasts of augmented reality therefore think that the technology will not take off properly until smartphones can be abandoned in favour of smart spectacles that can superimpose images on whatever their wearers happen to be looking at.

Such glasses do exist. So far, though, they have made a bigger impact on the workplace than in the home. Companies such as Ubimax, in Germany, or Vuzix, in New York, make AR spectacles that include cameras and sensors,

and which use a projector mounted on the frame to place what looks like a small, two-dimensional screen into one corner of the wearer's vision.

Used in warehouses, for instance, that screen—in combination with technology which tracks workers and parcels—can give an employee instructions on where to go, the fastest route to get there and what to pick up when he arrives, all the while leaving both of his hands free to move boxes around. Ubimax reckons that could bring a 25% improvement in efficiency. At a conference in London in October, Boeing, a big American aeroplane-maker, described how it was using AR glasses to give workers in its factories step-by-step instructions on how to assemble components, as well as to check that the job had been done properly. The result, said Paul Davies of Boeing's research division, is faster work with fewer mistakes.

The one serious attempt to offer individual consumers such technology did not, though, go well. Like Vuzix's and Ubimax's products, Google's "Glass", unveiled in 2013, was a pair of spectacles with a small projector mounted on one arm. The idea was, in effect, to create a wearable smartphone that would let its user make calls, read e-mails, see maps and use the Glass's built-in GPS to navigate, all the while leaving his hands free for other tasks.

The problem was not with the users. Google's "Glass Explorers"—those willing to pay \$1,500 for early access to the hardware—seemed happy enough. But, often, those they interacted with were not. Glass Explorers quickly attracted the nickname "Glassholes" from those annoyed by their proclivity to glance at e-mails in the middle of a conversation, or worried that the device let wearers record everything going on around them. (Some restaurants banned Glass users on privacy grounds.) Google stopped making Glass early in 2015, although it is working on a new version aimed at businesses instead of individuals.

Other firms have more limited ambitions, but may do better for that.

RideOn, for instance, is an Israeli outfit founded by three engineers with experience in designing heads-up displays for aircraft. It will soon start selling augmented-reality ski goggles. The idea is to turn skiing into a video game, by showing users routes, letting them time runs, compete with their friends, shoot footage and the like.

Some companies are building much more capable displays. Instead of 2D images, they propose to create augmented reality in three dimensions. In March 2016 Microsoft began making early versions of a headset called the HoloLens available to software developers around the world. Unlike the AR glasses produced by Vuzix and Ubimax, or Google's Glass, the HoloLens can draw 3D images that appear to exist in the real world. Users can walk around a virtual motorbike, for instance, to inspect it from behind, or place virtual ornaments on real tables or shelves.

It is, in other words, like a Tango-enabled smartphone—only much more capable. The device's cameras, derived from the Kinect (an accessory originally developed for Microsoft's Xbox 360 games console), scan the world around it. Those cameras generate such a flood of information that Microsoft has had to design a special chip to process all the incoming data. Armed with that understanding, and with the ability to track the position of its user's head, the machine can tailor its graphics accordingly: making a virtual motorbike appear to be standing on a real floor, for instance. The same cameras let the wearer interact with the machine via voice commands, by making gestures in mid-air, or by tracking precisely where he is looking.

Unlike VR headsets, which must be connected to either a PC or a smartphone to work, the HoloLens is a self-contained computer that needs no accessories. Users view the world through a pair of thick, transparent lenses. A pair of projectors feed light into the top of these lenses. Three optical waveguides (one each for red, green and blue light—the primary

colours from which others can be created) funnel that light down the lenses before bending it through 90° and into the user's eyes.

By overlaying its images onto the real world, the HoloLens headset turns reality into a computer monitor. A window containing a Skype call can be placed onto an office wall, disappearing when the user looks away and returning when he looks back at it. A computerised calendar can be placed on the desk (or the ceiling, if you prefer). All this information can be seen without having to cut yourself off completely from the outside world, as a VR headset would require.

Some of the first demonstrations of the HoloLens involved games. In one, users blasted aliens that took cover behind their living-room sofas. In a second, they played with blocks from Minecraft, a sort of virtual Lego, on their living-room tables. More recent apps have focused on business and training. One such, developed in collaboration with Case Western Reserve University, in Cleveland, projects a human body into the room to help with the teaching of anatomy. A wave of the hands can add muscles to the skeleton, or bring the heart out of the chest to examine it more closely.

| *Augmenting the enterprise*

The HoloLens can be used collaboratively, as well. Another demo has someone being instructed how to repair a light-switch by someone else, who is employing videoconferencing software in another room to do so. The guide can see what the HoloLens user sees, and can draw on top of his field of view—putting circles around objects of interest or highlighting the correct tool in a box. ThyssenKrupp, a German engineering firm, is experimenting with giving the devices to its lift repairmen. Should anyone encounter a particularly difficult job, he can call head office for specialist advice. Users can also connect to each other and see the same augmented reality (in true science-fiction style, other users appear as golden, androgynous, vaguely Art Deco-looking figures).

Aecom, an international firm of architects and engineers, is already using the HoloLens to help design buildings. Modern building projects can be very complicated, says John Endicott, one of Aecom's executive directors—to the point where even experienced designers have trouble keeping everything in their heads.

In 2016 the firm designed buildings around the Serpentine art gallery, in London. Mr Endicott observes that, “the roofs of these things had very complex geometry. We simply couldn't check it on a 2D screen, but the HoloLens let us all review it together.” Trimble, an American engineering firm, helped Aecom develop the system. “We're also finding it has applications in everything from mining to agriculture to facilities management,” says Aviad Almagor, the director of Trimble's “mixed reality” programme. “You can do things like track assets [such as miners, lorries or equipment] as they move round a 3D model of a mine, in real time.”

The HoloLens is far from perfect, however. The AR magic happens in only a small slice of a user's view (some have likened it to looking in on the computer-generated world through a letterbox). Though the headset is light (weighing around 600g) and comfortable, it is bulky and not exactly fashionable. And using the gesture-tracking system to interact with the illusions the headset generates can feel clunky and awkward. It is not yet on general sale, but when it is (Microsoft has given no firm date) its price tag—also unknown, though the versions sold to software developers go for at least \$3,000—is likely to make it a business-only proposition.

Microsoft is not the only firm working on advanced AR headsets. One rival is Meta, in San Mateo, California. Compared with Microsoft this firm is a tiddler, having raised only \$73m in funding so far. But its engineers promise a much wider field of view than the HoloLens's. Microsoft's product can track a few hand gestures. Meta's is designed to keep a constant eye on exactly what a user's hands are up to, letting him “handle” virtual

objects simply by picking them up and rotating them.

Another potential rival, Osterhout Design Group, in San Francisco, which makes AR glasses for industrial and medical companies, has announced two products aimed at individuals. Though less technically capable than the HoloLens, both are sleeker than their rival. Microsoft's best-known competitor in this area, though, is Magic Leap, a firm founded in Florida in 2010, which has attracted \$1.4 billion in investment from companies such as Google and Ali Baba, China's biggest online retailer, as well as plenty of attention for its snazzy promotional videos. It has kept its technological cards close to its chest—to the point where some sceptics think that its technology has been oversold. But the demos it has released show images much clearer and crisper than those Microsoft can manage with the HoloLens.

| *Curb your enthusiasm*

For all the hype, AR is still at an early stage, especially as a consumer technology. Forecasts of markets worth squillions by the end of the decade should be taken with a good deal of salt, especially since virtual reality, AR's close and even-more-hyped cousin, has so far proved a bit of a damp squib. No VR headset-maker has yet released official sales figures, but the numbers that have trickled out look modest.

In October 2016 Cher Wang, chairwoman of HTC, a Taiwanese consumer-electronics company, told 87870 News, a Chinese website, that her firm had sold 140,000 of its Vive headsets since their launch the previous April. (By way of comparison, Apple sells more than 870,000 iPhones a day.) In November SuperData, a market-research firm in New York, described VR as “the biggest loser” in the American shopping season around Thanksgiving, and cut its sales forecasts for Sony's PlayStation VR headset in 2016 from 2.6m to 750,000. Even among keen techies, enthusiasm for VR seems limited. A survey by Steam, an online shop that dominates the market for

PC gaming, found that just 0.38% of its customers owned a VR headset in December, a number unchanged from the previous month.

If AR is not to go the same way, it will have to be made easier to use. That probably means consumer versions will be adapted for peoples' phones. As Tim Merel, Digi-Capital's boss, points out, phones are a known quantity that people are comfortable with. They have become, for many, their default computing device. Their existing app stores offer developers an easy way to sell software, and their business model—in which the cost of the hardware is often subsidised by network operators, who recoup this investment with fees and rental charges as they go along—could help draw some of the financial sting of the initial outlay a customer must make. On the other hand, a phone's screen is small and fiddly, and holding it up every time you want to use an AR app could become tedious.

Headsets such as the HoloLens offer a way around this problem. Those currently in development will cost thousands of dollars and look more than a little silly. For now, that will limit their uptake to companies, which can afford the hardware and are less worried about the aesthetics. But the hope is that the mix of sensors and computing power needed to run AR can be shrunk to the point where, as Mark Zuckerberg, Facebook's boss, put it at a show for developers last April: "we're going to have what look like normal-looking glasses that can do both virtual and augmented reality." Others want to go further still. Samsung and Apple, for instance, are exploring the idea of AR-enabled contact lenses.

For now, such devices remain far away. Those in the computing industry like to talk of an "iPhone moment", when a well-crafted product launches, almost single-handedly, a new phase of the computing revolution. But such moments are the culmination of years of research into, and development of, many different technologies. The iPhone was not the first smartphone. No self-respecting salaryman of the mid-2000s was without a BlackBerry,

and the basic idea can trace its ancestry back at least as far as the hand-held personal digital assistants of the 1990s. None of the present approaches to AR seems likely to change the world as the iPhone did. But those behind them hope that, one day, a combination of them will. ■



增强现实

比真实更好

用虚拟世界取代真实世界是一个漂亮的技巧，将两者结合起来则更加实用

科幻作品既预测未来，也影响了致力于实现这种未来的科学家和技术人员。一个著名的例子是手机。《星际迷航》（Star Trek）“原初系列”电视剧中，寇克舰长及其船员们手中挥舞着一些手持式通讯设备。手机实质上就是它们的现实世界版本。2005年左右流行的翻盖式手机甚至是从这类虚构的设备中直接汲取了设计灵感。

从微软和谷歌之类的巨头，到Magic Leap和Meta等创业公司，如果这些企业都能实现自己的创想，那么从虚构一跃成为现实的下一个事物将是增强现实（AR）。AR是科幻的一个主要元素：阿诺·施瓦辛格在电影《终结者》中使用平视显示器；汤姆·克鲁斯在《少数派报告》中扮演的未来派警察在空中随手一挥就出现了全息电脑屏幕。

AR是虚拟现实（VR）的近亲，但两者有着重大的差异：它们赋予“现实”一词的意义近乎相反。VR的目标是把用户放进一个逼真的世界，但这个世界是人为创造的。相反，AR在真实世界上叠加由电脑生成的有用或是有趣的数据，从而对真实世界做出补充。这层叠加的信息可能是一张加注了方向的地图、一个会议提醒，或者甚至是一个虚拟的外星人手持一把激光枪准备射击。尽管近来VR获得大量的宣传和关注，但人们在真实的现实中花费的时间往往比在电脑生成的“现实”中要多。所以技术达人们正垂涎欲滴地期待着一个巨大的AR新市场。加州分析公司Digi-Capital预计到2021年，每年花在VR和AR上的费用总额将高达1080亿美元，其中AR将占到四分之三。

| 改善世界

和许多科幻技术一样，AR实际上已经存在，只是分布不均。它的一个早期版本是自1950年代开始安装在喷气式战斗机上的头顶显示器。它们将罗盘航向、海拔高度、倾斜角度等信息投射到驾驶舱盖上。这类显示有时也

出现在汽车中。然而只有到了现在，当计算机变得足够小且足够强大，人们才可能在日常生活中获得类似的体验。

比如，去年，全世界曾一度为一款名为精灵宝可梦Go（Pokémon Go）的手机AR游戏着迷。玩家们需要到处乱走来抓捕虚拟的小怪兽。这些精灵被叠加在手机摄像头扫视的楼房大厅或树丛里。另一个例子是Snapchat这类应用。Snapchat带有的图像滤镜让用户可以在给自己或别人拍照时添加计算机生成的兔子耳朵或精致的虚拟妆容。

也有更正儿八经的应用。谷歌的Translate利用计算机视觉、自动翻译以及智能手机的摄像头来显示带有文字的图像，比如对准餐单上的选项和路标时，即可将这些文字翻译成几十种语言中的任何一种。

像Snapchat和Translate这类应用依赖机器视觉算法发挥魔力。Snapchat设计为自动识别面部，这项功能的效果足够好，但也意味着兔子耳朵只会被添加在头顶。同样地，Translate寻找真实世界中存在的文字来施展自己的魔法。但智能手机制造商的计划还不止于此。

去年底，谷歌和中国硬件制造商联想发布了Phab 2 Pro手机。这是首款可运行谷歌Tango技术的手机。它的创意是这样的：给手机安装一套额外的传感器，让它能够识别周遭环境的形状。运用来自红外探测器、广角镜头以及“飞行时间”摄像头（测算光脉冲从周遭物体反射的时长）的信息，Tango能对周遭物体描绘出三维图像。配备了这些设置后，装载了Tango的手机可以给一栋房子、一间办公室或任何其他空间都建立模型，而后把该模型当作画布，在上面添加东西。

为了让人们明白这项技术到底可以拿来干什么，谷歌设计了一些在没有装载Tango的手机上无法运行的应用。比如，Measure这款应用在手机屏幕上添加了一条虚拟卷尺。把它指向一扇门，它会告诉你门的宽度和高度。把它指向一张床，你就能得到这张床的尺寸，这样你就知道它是否可以通过这扇门。另一款Tango应用的名字有点奇怪——Woorld。它让用户在客厅里添加虚拟的鲜花、房屋、火箭飞船等等，所有添加物都会和整个场景

恰当互动。比如，把火箭放在电视机的后方，电视机就会把它挡住了。

| 透过一副虚拟眼镜

Tango产生的效果让人眼前一亮，但这项技术仍处于初期阶段。打造世界的3D模型对计算的要求很高，哪怕是Phab 2 Pro配备的强劲电池也会很快耗尽。那些模型本身又会很快用完手机的数据存储量，而用手机触摸屏和软件沟通也显笨拙。所以有些AR爱好者认为这项技术难以真正腾飞，直到智能手机被智能眼镜取代。这种眼镜可以把图像叠加在佩戴者看到的任何景象上。

这种眼镜确实存在，但目前为止它们对工作场所的影响要比对家庭的影响更大。德国的Ubimax或纽约的Vuzix这类公司制造的AR眼镜带有摄像头和传感器，镜框上方装有一台投影仪，把一个二维小屏幕投射到佩戴者视野的一角。

举例而言，在仓库里使用时，将这个屏幕和追踪工人及包裹位置的技术相结合，就可以对员工给出指示：该去哪里、到达那里的最快线路、到达后该拿什么，而与此同时他可以腾出两只手来搬箱子。Ubimax估计这能将效率提升25%。在去年10月于伦敦举行的一次会议上，美国大型飞机制造商波音描述了该公司如何使用AR眼镜来为组装零部件的工厂工人提供分步骤指令，以及检查工作是否被正确完成。波音研究部门的保罗·戴维斯（Paul Davies）说，这提高了效率，减少了失误。

不过，曾有公司认真地尝试为个人消费者提供这种技术，却不太成功。谷歌在2013年推出的“谷歌眼镜”和Vuzix和Ubimax的产品类似，也在一根镜脚上安装了一台小型投影仪。它的构想实际上是一台可穿戴手机，佩戴者可以打电话、看邮件、查地图，并用眼镜内置的GPS来导航，并可以始终腾出两只手来干其他事。

问题没出在使用者身上。谷歌的“眼镜探索者”们愿意花费1500美元来尝试最早的版本，他们看起来很满意。但和他们互动的人常常不太高兴。这些人很快就给“眼镜探索者”取了个“眼镜混蛋”（Glassholes）的绰号，他们因

为对方忍不住在聊天中途瞥一眼邮件而感到恼火，而且还担心整个聊天过程会被眼镜记录下来。（一些餐馆出于隐私的顾虑禁止人们在店内佩戴这种眼镜。）谷歌在2015年初停产这幅眼镜，不过它正在研制一个新版本，专门针对企业而非个人用户。

其他公司的野心没那么大，却可能做得更好。比如以色列的RideOn公司，它的三位工程师创始人都有为飞机设计头顶显示器的经验。它很快就将开始出售AR滑雪眼镜。其设想是将滑雪变成一种视频游戏，向玩家显示路线、让他们为每一次滑雪计时、和朋友们比赛、拍下视频等。

有些公司正在研制强大得多的显示器。它们计划创造三维而非二维的AR影像。2016年3月，微软开始制造HoloLens头戴设备的早期版本，向全球软件开放者发售。和Vuzix、Ubimax的AR眼镜或谷歌眼镜不同，HoloLens可以绘制出仿佛存在于现实世界的三维图像。比如玩家可以围绕一台虚拟的摩托车走动，从后方仔细查看它，或者在真实的桌子和柜子上放置虚拟装饰品。

换言之，这就像一台装载了Tango的手机，只不过功能要强大得多。该设备的摄像头从Kinect（为微软的Xbox 360游戏机开发的配件）演变而来，会环视周围的世界。这些摄像头生成了庞大的信息流，微软不得不设计一个专用芯片来处理所有导入的数据。在配备这么强大的信息武装后，结合追踪用户头部位置的功能，这台机器就可以相应地调整其图形，比如让一台虚拟的摩托车看上去像是放置在真实的地板上。同样的这套摄像头还可以让玩家通过语音指令、在半空中做手势，或精确追踪其视线来和机器互动。

VR头戴设备必须和一台个人电脑或智能手机连接才能运作，HoloLens却不需要，它本身就是一台完备的计算机，无需配套设备。玩家透过一副很厚的透明镜片来观察外界。两个投影仪把光投向镜片的上方。三个光波导管（分别传导红、绿、蓝三原色光）向镜片下方传输光，然后将其弯折90度后投入用户的眼睛。

HoloLens把它生成的图像叠加到真实世界上，从而把现实变成了一台电脑显示器。一个包含Skype通话程序的窗口可以被投射到办公室的墙上，当用户的目光移开时会自动关闭，目光移回时又会重新打开。一台数字日历可以被放在办公桌上（或天花板上——如果你喜欢的话）。和VR头戴设备不同，你无需与外部世界完全隔绝就能看到所有这些信息。

HoloLens最初的一些展示包含了游戏。在其中一款游戏中，玩家轰炸躲在客厅沙发后的怪兽。在另一款游戏中，他们在客厅的桌子上玩虚拟乐高游戏Minecraft中的积木。更新一些的应用专注于商家和培训。其中之一是和克里夫兰的凯斯西储大学（Case Western Reserve University）合作开发的。它把一个人体投射到房间内，辅助解剖学教学。挥一挥手就可以把肌肉加到骨骼上，或从胸部掏出心脏来仔细检查。

| 增强企业

HoloLens还可以协作使用。另一则演示视频显示了如何指导一个人修电灯开关。指导者在另一个房间里使用视频会议软件给出指示。他可以看到佩戴HoloLens的人所看到的画面，并在他的视野上画图，比如在某个相关内容上画个圈，或者突出显示工具箱里那个正确的工具。德国工程企业蒂森克虏伯（ThyssenKrupp）正在尝试让它的电梯修理工使用这套设备。如果有人遇到尤其难以解决的问题，他可以再致电总公司寻求专家的意见。用户们也可以相互连接来看到同样的增强现实景象（在真正的科幻风中，其他玩家会以金色、亦男亦女、略带装饰艺术风格的形象出现在画面中）。

国际建筑师和工程师企业Aecom已经使用HoloLens来帮助设计建筑。公司的执行董事之一约翰·恩迪科特（John Endicott）说，现代建筑项目有时可以非常之复杂，即便是经验丰富的设计师也难以记住所有事项。

2016年，该公司设计了伦敦蛇形画廊周围的建筑。恩迪科特观察称：“这些楼房的屋顶是非常复杂的几何结构。我们无论如何都无法在二维屏幕上查看它们，而HoloLens让我们可以一眼看到全景。”美国工程企业天宝导航（Trimble）帮助Aecom发展了这套系统。“我们还发现它可以被应用于

采矿、农业、设施管理等各种领域。”天宝“混合现实”项目的主管阿维亚多·阿尔马戈（Aviad Almagor）说。“当它们实时来回移动一个矿场的三维模型时，你可以做追踪资产（比如矿工、矿车或设备）等各种事情。”

然而HoloLens还远不完美。AR的魔力只发生在玩家视野的一小块区域（有些人把这比做透过信箱的投信口窥看一个计算机生成的世界）。虽然这幅眼镜很轻（约重600克）也很舒适，但它很大，看起来也不大时髦。当使用手势跟踪系统来和设备生成的幻像互动时，体验会不够灵活流畅。它目前尚未公开发售，而一旦开始销售（微软没有提供明确日期），其售价很可能令它的用户仅限于企业。这一售价迄今未知，但出售给软件开发者的版本最低价格为3000美元。

微软并不是唯一一家研发高端AR头戴设备的公司。它的一个竞争对手是位于加州圣马刁（San Mateo）的Meta。和微软相比，这家公司只是一只小虾米，到目前为止只融资了7300万美元。但它的工程师们承诺创造出视野远较HoloLens宽广的设备。微软的产品只能追踪少数几个手势。Meta则被设计成能一直观测玩家的手要做什么，让他能够用手“操作”虚拟物体——只要拿起来并转动物体就可以了。

另一个潜在对手、旧金山的ODG公司（Osterhout Design Group）为工业和医疗企业制造AR眼镜，已经公布了两款针对个人的产品。虽然它们在技术上没有HoloLens那么强大，但外观更漂亮。不过，微软在这个领域里最为人熟知的对手是Magic Leap，该公司于2010年在佛罗里达创办，已从谷歌和中国最大的网上零售商阿里巴巴等公司融资14亿美元，也因其炫目的推广视频获得了大量关注。它对自家技术三缄其口的程度使得一些怀疑论者认为它故弄玄虚。但在它发布的演示视频中可以看到，其图像要比微软的HoloLens清晰和锐利得多。

| 给你的热情泼泼凉水

尽管被大肆炒作，AR仍处于初期阶段，尤其是作为一项消费者技术而言。有些人预测到这个十年结束时其市场价值亿万，对此不可轻信，尤其是AR的近亲、被捧得更厉害的VR到目前为止有点像一记哑炮。目前还没

有VR头戴设备制造商公布过官方销售数据，但逐渐透露出来的数字看起来实属平平。

2016年10月，台湾消费电子产品企业宏达电（HTC）的董事长王雪红对中国网站“87870 虚拟现实新闻中心”（87870 News）表示，她的公司自2015年4月发布Vive头戴设备以来共销售了14万台该设备（相比之下，苹果每天卖出超过87万台iPhone）。11月，纽约市场调研公司SuperData形容VR是美国感恩节销售季“最大的输家”，并将它对索尼PlayStation VR头戴设备2016年销售量的预测从260万台下调至75万台。即便是在狂热的科技迷当中，对VR的热情看来也很有限。在PC游戏市场占据主导优势的在线商城Steam的一项调查发现，其顾客中仅有0.38%的人在去年12月拥有一台VR头戴设备，相较11月的数字并无变化。

如果AR不想重蹈覆辙，那么它得变得更易操作。这可能会意味着消费者版本的AR需要针对手机来做调适。正如Digi-Capital的老板蒂姆·梅雷尔（Tim Merel）所指出，手机的数量之大已是既成事实，人们使用手机已很顺手。它们已成为许多人默认的计算设备。手机现有的应用商店也为开发者销售软件提供了方便的途径，而它们的商业模式（硬件成本通常由网络运营商资助，它们通过对使用网络收取费率和租赁费拿回投资）可以让消费者者无需一次性拿出一大笔钱来购买设备，从而缓解财务上的压力。但另一方面，手机的屏幕太小太过精细，如果每次想使用AR应用时都得举起手机，可能也会让人厌烦。

HoloLens这类头戴设备提供了一种解决方案。目前开发中的设备售价将达数千美元，看上去也不止一点点傻。目前而言，这会让它们的客户仅限于买得起硬件又不那么关心审美的企业用户。不过，希望在于运行AR所需的传感器和计算能力都会缩减到较低的程度，就如Facebook的老板扎克伯格在去年4月的一次开发者大会上所言：“我们将会拥有看上去如同普通眼镜的设备，它们可以同时实现虚拟和增强现实的体验。”其他人还想走得更远。比如三星和苹果正在探索AR隐形眼镜。

目前，这类设备离我们还很遥远。那些身在计算行业的人喜欢说“iPhone

时刻”——当一个精心制作的产品发布时，它几乎能单枪匹马地开启计算革命的新阶段。但这样的时刻是经过许多不同技术延续多年的研发才达到的顶峰。iPhone并不是第一台智能手机。在2005年前后，没有哪个自尊的白领手里没有一台黑莓手机，而手机基本创意的产生至少可追溯到上世纪九十年代的手持式PDA。目前的AR设备看起来无一会像iPhone那样改变世界，但那些开发AR的人们希望，某天它们组合起来会创造这样的时刻。





American trade policy

Plan of action

The Trump administration's trade strategy is dangerously outdated

ON THE campaign trail, Donald Trump's trade policy was an alarming mixture of coruscating complaints and fierce threats of protectionist retaliation. But the world has been in the dark about how much of this rhetoric his administration might turn into reality. A flicker of light came on March 1st as the administration's trade-strategy document was presented to Congress. Washington wonks see the hand of Peter Navarro, Mr Trump's trade adviser and author of a book (and film) called "Death by China". Robert Lighthizer, the nominee for the United States Trade Representative (USTR), has not yet been confirmed.

Little is new in the document's promises of "new and better trade deals" or of strict enforcement of American trade laws. But a preference for bilateral trade deals over multilateral ones is a change of tack. And the tone is certainly confrontational: "It is time for a more aggressive approach." The document also gives an indication of how a Trump administration might take a trade fight to China: by using sections 201 and 301 of the Trade Act of 1974.

The first weapon, section 201, allows tariffs to be imposed as a safeguard to protect American producers from a surge of imports. Affected companies must show that they have suffered "serious injury", but need not prove any unfair practice by the foreign firms.

Mr Trump's trade team may be reliving the experience of the Reagan administration, which in 1983 slapped an extra 45% tariff on imports of motorcycles in response to a petition from Harley-Davidson, an American manufacturer. Mr Trump has referred to this as having had a "big impact".

But as a trade-enforcement tool, section 201 has drawbacks. Proving a case can be tricky, since there is a high legal threshold for proving injury and the adjudicator, the International Trade Commission, is an agency respected for its independence. (The Department of Commerce, which makes rulings on anti-dumping, is seen as a softer touch.) Moreover, indiscriminate use of the provision will provoke other countries into retaliation. In 2002 America tried to slap tariffs of 30% on steel in violation of the World Trade Organisation's (WTO) rules, but was forced to retract when faced with the threat of \$2.2bn-worth of tit-for-tat tariffs on exports ranging from sunglasses to orange juice.

The second weapon in the arsenal, section 301, is "scarier" than 201, says Kim Elliott, a trade expert. "The grounds for taking action are less well-defined." It allows the administration to take action against "unfair" trade practices. America used to invoke this section to hit its trade opponents before disputes could be dealt with by the General Agreement on Tariffs and Trade, the WTO's precursor.

Since the establishment of the WTO in 1995, the section has fallen into disuse, on the understanding that it could be implemented if a WTO ruling went in America's favour and authorised tariffs on a trading partner that was breaking the rules. The fear, however, is that last week's mention of section 301 implies the Trump administration might start going outside the global rules of the WTO system. Intensifying the alarm is that an entire section of the strategy document focuses on defending American "national sovereignty over trade policy". It also emphasises that a WTO ruling against America need not automatically lead to a change in American law or practice.

The document complains about the weakness of WTO rules. The implicit target is China. In one of the most important of several disputes which are currently working their way through the WTO courts, China challenges

America's refusal to treat it as a "market economy". If the WTO granted China "market-economy status", it could limit the level of WTO-compliant tariffs America could impose on its exports.

The echoes of the Reagan glory days seem to ignore how much the world has changed since the 1980s. Then the main object of America's trading ire was Japan, an ally, which was both far smaller and often loth to retaliate when hit with trade measures. China is bigger and happier to fight back. For all its flaws, the WTO may be the best defence against an all-out trade war. In the words of Carla Hills, a USTR in the early 1990s: "without the WTO it would be the law of the jungle." ■



美国的贸易政策

行动计划

特朗普政府的贸易策略严重过时

在竞选期间，每当谈及贸易政策，唐纳德·特朗普或是厉声控诉，或是气势汹汹地威胁要采取带有保护主义色彩的报复手段，令人担忧。不过世界并不清楚特朗普政府会在多大程度上将这些堂皇的高谈付诸实践。3月1日提交国会的贸易政策议程报告微露端倪。华盛顿的政策专家们从中嗅到了彼得·纳瓦罗（Peter Navarro）的影响。纳瓦罗是特朗普的贸易顾问，也是《致命中国》（Death by China，后被改编为同名影片）一书的作者。罗伯特·莱特西泽（Robert Lighthizer）已被提名为美国贸易代表署（USTR）代表，但尚未获得国会批准。

无论是许诺要为美国争取“新的更好的贸易协定”，还是要严格执行美国贸易法，报告在这些方面无甚新意。不过它偏向双边贸易协定更甚于多边贸易协定，这是一种方针上的转变。报告的口气无疑很强势：“眼下需采取更为强硬的手段。”此外它还显露出这样一个迹象：特朗普政府也许会动用1974年《美国贸易法》的201及301条款向中国发起贸易战。

作为这场战斗的第一件武器，201条款允许美国以关税作为一种防护措施，在面临进口商品大量涌入时保护美国的生产商。受影响的公司必须证明自己遭受“严重损害”，但无需证明外国公司在贸易中采取了不公平的手段。

特朗普的贸易团队似乎是在重温里根时代的经验。1983年，里根政府应美国摩托车制造商哈雷戴维森（Harley-Davidson）的请求，向进口摩托车额外征收45%的关税。特朗普曾称此事产生了“重大影响”。然而201条款作为一种贸易执法工具却也存在不足。要举证并不容易，因为公司要证明自身遭受损害有很高的法律门槛，此外作为裁判者的国际贸易委员会（International Trade Commission）又是一个因其独立性而受尊重的机构。（在企业看来，裁决反倾销案的美国商务部要好对付些。）除此之

外，随意施用这一条款还会刺激其他国家采取报复手段。2002年美国曾罔顾世界贸易组织（WTO）的规定，试图对进口钢材征收30%的关税，但在贸易伙伴威胁要对包括太阳镜、橙汁在内的各类美国出口产品征收总价值高达2.2亿的报复性关税后，美国不得不撤回了这项决定。

特朗普军火库中第二件武器是301条款。贸易领域的专家金·艾略特（Kim Elliott）称此条款要比201条款“可怕些”。相比之下，它“采取行动的依据界定得不是那么清楚”。301条款使美国政府可以针对“不公平”的贸易行为采取行动。美国曾援引这一条款来打击自己的贸易对手，而后留待WTO的前身《关贸总协定》来解决争端。

自1995年WTO成立以来，美国已弃用该条款。美国认同如果WTO的裁决对美国有利并批准美国向违反规则的贸易伙伴征收关税，实际上等同于贯彻301条款。不过令人担忧的是，上周这份报告对301条款的提及暗示特朗普政府也许会逐步脱离WTO体系下的全球性规则行事。报告专门辟出一个章节阐述要捍卫美国“在贸易政策方面的国家主权”，这更是加剧了世界的恐慌。报告还强调，即便WTO对美国做出了裁决，也不意味着美国的法律或贸易行为就要自动进行调整。

这份报告抱怨WTO组织规则不够强硬——虽未言明，但所指的对象就是中国。最近WTO法庭正在处理的数起中美贸易争端中，最重要的一起就是美国因拒绝认可中国是“市场经济”而遭到后者的挑战。如果WTO承认中国的“市场经济地位”，美国对中国出口商品征收的符合WTO规则的关税水平会受到限制。

特朗普贸易团队想重现里根时代的辉煌，但似乎忘记了今日世界已和上世纪80年代大不相同。那时在贸易中激怒美国的主要是日本。美国的这个盟友经济体量小得多，在遭受贸易措施打击时也不愿积极反击。中国的经济规模则更大，而且还很乐意以牙还牙。尽管存在缺陷，WTO也许仍是防御全面贸易战爆发的最佳手段。用上世纪90年代初美国贸易代表卡拉·希尔斯（Carla Hills）的话来说，“如果没有WTO，那就只剩丛林法则了。”■



Politics and sentiment

Utopia of reason

A moral psychologist argues for setting aside feelings in favour of facts

IN an age of partisan divides it has become popular to assert that the wounds of the world would heal if only people made the effort to empathise more with each other. If only white police officers imagined how it feels to be a black man in America; if only black Americans understood the fears of the man in uniform; if only Europeans opposed to immigration walked a mile in the shoes of a Syrian refugee; if only tree-hugging liberals knew the suffering of the working class.

Barack Obama warned of an empathy “deficit” in 2006, and did so again in his valedictory speech in January: “If our democracy is to work in this increasingly diverse nation,” he said, “each one of us must try to heed the advice of one of the great characters in American fiction, Atticus Finch, who said, ‘You never really understand a person until you consider things from his point of view...until you climb into his skin and walk around in it.’”

It is a piece of generous, high-minded wisdom with which few would dare to disagree. But Paul Bloom, a psychologist at Yale University, does disagree. His new book, “Against Empathy”, makes the provocative argument that the world does not need more empathy; it needs less of it. People are bingeing on a sentiment that does not, on balance, make the world a better place. Empathy is “sugary soda, tempting and delicious and bad for us”. In its stead, Mr Bloom prescribes a nutritious diet of reason, compassion and self-control.

To be clear, Mr Bloom is not against kindness, love or general good will toward others. Nor does he have a problem with compassion, or with

“cognitive” empathy—the ability to understand what someone else is feeling. His complaint is with empathy defined as feeling what someone else feels. Though philosophers at least as far back as Adam Smith have held it up as a virtue, Mr Bloom says it is a dubious moral guide. Empathy is biased: people tend to feel for those who look like themselves. It is limited in scope, often focusing attention on the one at the expense of the many, or on short-term rather than long-term consequences. It can incite hatred and violence—as when Donald Trump used the example of Kate Steinle, a woman murdered by an undocumented immigrant, to drum up anti-immigrant sentiment, or when Islamic State fighters point to instances of Islamophobia to encourage terrorist attacks. It is innumerate, blind to statistics and to the costs of saccharine indulgence.

Empathy can be strategically useful to get people to do the right thing, Mr Bloom acknowledges, and it is central to relationships (though even here it must sometimes be overridden, as any parent who takes a toddler for vaccinations knows). But when it comes to policy, empathy is too slippery a tool. “It is because of empathy that citizens of a country can be transfixed by a girl stuck in a well and largely indifferent to climate change,” he writes. Better to rely on reason and cost-benefit analysis. As rational arguments for environmental protection or civil rights show, morality is possible without sentimental appeals to individual suffering. “We should aspire to a world in which a politician appealing to someone’s empathy would be seen in the same way as one appealing to people’s racist bias,” Mr Bloom writes. Racism, like anger or empathy, is a gut feeling; it might be motivating, but that kind of thinking ultimately does more harm than good.

That is a radical vision—and like many Utopias, one with potentially dystopian consequences. Unless humans evolve into something like the Vulcans from “Star Trek”, guided purely by logic, it is also unimaginable. Reason should inform governance, but people tend to be converted to a cause—gay marriage, for instance—by emotion. Yet Mr Bloom’s point is a

good one: empathy is easily exploited, marshalled on either side of the aisle to create not a bridge but an impasse of feelings. In a time of post-truth politics, his book offers a much-needed call for facts. ■



政治与情感

理性乌托邦

一位道德心理学家主张轻情感而重事实

在党派纷争的时代，越来越多人断言，如果大家能尽力去对彼此的立场更加感同身受，世界的诸多创伤便可愈合：如果白人警察能想象作为黑人生活在美国的感受；如果非裔美国人能理解警察内心的恐惧；如果反移民的欧洲人能设身处地去感知一个叙利亚难民的处境；如果言必称环保的自由派能明白工薪阶层的疾苦……

奥巴马在2006年警告说，人们的同理心已处于“赤字”状态。在今年1月的卸任演讲中，他再次提醒道：“在这个日益多样化的国家，民主若要有效运作，我们每个人都必须努力听取美国小说中的一位伟大人物阿迪克斯·芬奇（Atticus Finch）的箴言。他说，‘不从他人的视角考虑问题，……不走进他的内心世界，你就永远无法真正理解一个人。’”

对于如此高致宽宏的箴言，很少人敢提出异议。但是，耶鲁大学心理学家保罗·布卢姆（Paul Bloom）却不认同。他在新书《反对同理心》（Against Empathy）中提出了挑战性的观点：世界不需要更多的同理心，而是要少些。人们不节制地使用情感，但总的来说，情感并不能改善世界。同理心是“含糖汽水，美味诱人，但于我们有害”，布卢姆为我们开出这样一份营养配餐来取代它：理性、同情及自我控制。

需要澄清的是，布卢姆并非反对善意、爱心或一般意义上的与人为善。他也不排斥同情或“认知”同理心——理解别人感受的能力。他反对的是被定义为“感同身受”（即感受别人的感受）的同理心。虽然以此为美德的哲学家起码可以追溯到亚当·斯密（Adam Smith），布卢姆却表示，这是一种可疑的道德指引。同理心带有偏向性：人们倾向于同情与自己相像的人。它具有局限性，往往只见树木不见森林，或者只关心短期效果而忽视长期后果。它还会引发仇恨和暴力，比如特朗普利用被一名非法移民杀害的女子凯特·施泰因勒（Kate Steinle）鼓动反移民情绪，又如激进组织

“伊斯兰国”（Islamic State）的武装分子利用“恐伊斯兰”事例煽动恐怖袭击。这种同情心是一种“数学盲”，不顾统计数字，对一味煽情的代价也视而不见。

布卢姆承认，同理心可发挥战略作用，让人们为所应为，也是人际关系的核心（不过即便如此，有时还是要放弃同理心，任何带幼儿接种过疫苗的父母都明白这一点）。但谈到政策，同理心并非可靠的工具。“正是由于同理心，国民可能无法把目光从一个被困井底的女孩身上移开，却对全球气候变化满不在乎。”他写道。最好还是依赖理性思考和成本效益分析。正如倡议环保或争取民权的理性论证所示，无需借个人困境煽情，也能实现道德。“我们应该争取建立这样一种社会，政客如果诉诸于人们的同理心，会被视为和诉诸于人们的种族偏见无异。”布卢姆写道。种族主义和愤怒或同理心一样，属于一种直觉感受，也许能激励人心，但这类想法最终还是弊大于利。

这种视野颇为激进，而且就像许多乌托邦构想一样，潜藏着反乌托邦的后果。它也是难以想象的，除非人类进化成类似于《星际迷航》中的瓦肯人，完全按逻辑行事。管治须秉持理性，但人们往往被情感牵引而去支持某种事业或追求某个目标，例如同性婚姻合法化。然而，布卢姆的观点仍有其价值：在对立的双方，同理心都容易被利用和调动起来，从而制造情感僵局，而非搭建桥梁。在后真相政治的时代，布卢姆的这本书呼吁关注事实，给予了世人亟需的警醒。 ■



Gender budgeting

Making women count

An idea to help governments live up to their promises

IT IS easy to be cynical about government—and rarely does such cynicism go unrewarded. Take, for instance, policy towards women. Some politicians declare that they value women's unique role, which can be shorthand for keeping married women at home looking after the kids. Others create whole ministries devoted to policies for women, which can be a device for parking women's issues on the periphery of policy where they cannot do any harm. Still others, who may actually mean what they say, pass laws giving women equal opportunities to men. Yet decreeing an end to discrimination is very different from bringing it about.

Amid this tangle of evasion, half-promises and wishful thinking, some policymakers have embraced a technique called gender budgeting. It not only promises to do a lot of good for women, but carries a lesson for advocates of any cause: the way to a government's heart is through its pocket.

| *What counts is what's counted*

At its simplest, gender budgeting sets out to quantify how policies affect women and men differently. That seemingly trivial step converts exhortation about treating women fairly into the coin of government: costs and benefits, and investments and returns. You don't have to be a feminist to recognise, as Austria did, that the numbers show how lowering income tax on second earners will encourage women to join the labour force, boosting growth and tax revenues. Or that cuts to programmes designed to reduce domestic violence would be a false economy, because they would cost so much in medical treatment and lost workdays.

As well as identifying opportunities and errors, gender budgeting brings women's issues right to the heart of government, the ministry of finance. Governments routinely bat away sensible policies that lack a champion when the money is handed out. But if judgments about what makes sense for women (and the general good) are being formed within the finance ministry itself, then the battle is half-won.

Gender budgeting is not new. Feminist economists have argued for it since the 1980s. A few countries, such as Australia and South Africa, took it up, though efforts waxed and waned with shifts in political leadership—it is seen as left-wing and anti-austerity. The Nordic countries were pioneers in the West; Sweden, with its self-declared “feminist government”, may be the gold standard. Now, egged on by the World Bank, the UN and the IMF, more governments are taking an interest. They should sign on as the results are worth having.

Partly because South Korea invested little in social care, women had to choose between having children, which lowers labour-force participation, or remaining childless, which reduces the country's fertility rate. Gender budgeting showed how, with an ageing population, the country gained from spending on care. Rwanda found that investment in clean water not only curbed disease but also freed up girls, who used to fetch the stuff, to go to school. Ample research confirms that leaving half a country's people behind is bad for growth. Violence against women; failing to educate girls properly; unequal pay and access to jobs: all take an economic toll.

Inevitably there are difficulties. Dividing a policy's costs and benefits between men and women can be hard. Sometimes, as with lost hours of school, the costs have to be estimated. Redesigning the budgeting process upends decades of practice. If every group pressing for change took the same approach, it would become unmanageable. In a way, though, that is the point. Governments find it easy to pay lip-service to women's rights.

Doing something demands tough choices. ■



性别预算

要对女性负起责任

一个帮助政府履行承诺的方法

对政府冷嘲热讽很容易，而且花在这方面的功夫很少会白费。以针对女性的政策为例。有些政客宣称自己重视女性独一无二的角色，简言之，就是让已婚女性在家带孩子。其他一些政客专门为制定女性政策成立了完整的部门，这么做可将女性问题推到大政方针的边缘搁置起来，如此便不会招来任何麻烦。还有一些人或许可算真心诚意，他们通过了法律，给予女性和男性同等的机会。然而，歧视的产生可不是颁布政令就可以终止的。

在这一片闪烁其词、虚与委蛇以及一厢情愿构成的纷乱之中，一些政策制定者欣然采纳了一个名为性别预算的方法。不仅女性有可能因此得到莫大的好处，为实现任何其他目标而努力奔走的人也可得到启发：要抓住政府的心，就得把手伸进它的钱袋子里。

| 被计数的才作数

简单来说，性别预算的目的在于量化各种政策对女性和男性的不同影响。这一看似无关紧要的步骤却可将公平对待女性的殷切劝导转变为政府的财务考量：成本与收益，投资与回报。一个人即使不是女权主义者，也能和奥地利那样，承认有数据显示降低伴侣中收入较低者的所得税会鼓励女性就业，从而刺激增长并增加税收；或者，削减对减少家暴项目的投入看似会省钱，实际上却得不偿失，因为这会导致大笔的医疗支出，还会耽误工作。

除了识别机遇与失误，性别预算还会将女性问题直接带至政府的核心部门：财政部。政府在拨款时历来都对那些缺少强力支持者的明智政策不予理会。但怎样做才符合女性利益（也会符合社会整体利益）的判断如果是在财政部内部做出，那么就已取得了一半的胜利。

性别预算并不是新鲜事物。女权主义经济学家自上世纪80年代以来就在为

之呼号。一些国家例如澳大利亚和南非等已采纳这种方法，不过为之付出的努力因权力更迭而遭遇起伏——性别预算被视为一种左派和反紧缩的行为。在西方，北欧国家是这方面的先行者，其中自诩“女权主义政府”的瑞典也许堪称典范。在世界银行、联合国以及国际货币基金组织的鼓动下，如今已有更多的政府对性别预算产生了兴趣。它们确实应该参与到这一实践中，因为它带来的成果会非常值得。

从前，某种程度上因韩国在社会照护方面投入甚少，该国女性不得不在生与不生孩子之间做选择；前者会降低劳动力参与度，后者则会降低国家的生育率。性别预算表明，这个人口日趋老龄化的国家因对社会关怀的投入而获益。卢旺达政府发现，投资于洁净水不仅可以遏制疾病，还可将女孩们从取水的劳动中解放出来，让她们去上学。有充足的研究证实，不顾任何一国的一半人口、将她们抛诸脑后，都会对经济增长产生负面影响。女性遭受暴力对待、女孩未能获得像样的教育、薪酬与工作机会不均等——这些问题都会造成经济损失。

困难在所难免。将一项政策的成本与收益依据性别分别计算会是一道难题。有时，类似耽误上学这样的情况要付出多大的代价，只能估算出个大概。重新设计预算流程也会颠覆已执行数十年的实践。如果每一个积极寻求改变的团体都采用了这样的手段，情形就会变得难以驾驭。不过，在某种程度上，这也是意义所在。因为对政府来说，面对女性权益问题时开空头支票太容易了。要成就某些事，就必须做出艰难的抉择。■



Diamonds and marriage

A girl's new best friend

The diamond engagement ring may not have a future as a symbol of courtship. What could replace it?

PEACOCKS strut; bowerbirds build lovenests; spiders gift-wrap flies in silk. Such courtship rituals play an important role in what Charles Darwin called sexual selection: when the female of a species bears most of the costs of reproduction, males use extravagant displays and gifts to demonstrate their “reproductive fitness” and females choose between them. For human males, shards of a crystalline form of carbon often feature. A diamond engagement ring signals a man's taste, wealth and commitment, all to persuade a woman that he is a good bet.

This particular courtship gift was dreamed up by an ad agency for De Beers, the cartel that sold almost all of the world's diamonds throughout the 20th century. In the 1930s it started to promote a link between diamonds and marriage. Diamonds' unmatched hardness would symbolise love's endurance and their “fire”, or brilliance, its passion. Two months' salary, the firm suggested, was what the ring should cost—a good investment since, as the admen said, “A diamond is forever.”

Now, that promise is dimming. Though a growing Chinese middle class will probably prop up demand for a while, millennials in Western countries seem keener on memorable experiences than on bling. Diamonds' image has been blemished by some being mined in warzones and sold to pay for the fighting. Meanwhile, laboratory-grown “synthetic” diamonds, long fit only for industrial use, are becoming good enough to compete with gems from out of the ground.

But the long-term threat to diamonds' lustre is more surprising: that their

price could plummet. In recent years regulators (and market forces) have undermined De Beers's cartel by limiting the share of other producers' stones that it can buy. Now responsible for just a third of global sales, the company can no longer manage supply by stockpiling gems when demand turns down. It is spending less on advertising, since it no longer gets the lion's share of the benefits. But the very value of diamonds lies in being scarce and coveted—that is, costly. In the jargon, they are “Veblen goods”, named after a 19th-century economist: prestige-enhancing trinkets for which a higher price encourages buyers. With most products, lower prices increase demand; with diamonds, they could kill it.

Greater equality for women might seem to render male-courtship displays redundant. But mating preferences evolved over millennia and will not change quickly. If diamonds were to cease being a way to signal a man's marriageability, what might take their place?

A different gift, perhaps. In China skewed sex ratios mean that a prospective bridegroom must own an apartment and shower his future in-laws with cash. But a glittering stone goes to the woman, not her family. And it is more than a gift: it is a status symbol, demonstrating that even as a man approaches the expenses of married life, he can still splash out on a bauble. Or a man could rely on more generic forms of display, such as a fancy degree, good job or sharp suit. But these can impress one woman as easily as another, or several simultaneously. He must show commitment—a need not unique to courtship. Salvadoran gangsters get extravagant tattoos; Japanese *yakuza* cut off a fingertip. These visible signs of allegiance make it hard to defect, and impose heavy costs. But as marriage proposals they would fall short. Few women would feel proud to carry around their fiancé's severed pinkie.

| *Love is a multifaceted thing*

Many millennial women seek a mate who is creative, charitable and earns

enough not to live with his parents. The millionaire founder of a startup that makes an app to teach yoga to orphans would be ideal. As a token of his commitment, a suitor might offer the object of his affections 51% of his shares—so much nicer than a joint bank account. Less eligible men could offer instead to link Uber accounts, thus entwining the couple's reputations: their joint five-star rating would be at risk if either misbehaved. Uber-linking would also allow each to keep track of the other's whereabouts, discouraging infidelity. Whatever ultimately replaces diamonds, it will surely be digital, not worn on a digit. ■



钻石和婚姻

女孩的新闺蜜

订婚钻戒作为求爱信物可能没什么前途了。什么会取代它？

孔雀昂首阔步；园丁鸟建起爱巢；蜘蛛吐丝把苍蝇包起来作为礼物。这样的求爱仪式在达尔文所说的“性选择”中扮演着重要的角色：当一个物种的雌性为繁殖承担了大部分代价时，雄性会极尽炫耀之能事，并伴之以礼物，来展现自己的“生殖适合度”，而雌性则会从它们当中挑选。对男性而言，碳晶体碎颗粒往往是求爱过程的重头戏。一枚订婚钻戒彰显一个男人的品味、财富和承诺，所有这些都是为了让女人相信他是个好的选择。

钻石作为求爱礼物是一家广告公司为戴比尔斯（De Beers）编织的想象。整个20世纪全世界几乎所有的钻石都由这一垄断组织售出。20世纪30年代，它开始宣传钻石和婚姻之间的联系。钻石无与伦比的硬度象征着爱的恒久，而钻石的“火彩”即光彩则象征着爱的热烈。该公司建议，男士们应该花两个月的薪水来买一枚戒指，而且就像广告词所说的那样，“钻石恒久远，一颗永流传，”买钻戒还会是个不错的投资。

现在，这一允诺暗淡下来。尽管日渐壮大的中国中产阶级可能会在一段时间里支撑起需求，但比起锦衣美钻，西方国家的千禧一代似乎更热衷难忘的经历。有些钻石是在战乱地区开采的，卖掉它们是为战争买单，钻石的形象因此沾上污点。与此同时，在实验室里制成、一直以来仅适用工业用途的“合成”钻石，正变得足以与地下出产的宝石相媲美。

不过光彩夺目的钻石所面临的长期威胁要更令人惊讶：它们的价格可能会暴跌。最近几年监管机构（和市场力量）对戴比尔斯从其他生产商处购买钻石的份额做出限制，削弱了它的垄断力量。现在这家公司的销售量仅占全球的三分之一，已无法通过在需求下降时囤积宝石来管理供应。它的广告支出也在减少，因为它已不再占有最大份额的收益。但是钻石的价值恰恰在于它的稀有和人们对它的渴求，换言之，就是它的昂贵。用行话说，它们属于“凡勃伦商品”（Veblen goods，以19世纪的一位经济学家的名字

命名)，指的是那种提高名望的小玩意儿，价格越高越能激发人们的购买欲。对于大多数商品来说，价格降低会提升需求；但对钻石来说，低价却会让它断送未来。

女性地位的提升看似令男性求偶的炫耀行为变得多余。但人类的择偶偏好历经数千年的演化，并不会迅速发生改变。如果钻石不再是一个男人适合结婚的信号，那什么会成为它的替代品？

或许是另一种形式的礼物。中国性别比例失衡，导致男性要当新郎必须得有房，此外还需向未来的岳父母奉上大笔现金。不过一颗闪闪发光的石头是送给女人的，并不是她的娘家。而且它不仅仅是一份礼物，还是一种身份的象征，表明即便一个男人要开始养家糊口了，他仍然会为了一件小玩意一掷千金。或者，男人也可以依赖更通用的炫耀形式，比如高学历、好工作或是一身考究的西装。但这些可以打动一个女人，也可以打动另一个，或是同时打动好几个。他必须有所行动，以显示自己的忠诚。这一点不仅仅在求偶时才需要，比如萨尔瓦多的黑帮成员就会刺上繁复的纹身，日本的黑社会成员则要切掉一节手指。这些一望而知的效忠记号让人很难变节，为之付出的代价也很高昂，但作为求婚信物它们都还不够。极少会有女人觉得带着未婚夫切下来的小指头是件值得骄傲的事。

| 爱是多面体

很多千禧一代的女性都寻求这样的伴侣：有创造力、慷慨仁慈、赚得够多因而无需和父母一起住。成立公司，开发应用教孤儿学瑜伽，从而身家百万——这样的人会是理想之选。为表忠诚，求婚者可能会向意中人奉上51%的股份，这可比银行联合账户要美得多。不那么理想的男人可以做的是绑定两人的优步账号，从而将两人获得的评价合二为一：如果有一方行为不当，他们共同的五星评价可就危险了。共享优步账号还能知道对方的行踪，打消其不忠的念头。无论是什么最终取代了钻石，它都必将是数字化的，而不是戴在手指上的。■



Free exchange

I, taxpayer

A tax on robots is an intriguing but misguided solution to worker woes

BILL GATES is an unlikely Luddite, however much Microsoft may have provoked people to take a hammer to their computers. Yet in a recent interview with *Quartz*, an online publication, he expressed scepticism about society's ability to manage rapid automation. To forestall a social crisis, he mused, governments should consider a tax on robots; if automation slows as a result, so much the better. It is an intriguing if impracticable idea, which reveals a lot about the challenge of automation.

In some distant future robots with their own consciousnesses, nest-eggs and accountants might pay income taxes like the rest of us (presumably with as much enthusiasm). That is not what Mr Gates has in mind. He argues that today's robots should be taxed—either their installation, or the profits firms enjoy by saving on the costs of the human labour displaced. The money generated could be used to retrain workers, and perhaps to finance an expansion of health care and education, which provide lots of hard-to-automate jobs in teaching or caring for the old and sick.

A robot is a capital investment, like a blast furnace or a computer. Economists typically advise against taxing such things, which allow an economy to produce more. Taxation that deters investment is thought to make people poorer without raising much money. But Mr Gates seems to suggest that investment in robots is a little like investing in a coal-fired generator: it boosts economic output but also imposes a social cost, what economists call a negative externality. Perhaps rapid automation threatens to dislodge workers from old jobs faster than new sectors can absorb them. That could lead to socially costly long-term unemployment, and potentially to support for destructive government policy. A tax on robots that reduced

those costs might well be worth implementing, just as a tax on harmful blast-furnace emissions can discourage pollution and leave society better off.

Reality, however, is more complex. Investments in robots can make human workers more productive rather than expendable; taxing them could leave the employees affected worse off. Particular workers may suffer by being displaced by robots, but workers as a whole might be better off because prices fall. Slowing the deployment of robots in health care and herding humans into such jobs might look like a useful way to maintain social stability. But if it means that health-care costs grow rapidly, gobbling up the gains in workers' incomes, then the victory is Pyrrhic.

The thorniest problem for Mr Gates's proposal, however, is that, for the moment at least, automation is occurring not too rapidly but too slowly. The displacement of workers by machines ought to register as an increase in the rate of productivity growth—and a faster-growing economy. But since a burst of rapid productivity growth in the late 1990s and early 2000s, America's economy has persistently disappointed on these measures. Mr Gates worries, understandably, about a looming era of automation in which machines take over driving or managing warehouses. Yet in an economy already awash with abundant, cheap labour, it may be that firms face too little pressure to invest in labour-saving technologies. Why refit a warehouse when people queue up to do the work at the minimum wage? Mr Gates's proposal, by increasing the expense of robots relative to human labour, might further delay an already overdue productivity boom.

When faster automation does arrive, robots might not be the right tax target. Automation can be understood as the replacement of labour with capital. To save humans from penury, the reasoning goes, a share of the economy's capital income needs to be diverted to displaced workers. Expanding capital ownership is one strategy; people could own driverless

vehicles that operate as taxis, for instance, and rely on the flow of fares for part of their income. Taxing robots and redistributing the proceeds is another.

But as machines displace humans in production, their incomes will face the same pressures that afflict humans. The share of total income paid in wages—the “labour share”—has been falling for decades. Labour abundance is partly to blame; the owners of factors of production in shorter supply—such as land in Silicon Valley or protected intellectual property—are in a better position to bargain. But machines are no less abundant than people. Factories can churn out even complex contraptions; the cost of producing the second or millionth copy of a piece of software is roughly zero. Every lorry driver needs individual instruction; a capable autonomous-driving system can be duplicated endlessly. Abundant machines will prove no more capable of grabbing a fair share of the gains from growth than abundant humans have.

A new working paper by Simcha Barkai, of the University of Chicago, concludes that, although the share of income flowing to workers has declined in recent decades, the share flowing to capital (ie, including robots) has shrunk faster. What has grown is the markup firms can charge over their production costs, ie, their profits. Similarly, an NBER working paper published in January argues that the decline in the labour share is linked to the rise of “superstar firms”. A growing number of markets are “winner takes most”, in which the dominant firm earns hefty profits.

| *DOS Kapital*

Large and growing profits are an indicator of market power. That power might stem from network effects (the value, in a networked world, of being on the same platform as everyone else), the superior productive cultures of leading firms, government protection, or something else. Waves of automation might necessitate sharing the wealth of superstar firms:

through distributed share-ownership when they are public, or by taxing their profits when they are not. Robots are a convenient villain, but Mr Gates might reconsider his target; when firms enjoy unassailable market positions, workers and machines alike lose out. ■



自由交流

我，纳税机器人

通过征收机器人税来解决工人的困苦很有意思，但方向有误

微软也许令人们恨不得对自己的电脑举起锤子，但比尔·盖茨本人却并不太像一个反对自动化的卢德派分子。然而，在最近一次接受新闻网站 Quartz 的采访时，盖茨对社会管理快速自动化进程的能力表示了怀疑。为了预防社会危机，他深思道，政府应该考虑征收机器人税；如果自动化进程因此放缓，那就更好了。这个想法很有意思，但不切实际，它显现了自动化带来的众多挑战。

在还很遥远的未来，当机器人拥有了自己的意识、退休金和会计师，它们可能会像人类一样支付所得税（估计同样热情不高）。不过这和盖茨考虑的是两回事，他认为应该对现在的机器人征税，要么根据安装的数量，要么根据公司通过节省人力成本而获得的利润。所得资金可用于对工人再培训，还可能用于扩大医疗保健和教育产业——在教学或照顾老人和病患的领域有大量难以被自动化取代的工作。

和高炉或计算机一样，机器人是一种资本投资。经济学家通常不建议对这类物品征税，以便使经济有更大的产出。他们认为阻碍投资的税收会让人们变得更穷，又收不到多少钱。但盖茨似乎认为对机器人的投资有点像投资燃煤发电机：提高了经济产出，但也带来了社会成本，经济学家称这种情况为负外部性。也许快速自动化的威胁是，它把工人赶出旧岗位的速度快于新行业可以吸纳他们的速度。这可能会导致长期失业，社会成本巨大，还可能导致人们支持破坏性的政府政策。机器人税如果能降低这些成本，可能是值得开征的，就像对有害的高炉排放征税可以防止污染、让社会更好一样。

然而，现实要更复杂。对机器人的投资可以使工人的生产力更高，而不是成为牺牲品；对机器人征税可能会让受自动化影响的员工境遇更糟。某些工人可能会因为机器人而失业，但整个工人群体可能因为商品价格下降而

受益。在卫生保健领域放缓部署机器人，让人类大量进入这样的岗位看起来可能像是维持社会稳定的有益方式，但如果因此导致医疗成本迅速上涨，从而吞噬了工人收入的增长，那就得不偿失了。

然而，盖茨的建议最棘手的地方是，至少在目前，自动化的进程并不是太快，而是太慢。机器取代工人本应体现为生产力增长率提升，经济增长加快。但自从20世纪90年代末和21世纪初生产力快速增长以来，美国经济在这类指标上的表现一直令人失望。盖茨担心自动化时代即将到来，机器将接管驾驶或仓库管理，这种担心可以理解。然而在一个已经有大量廉价劳动力的经济体中，企业可能没什么压力要去投资节约劳动力的技术。既然还有很多人在排队争取最低工资岗位，哪里还需要改造仓库？盖茨的建议增加了机器人相对于人力的费用，可能会进一步推迟早该到来的生产力大增长。

当更快的自动化真的到来时，机器人可能不是正确的征税目标。自动化可以理解为用资本替换劳动力，这种观点的逻辑是，为了拯救人类免于陷入贫困，经济中的部分资本收入需要转移到失业工人的身上。一种做法是扩大资本所有权，例如人们可以自己拥有无人驾驶车辆作为出租车，就可以依靠乘车费用作为部分收入。征收机器人税和重新分配收益是另一种做法。

但是，随着机器在生产中逐步取代人类，人类所遭受的压力将同样影响机器人。工资总额所占GDP的比重，即劳动份额，几十年来一直在下降。原因之一是劳动力充足，而供应较短缺的生产要素（如硅谷的土地或受保护的知识产权）的所有者在议价中处于更有利的地位。但机器和工人一样供应充足。工厂现在甚至可以批量生产复杂的装置；生产软件的第二个或第一百万个拷贝的成本基本为零。每个货车司机都需要个别指导，而一个完备的自动驾驶系统则可被不断复制。大量的机器并不会比大量的人类更能从增长收益中获得公平的份额。

芝加哥大学的西姆哈·巴凯（Simcha Barkai）的一份新工作论文得出的结论是，尽管近几十年来工人的收入份额有所下降，但资本（即包括机器

人) 份额缩减得更快。一直在增长的是企业在生产成本基础上加收的费用, 即利润。同样, 美国国家经济研究局 (NBER) 1月份发表的工作论文认为, 劳动份额的下降与“超级巨星公司”的兴起有关。越来越多的市场都是“赢家通吃”, 即主导企业攫取巨额利润。

| 自动化论

不断增长的高额利润是市场力量的指征, 这种力量可能来自网络效应 (在网络世界中与其他所有人共处同一平台所产生的价值)、领头企业卓越的生产文化、政府保护或其他因素。自动化的浪潮可能会使得超级巨星公司分享财富成为必须: 上市公司通过分散股权来分享, 对于非上市公司则通过对它们的利润征税的方式。归咎于机器人很容易, 但盖茨可能要重新考虑他的目标。如果企业的市场地位不可撼动, 那么工人和机器都将是输家。■



French and Italian firms

Into the frame

A continental merger between Luxottica and Essilor fits a pattern

IT MAY be an exaggeration to talk of French firms “colonising” corporate Italy. Some Italian business leaders nonetheless fret about expansionists from across the northern border plucking control of some of their most celebrated local firms. Family-run companies, especially, can make tempting prospects: ones that make excellent products but struggle to grow, or that face agonising succession problems, are notably juicy targets.

The latest example, announced in January, is the merger between Luxottica, an Italian maker of fancy specs, and Essilor, a spiffy French producer of lenses. Together they will produce an entity with a market value of at least €46bn (\$49bn), 140,000 staff and annual revenues of €15bn. The deal, one of the largest cross-border tie-ups attempted by European firms, had long been expected by industry watchers. The idea is to produce an entity that combines Italian style and skills in marketing with deft French engineering.

The new firm will be listed on the Paris bourse (as probably its eighth-largest firm) later this year. That will mark the culmination of a long campaign by Essilor to arrange a merger. The founder and owner of Luxottica, Leonardo Del Vecchio, now 81 years old, had long resisted. But he now gushes that “two products which are naturally complementary, namely frames and lenses, will be designed, manufactured and distributed under the same roof.”

His change of heart may stem from the problem of arranging for a successor. The company he founded in 1961 is widely lauded and owns global brands such as Ray Ban, Oakley and Sunglass Hut. Mr Del Vecchio

himself rose from poverty (he spent some of his childhood in an orphanage) to become Italy's second-richest man, worth some €20bn. Yet for all his strengths, he could not foster a strong alternative leader and would not let any of his children (from various marriages) become managers. Colleagues felt squeezed out, seeing the boss as reluctant to delegate. One ex-employee says "90% of top management" abandoned the company in recent years.

The deal with Essilor is thus a way out, even if Mr Del Vecchio is not stepping down yet. Through his family trust, Delfin, he will be the largest shareholder in the merged entity (potentially with 38% of it) and its "executive chairman and chief executive" for the next few years. But Essilor's boss, Hubert Sagnières, who is 61 and will share equal managerial duties of the new entity, looks well placed to take charge once Mr Del Vecchio retires.

Building a bigger company looks possible. Some savings will come from knitting two teams of managers together. The global eyewear market, already worth some €90bn, is alluring. It is expected to grow as cohorts of middle-class consumers in Asia, especially, find they need eyesight correction and develop a liking for specs as accessories or protection against ultraviolet rays.

An amicable merger hardly ranks as a French assault on Italy. But it does come in the context of other Franco-Italian tie-ups. In luxury goods, for example, French conglomerates with deep pockets, notably LVMH and Kering, have been acquiring smaller Italian rivals for years. French firms first grew faster by attending to flourishing markets for accessories such as handbags. Then they paid handsomely to take over prominent Italian brands, including Gucci, Bulgari and Fendi.

The French are active in other sectors, too. Vincent Bolloré, a swaggering

billionaire who is determined to grow in Italy, last year led his firm, Vivendi, to buy nearly a quarter of Telecom Italia. (Unconfirmed rumours say he might sell to another French operator, Orange.) The daring Frenchman is also pushing Vivendi in a second bold bid, for Mediaset, a company in which Silvio Berlusconi, a former Italian prime minister, and his family are the biggest owners. Vivendi now owns nearly 29% of Mediaset.

In retailing, too, a pair of French supermarket chains, Auchan and Carrefour, together operate more than 2,000 supermarkets in Italy's unusually fragmented industry. Given that many businesses in Italy are run by ageing, first-generation founders with no clear plan for succession, more targets are bound to attract buyers from its neighbour to the north. ■



法国和意大利公司

嵌入版图

陆逊梯卡与依视路合并，欧陆企业联姻有迹可循

说法国公司“殖民”意大利商界也许是夸大其词，不过一些意大利商界领袖确实对跨北面边境线而来的扩张主义者感到头疼——它们正在夺去一些最著名本地企业的控制权。家族企业尤其容易成为诱人目标：那些制造精良产品但增长乏力或者深受接班问题困扰的家族企业会被视为盘中美餐。

最新的一个例子，就是于1月宣布的意大利高级眼镜制造商陆逊梯卡（Luxottica）和法国时尚镜片制造商依视路（Essilor）的合并。合并后的集团市值将至少为460亿欧元（490亿美元），拥有14万员工，年收入达150亿欧元。此次交易是欧洲企业间最大的跨境合并案之一，业内观察人士对此早有预料。合并是为了打造一个实体，融合意大利的时尚风格、巧妙的营销手法以及法国娴熟的工程技艺。

这家新公司将于今年早些时候在巴黎证券交易所上市，并有可能成为其第八大上市公司。这将标志着依视路漫长的并购征程终于达致圆满。陆逊梯卡的创始人及所有人莱昂纳多·戴尔·维吉奥（Leonardo Del Vecchio，现年81岁）过去一直不愿合并，但如今他改口大谈道，“两家公司的产品，也就是镜框和镜片，天然相辅相成。以后它们的设计、制造和分销都将在同一屋檐下进行。”

他之所以改变主意，也许是在安排继任人方面出现了困难。陆逊梯卡创建于1961年，广受赞誉，拥有雷朋、Oakley、Sunglass Hut等全球品牌。戴尔·维吉奥本人从穷小子（他童年时曾一度生活在孤儿院）摇身变为意大利第二大富豪，身家约200亿欧元。尽管他实力不俗，但却无法培养出强有力的接班人，也不愿让子女们（多段婚姻的结晶）成为管理者。公司同僚眼见这位总裁不愿下放权力，感觉备受挤压。一名前雇员说，近年已有“90%的高管”舍这家公司而去。

因此，与依视路的合并是一条出路，即便戴尔·维吉奥还没打算退位。凭借其家族信托Delfin，他将成为合并后实体的最大股东（可能持有38%的股份），并在未来几年担任“执行董事长兼首席执行官”。而依视路的老板，61岁的孙余沛（Hubert Sagnieres）将在新实体分担同等管理职责。一旦戴尔·维吉奥退休，孙余沛似乎正是最佳接替人选。

他们很可能会扩大公司规模。两家公司管理团队的合并会节省一定的成本。目前全球眼镜市场价值约900亿欧元，极具吸引力。特别是由于亚洲的大批中产阶级消费者有着矫正视力的需求，以及他们愈加钟爱以眼镜作为饰品或用它们防止紫外线伤害，全球眼镜市场预计还会进一步增长。

一场友好的合并很难算得上是法国对意大利的攻击。但就其他法意合并案来说，的确存在这样的情况。例如在奢侈品方面，财大气粗的法国集团企业，特别是LVMH和开云集团（Kering），多年来一直在收购意大利的小型竞争对手。法国的公司凭借投身手袋等蓬勃发展的配饰市场占取先机，取得较快增长。随后，它们以高价收购著名的意大利品牌，包括古驰、宝格丽和芬迪。

法国人也活跃在其他行业。神气十足的亿万富翁万桑·博洛莱（Vincent Bolloré）一心要在意大利大展拳脚，去年他让自己的公司维旺迪（Vivendi）买入意大利电信（Telecom Italia）近四分之一的股份。据未经证实的传闻，他可能会再转售给另一法国电信运营商Orange。这位果敢的法国富翁还在推动维旺迪进行第二宗大胆的收购，目标是意大利传媒集团Mediaset，意大利前总理贝卢斯科尼及其家族是该集团的最大股东。维旺迪目前拥有Mediaset近29%的股份。

零售业也是如此。意大利的超市业向来都破碎而分散，法国连锁超市欧尚（Auchan）和家乐福已在意大利共开设超过2000家门店。由于意大利许多企业均由年事已高的第一代创始人经营，而他们没有明确的接班人计划，必然会有更多意大利企业成为北方邻国买家的收购目标。■



Information technology

Reboot

Indian outsourcing specialists must upgrade their strategies

COMPUTERS slow as they age, and before long must be replaced by newer models. Something similar is true of the business models of Indian IT firms. Specialised in running global companies' outsourced back-offices, the likes of Infosys, Wipro and Tata Consultancy Services (TCS) used to be national champions growing at double-digit rates. Their prospects have dimmed of late; an entire industry built on the back of globalisation is fretting about the incoming American president. But Donald Trump is merely the latest threat to their operating systems.

Over three decades, Indian IT has become a \$140bn industry built on a simple proposition: rich-country companies could trim costs by getting tedious behind-the-scenes IT work done by cheap engineers in India. The Indian firms hoovered up bright graduates—the big three have over 700,000 employees in total—paying them starting salaries of \$5,000 or so, a decent local wage. After gaining some experience, tens of thousands were dispatched to client sites in Europe or America, along with a few expensive local staff. The rest ensured their clients' computer systems kept ticking over from cosy cubicles in Bangalore, Hyderabad and elsewhere.

Growth spurts and stalls are nothing new for the trio, the most international of dozens of Indian IT firms (American and European companies such as IBM, Accenture and Capgemini have large Indian presences, too). Their prospects are ultimately tied to the sluggish rich-world economies of their clients: America makes up over half of Indian IT sales, Europe a quarter. Banks and insurance companies, the biggest customers, have been in penny-pinching mode of late; ditto energy companies struck by falling oil prices.

But what felt like cyclical softness looks increasingly like it is being compounded by structural decline. Dollar-denominated growth rates have oscillated but clearly trended downwards and are now firmly in the single digits (see chart). Margins of over 20% are coming under pressure, even after a sustained fall in the rupee against the dollar increased the cost advantage of earning in America and paying staff in India.

There is still plenty of the \$900bn global IT services budget for them to capture. But some headwinds now look like they will endure. Mr Trump's swearing-in is the most immediate concern. The incoming president has railed against certain visas for skilled workers, many of which are gobbled up by Indian IT firms to send staff on stints to America. A proposal to hike the minimum salaries to qualify for such schemes from \$60,000 to \$100,000 would make many postings uneconomical.

That would mean replacing Indian expats to America with locals, especially if the cap for the number of new visas is lowered from the existing 65,000 a year. Add in higher visa-application fees for large-scale labour importers, and that might trim up to five percentage points from IT companies' margins, analysts think. Fuzzy talk of an "outsourcing tax" will in any case hardly encourage IT procurement managers to look overseas.

Changes in how clients think about technology is a bigger worry for Indian IT firms. Budgets globally are growing steadily, at about 3% a year reckons Gartner, a research outfit. But an increasing amount of the money is spent on trendy stuff like analytics or the internet of things. Such new "digital" services will rise from a tenth of total IT spending in 2014 to over a third in 2020 according to McKinsey, a consultancy.

IT managers at big firms think they can finance the development of snazzy big-data projects and mobile apps by trimming spending in their existing IT infrastructure, for example by replacing their own data centres (which

they pay Indian firms to maintain) with cloud storage (which they do not). And some of the tasks which engineers used to do, such as tailoring software for a client, can now be done by machines. It seems that workers in India's vast code-writing centres are as much at risk of being made obsolescent by automation as those in factories making cars or shoes.

Indian firms want to get in on the new digital action, which they think is less likely to be commoditised. But they specialise in fixing problems cheaply, not driving innovation. Devising a mobile-banking app for millennials, say, is a far cry from parsing lines of code for bugs.

The IT firms know they need to adapt. "We will not survive if we remain in the constricted space of doing as we are told, depending solely on cost arbitrage," Vishal Sikka, the boss at Infosys, wrote in a recent letter urging staff to shape up. "If we don't we will be made obsolete by the tidal wave of automation and technology-fuelled transformation that is almost upon us."

| *Please wait, update in progress*

Others have a head start in the race to the sunlit digital uplands. Accenture has digital-services revenue per employee around four times its Indian rivals, points out Vaibhav Dhasmana of Jefferies, a bank. It derives more than a fifth of its revenues from such work. Most Indian firms don't break out this figure, somewhat tellingly, but it is thought to be in the 10-17% range.

European and American rivals have heftier consulting arms that can shape companies' spending. They are eager acquirers of companies, often boutiques that give them skills they cannot develop internally. They spend more on research and development, too: 2% of revenues for Accenture, compared with a mere 0.5-1% of revenues at Indian firms. All this reduces profits: Accenture has margins on earnings before interest and tax of around 15%, not much more than half what Indian firms have traditionally

secured.

The Indian firms are moving in this direction. All have invested in “platforms” they can sell to more than one client—for example, to analyse social media. But by their own admission progress has been limited. Pivoting towards higher-value offerings requires an overhaul of Indian companies’ past models, not a tweak. The focus must now be on the quality, not the quantity, of employees. Hiring has slowed: in the nine months to end-December 2016, Infosys added 5,700 new staff, compared with 17,000 in the same period a year ago. There are fewer junior engineers—able only to carry out the most routine tasks—and more relatively senior staff as a result (see chart). This middle-age bulge in staffers increases staff costs by 5-7%, says Anantha Narayan of Credit Suisse, a bank.

All this is happening as Infosys and Wipro are still adapting to a newish generation of professional managers who took over from the entrepreneurs that founded these firms. On January 12th, meanwhile, TCS lost its respected boss, Natarajan Chandrasekaran, who has been tapped to take over the reins at the firm’s parent company. The economics that made Indian IT such a compelling proposition are fading rather than disappearing altogether. But as with computers, it is best to replace an ageing model before it unexpectedly crashes. ■



信息技术 重启

印度专业外包公司必须升级策略

计算机老化变慢，必定很快就被新款电脑取代。印度IT公司的商业模式也有相似之处。专为全球企业提供外包后台服务的印孚瑟斯（Infosys）、维布络（Wipro）及塔塔咨询服务（TCS）等公司曾是增速高达两位数的国内领军企业，近来却变得前景黯淡。整个行业都以全球化为根基，如今正因美国的新总统而忧心忡忡。但特朗普仅是该产业“操作系统”面对的一个最新威胁而已。

在三十多年的时间里，印度IT业已成长为价值1400亿美元的产业。它建立在一个简单的理念之上：富裕国家把单调乏味的后台IT工作外包给印度廉价的工程师完成，以此降低成本。印度公司吸纳大量优秀毕业生——上述三大公司共雇用了70万名员工，起薪约为5000美元，就当地水平而言是不错的收入。在获得一定的经验后，其中的数万名员工会被派往客户所在的欧洲或美国等地，配合一些薪金高昂的当地员工工作。其余人则留在班加罗尔、海德拉巴等地舒适的隔间里，确保客户的计算机系统运作正常。

这三家公司是印度众多IT公司中最国际化的（IBM、埃森哲和凯捷等欧美公司在印度也占有相当大的市场份额），对它们来说，增长加速和受挫都是常事。其前景最终还是与客户所在的富裕世界经济低迷相关联：印度IT业的销售额中，美国贡献了一半以上，欧洲占四分之一。行业最大客户银行及保险公司最近已开始精打细算，受油价下跌冲击的能源企业也是如此。

但是，原本感觉上像是周期性的疲软，如今越来越像是受结构性衰退的拖累。以美元计算的增长率震荡不断，但呈明显下行趋势，如今已稳稳保持在个位数水平（见图表）。即使卢比兑美元汇率持续下跌，令在美国赚取收入而在印度支付薪酬的公司成本优势提升，20%多的利润率仍然受压。

全球9000亿美元的IT服务预算中仍有大量空间供它们争取，但貌似有些阻力会长期存在。特朗普宣誓就职是最紧迫的问题。这位新总统痛斥面向技术劳工签发的某些签证，其中许多被印度IT公司包揽，用以派遣员工赴美短期工作。一项提案要求把申请这类签证的最低工资从六万美元提升至十万美元，这将让许多职位安排变得不经济。

这意味着美国当地人会取代赴美工作的印度人，特别是如果新签证的限额从目前的每年65,000人再次下调的话。加上大型劳务输入公司面临的签证费用上升，分析师们认为，IT公司的利润率可能会下降多达五个百分点。有关“外包税”的揣测肯定也会令IT采购经理们打消海外计划。

客户对技术的看法也在改变，这对印度IT公司来说是更大的忧虑。研究机构高德纳公司（Gartner）认为，在全球范围内，IT预算在稳步增长，每年提升约3%。但有越来越多的资金花在数据分析或物联网这类新潮项目上。据咨询公司麦肯锡的数据，这类新“数字”服务在2014年占IT总支出的十分之一，到2020年时，该比例将上升至超过三分之一。

大公司的IT经理们认为可通过减少现有IT基础设施的开支来为新潮的大数据项目及移动应用开发项目提供资金，例如用云存储（没有外包给印度公司维护）取代自有数据中心（外包给印度公司）。而以前工程师们做的一些工作，如为客户定制软件，现在可由机器来完成。印度那些庞大编程中心的员工似乎也面临被自动化淘汰的风险，与制造汽车和鞋子的工厂工人并无二致。

印度公司希望打入这股数字化新潮流，认为相比之下它不大会变得大宗商品化。但它们的专长在于以低成本解决问题，而非推动创新。举例来说，为千禧一代设计移动银行应用跟分析代码查找错误完全是两码事。

这些IT公司知道它们需要适应新趋势。“假如我们还局限于听命他人，只依赖成本优势，我们将无法生存。”印孚瑟斯的老板史维学（Vishal Sikka）在最近一封敦促员工升级的信中写道。“在自动化和科技的推动下，变革浪潮滚滚而来，我们不去适应就会被淘汰。”

| 正在升级，请稍候

数字化高地阳光灿烂，在奔往那里的竞赛中，其他人领先一步。杰富瑞银行（Jefferies）的瓦伊巴夫·达斯马纳（Vaibhav Dhasmana）指出，埃森哲员工的数字服务人均销售额约为其印度竞争对手的四倍。该公司有超过五分之一的收入来自这类工作。比较显而易见的是大部分印度公司都达不到这一水平，不过估计它们的占比处于10%到17%的范围之间。

欧美竞争对手拥有更强有力的咨询服务部门，能够影响公司的支出。它们热衷收购，对象往往是一些精品公司，能带来无法内部开发的新技术。它们也在研发上投入更多：埃森哲的投入是其营收的2%，相比之下，印度公司的该比例仅为0.5%到1%。所有这些都令利润下降：埃森哲的息税前利润率约为15%，充其量不过是印度公司传统上稳赚的一半。

印度IT公司正朝这一方向进发。大家都投资开发可向多个客户销售的“平台”，比如社交媒体分析平台。但它们承认进展有限。要朝着更高价值的服务转向，印度公司必须彻底改革旧有模式，而非微调。它们如今必须注重员工的素质而非数量。招聘已经放缓：在截至2016年12月底的九个月内，印孚瑟斯新招员工5700名，而去年同期则为17,000人。只能完成最常规任务的初级工程师在减少，较为资深的员工却在增加（见图表）。瑞信银行（Credit Suisse）的安纳塔·拿拉央纳（Anantha Narayan）表示，中年员工群体的增加令人力成本上升了5%至7%。

这一切发生时，印孚瑟斯和维布络正在适应新一代的管理者，这些职业经理从公司创始人的手上接管了企业。同时，1月12日，塔塔咨询服务公司备受尊敬的老板陈哲（Natarajan Chandrasekaran）离任，出任母公司董事长。将印度IT业塑造成诱人事业的经济模式正在褪色，而不是完全消失。但和计算机一样，最好在旧机器意外崩溃前就把它换掉。■



Free exchange

Borrowed time

Economic recovery will put the theory of “secular stagnation” to the test

IN PERIODS of economic stress all sorts of theories are entertained about the nature of the problem. When better times return, some theories fade from memory. Others linger, however. During the economic mess of the past decade, economists frightened themselves with tales of “secular stagnation”: a nasty condition that dooms its victims to chronically weak growth. Now that the economic outlook is brightening a bit—deflation has been dispatched, and for most advanced economies 2017 is forecast to bring a third consecutive year of economic growth—it is tempting to laugh off the idea of secular stagnation as a bit of crisis-induced hysteria. Tempting, but also premature.

In a time of secular stagnation, the normal relationship between saving and investment goes haywire. People save some portion of their income each year. Because one person’s spending is another’s income, such saving can drain away demand and lead to recession, unless the funds set aside by savers are reinjected into the economy through lending to those looking to invest: as when banks lend savers’ deposits to businesses, for example. Central banks help manage this process. When planned saving threatens to outstrip desired investment, they will reduce interest rates to keep the two in line and the economy on track. But when secular stagnation strikes, the gap between what people want to save and what they want to invest grows too large to reconcile. The interest rate needed to balance the two drops, ultimately to below zero. Central banks are stymied. The result is chronic economic weakness: low growth, low inflation, low interest rates and the constant threat of recession.

Several years ago those symptoms could be found across much of the global

economy. No longer. Headline inflation is trending upward, even in Europe and Japan. Commodity prices have stabilised, helping struggling emerging markets. And America's Federal Reserve has begun raising its benchmark interest rate, suggesting that the American economy is no longer trapped in a world in which rates cannot be pushed low enough to keep growth on track. In a speech on March 3rd Janet Yellen, the chairwoman of the Fed, reckoned that America was ready for more rate hikes than in 2015 and 2016, including at least three this year.

But the most devilish aspect of the secular-stagnation story is that good times do not necessarily indicate underlying health. The persistent gap between desired saving and investment that it describes can result from a scarcity of attractive investment options—owing to an ageing population or a slowdown in technological progress, for example. But it can also be driven by the concentration of income among those with little inclination to spend. Income inequality could contribute to stagnation, for instance, by leaving a shrinking share of income in the hands of the poorer households that would most like to spend.

In such cases, the bonds of secular stagnation may temporarily be broken by a period of financial excess in which bubble conditions drive speculative investment, or in which groups short of purchasing power borrow from those with savings to spare. The reason to doubt the solidity of this recovery is that we have been in such circumstances before, only to watch it end in tears. In the late 1990s, for example, soaring tech stocks drove a wave of investment in internet infrastructure which yanked the American economy out of a jobless recovery. When that fever broke, the economy slumped again, until the global financial system found a way to funnel credit to American households looking to buy or borrow against a home. In the euro area, thrifty core economies lent heavily to the periphery, often against soaring property prices, fuelling an economic boom that ended disastrously.

| *Post-traumatic stress*

Is this time different? It is, a bit. Across advanced economies, borrowing capacity is still impaired after the trauma of the crisis; and banking reforms mean that credit taps cannot be turned back on so easily. Those obstacles might simply delay rather than prevent a return to form, however. A mood of optimism is fuelled by a stockmarket that is scaling new heights. In America, household debt is rising again, driven by loans to students and for cars. Across advanced economies, private debt as a share of GDP is above the pre-crisis level and rising fast (see chart). Most dramatic of all has been the increase in borrowing in China, where private debt as a share of GDP has nearly doubled since 2008. It seems very unlikely that the world economy would have escaped its deflationary doldrums without this vast credit expansion, which has kept its building boom rumbling along.

Economists sympathetic to the secular-stagnation story argue that there are ways to escape the trap. Firms might suddenly find new capital projects in which to invest: thanks, perhaps, to technological advance. An effort to reduce inequality could be a way out: the rich could be taxed and their wealth redistributed rather than lent. A massive public-investment campaign would be another. Emerging markets contributed to the world's savings glut by buying government bonds in order to build up their foreign-exchange reserves, funnelling money to governments of advanced economies with little appetite for fiscal stimulus. Rather than see the private sector overextend itself, those rich-country governments could instead seize the opportunity to borrow more, soak up excess savings and invest the proceeds in new roads and railways, electric grids and broadband.

If the secular-stagnation idea holds, central banks face a stark choice until politicians do some of these things. The Fed seems confident it can tap its brakes and keep the American economy on a safe growth trajectory. But it might face a nastier dilemma: to tolerate the rising asset prices and

indebtedness which enable recovery, or to choke off recovery and wait for the government to solve the problem. Just what sort of story best describes the state of the economy—and how scary it is—will become clear this year, one way or another. ■



自由交流

借来的时间

经济复苏将验证“长期停滞”理论

在经济受压时期，有关问题实质的理论五花八门。经济稍有复苏，某些理论便会被淡忘。但也有一些理论萦绕不去。在过去十年的经济乱局中，经济学家中间流传着一种令他们忧心忡忡的“长期停滞”论：经济陷入险恶状态，导致长期的增长疲软。而如今，经济前景略有起色（通缩渐远，而且大多数发达经济体预计在2017年将连续第三年实现增长），人们很容易对“长期停滞”论不屑一顾，认为那不过是危机诱发的大惊小怪。是的，容易这么想，但还是过于草率了。

在长期停滞的时期，储蓄和投资之间的正常关系变得混乱失控。人们每年存起部分收入，但由于一个人的支出就是另一个人的收入，这样储蓄就会逐渐削弱需求，导致经济衰退，除非储户存起的这些资金能够被借出用于投资，重新注入经济体内：比如银行把储户存款贷给企业。央行会参与控制这一过程。当计划储蓄有超出预定投资之虞时，央行将降低利率以保持两者协调一致，稳定经济发展。但长期停滞来袭时，人们的储蓄和投资目标间的差距拉大至不可调和的程度。为平衡两者，利率下降并最终需要降至零以下。央行陷入困境。结果便是经济长期疲软：低增长、低通胀、低利率，以及持续的衰退威胁。

几年前，这类症状在全球大多数经济体中都能找到。但如今情况不再。总体通胀呈上升趋势，即便在欧洲和日本也是如此。大宗商品价格已经稳定，帮助了困顿的新兴市场。美联储也开始提高其基准利率，显示美国经济不再陷于无法通过降息来保证正常增长的困局。3月3日，美联储主席耶伦在一场演讲中表示，相比2015年和2016年，美国已准备好更多加息，今年至少会有三次。

但是，“长期停滞”论中最可怕的一个说法是，好光景并不一定代表内在健康。该理论所描述的预定储蓄和投资之间的持续差距可能源于缺乏有吸引

力的投资选择——原因可能是人口老化或技术进步放缓。但它也可能是收入向消费意愿较低的人群集中而造成的。例如，收入不平等可能会使消费意愿最高的较贫困家庭的收入占比不断减少，从而导致经济停滞。

在这类情况下，长期停滞的束缚可能被一时的金融过度暂时打破。金融过度的泡沫环境推动投机性投资，或者缺乏购买力的群体在此期间可以借贷他人的多余储蓄。怀疑此次“复苏”是否稳固是因为我们之前也经历过类似的情形，而结果却以悲剧收场。例如，上世纪90年代末，飙升的科技股带动一轮互联网基础设施的投资热潮，将美国经济拉出了无就业复苏。当热潮退去，经济再次下滑，直至全球金融体系找到一种方式向想要购房或贷款购房的美国家庭提供信贷。在欧元区，节俭的核心经济体向外围国家提供大量贷款，往往用于购买价格飙升的房产，令经济泡沫加剧，最终惨烈爆破。

| 创伤后遗症

这次会不一样吗？是的，稍有不同。在经济危机创伤后，各发达经济体的借款能力仍未恢复；而银行改革意味着信贷闸门不会轻易重开。然而，这些障碍可能只是延迟而非阻止泡沫再现。股市正创下新高，助长了乐观情绪。在美国，由于学生贷款及车贷的驱动，家庭债务水平再度上升。各发达经济体的私营部门债务占GDP比重高于危机前水平，并且正快速上升（见图表）。最瞩目的是在中国贷款的增加，中国私营部门债务占GDP比重自2008年以来几乎翻了一番。这种庞大的信贷扩张令建筑热潮轰隆不止。若没有这种扩张，世界经济似乎很难逃离通缩困境。

认同“长期停滞”论的经济学家们表示，确有办法逃离陷阱。企业可能突然发现可投资的新资本项目：也许是由于技术进步。减少不平等可能是出路之一：可以向富人征税，使其财富被重新分配，而非用于借贷。大型公共投资项目会是另一出路。新兴市场过去通过购买国债来建立自己的外汇储备，把资金输送给无意采取财政刺激手段的发达经济体政府，这加重了世界储蓄过剩的问题。与其坐视私营部门过度扩张，那些富裕国家的政府可以抓紧机会增加贷款，吸收过剩储蓄，把资金投入到建设新的公路、铁道、电网和宽带上。

假如“长期停滞”论成立，各国央行将面临严峻的选择，除非政客们能采取上述行动中的一些。美联储似乎自信能踩下刹车，使美国经济保持在安全增长的轨道上。但它面临的可能是更险恶的两难局面：是为复苏而容忍不断上升的资产价格和负债水平，还是遏制复苏，等待政府解决问题。什么理论最能说明目前的经济状态以及其可怕程度？不管怎样，答案将在今年显现。 ■



Subatomic opportunities

Quantum leaps

After a century stuck in textbooks, mind-bending quantum effects are about to power mainstream innovation

A BATHING cap that can watch individual neurons, allowing others to monitor the wearer's mind. A sensor that can spot hidden nuclear submarines. A computer that can discover new drugs, revolutionise securities trading and design new materials. A global network of communication links whose security is underwritten by unbreakable physical laws. Such—and more—is the promise of quantum technology.

All this potential arises from improvements in scientists' ability to trap, poke and prod single atoms and wispy particles of light called photons. Today's computer chips get cheaper and faster as their features get smaller, but quantum mechanics says that at tiny enough scales, particles sail through solids, short-circuiting the chip's innards. Quantum technologies come at the problem from the other direction. Rather than scale devices down, quantum technologies employ the unusual behaviours of single atoms and particles and scale them up. Like computerisation before it, this unlocks a world of possibilities, with applications in nearly every existing industry—and the potential to spark entirely new ones.

| *Strange but true*

Quantum mechanics—a theory of the behaviour at the atomic level put together in the early 20th century—has a well-earned reputation for weirdness. That is because the world as humanity sees it is not, in fact, how the world works. Quantum mechanics replaced wholesale the centuries-old notion of a clockwork, deterministic universe with a reality that deals in probabilities rather than certainties—one where the very act of measurement affects what is measured. Along with that upheaval came a

few truly mind-bending implications, such as the fact that particles are fundamentally neither here nor there but, until pinned down, both here and there at the same time: they are in a “superposition” of here-there-ness. The theory also suggested that particles can be spookily linked: do something to one and the change is felt instantaneously by the other, even across vast reaches of space. This “entanglement” confounded even the theory’s originators.

It is exactly these effects that show such promise now: the techniques that were refined in a bid to learn more about the quantum world are now being harnessed to put it to good use. Gizmos that exploit superposition and entanglement can vastly outperform existing ones—and accomplish things once thought to be impossible.

Improving atomic clocks by incorporating entanglement, for example, makes them more accurate than those used today in satellite positioning. That could improve navigational precision by orders of magnitude, which would make self-driving cars safer and more reliable. And because the strength of the local gravitational field affects the flow of time (according to general relativity, another immensely successful but counter-intuitive theory), such clocks would also be able to measure tiny variations in gravity. That could be used to spot underground pipes without having to dig up the road, or track submarines far below the waves.

Other aspects of quantum theory permit messaging without worries about eavesdroppers. Signals encoded using either superposed or entangled particles cannot be intercepted, duplicated and passed on. That has obvious appeal to companies and governments the world over. China has already launched a satellite that can receive and reroute such signals; a global, unhackable network could eventually follow.

The advantageous interplay between odd quantum effects reaches its

zenith in quantum computers. Rather than the 0s and 1s of standard computing, a quantum computer's bits are in superpositions of both, and each "qubit" is entangled with every other. Using algorithms that recast problems in quantum-amenable forms, such computers will be able to chomp their way through calculations that would take today's best supercomputers millennia. Even as high-security quantum networks are being developed, a countervailing worry is that quantum computers will eventually render obsolete today's cryptographic techniques, which are based on hard mathematical problems.

Long before that happens, however, smaller quantum computers will make other contributions in industries from energy and logistics to drug design and finance. Even simple quantum computers should be able to tackle classes of problems that choke conventional machines, such as optimising trading strategies or plucking promising drug candidates from scientific literature. Google said last week that such machines are only five years from commercial exploitability. This week IBM, which already runs a publicly accessible, rudimentary quantum computer, announced expansion plans. As our Technology Quarterly in this issue explains, big tech firms and startups alike are developing software to exploit these devices' curious abilities. A new ecosystem of middlemen is emerging to match new hardware to industries that might benefit.

| *The solace of quantum*

This landscape has much in common with the state of the internet in the early 1990s: a largely laboratory-based affair that had occupied scientists for decades, but in which industry was starting to see broader potential. Blue-chip firms are buying into it, or developing their own research efforts. Startups are multiplying. Governments are investing "strategically", having paid for the underlying research for many years—a reminder that there are some goods, such as blue-sky scientific work, that markets cannot be relied

upon to provide.

Fortunately for quantum technologists, the remaining challenges are mostly engineering ones, rather than scientific. And today's quantum-enhanced gizmos are just the beginning. What is most exciting about quantum technology is its as yet untapped potential. Experts at the frontier of any transformative technology have a spotty record of foreseeing many of the uses it will find; Thomas Edison thought his phonograph's strength would lie in elocution lessons. For much of the 20th century "quantum" has, in the popular consciousness, simply signified "weird". In the 21st, it will come to mean "better". ■



亚原子的机会

量子跃迁

在书本上停留一世纪之后，离奇古怪的量子效应势将推动主流创新

一顶能够观测单个神经元的泳帽，让人得以监测佩戴者的想法。一种可以发现隐藏核潜艇的传感器。一台能够发明新药、彻底改变证券交易，还能设计新材料的计算机。由牢不可破的物理定律保证其安全的全球通信网络。凡此种种，连同更多可能，就是量子技术的未来。

这些可能性都要归因于科学家能更好地捕获和摆弄单个原子以及被称作光子的微小光粒子。今天的计算机芯片更便宜更快，体积还更小，但量子力学认为在尺寸足够微小时，粒子会穿过固体，让芯片内部短路。量子技术用另一种思路来看这个问题，不是将设备缩小，而是利用单个原子和粒子的异常行为将设备放大。正如之前的计算机化那样，这一技术开启了各种可能性，几乎可以应用于各行各业，并且还有可能激发出全新的行业。

| 奇异但真实

量子力学是20世纪初提出的关于微观粒子运动规律的理论，说它怪异毫不为过。这是因为人类看到的世界实际上并不代表世界运转的真正方式。量子力学整体否定了延续数百年的观念，认为宇宙并不是有规律、有确定性的，是基于可能性而非确定性，其中测量行为本身就会影响被测量物。伴随着这一剧变而来的是一些真正离奇古怪的概念，例如粒子从根本上说既不是在这儿也不是在那儿，但一旦固定下来，就同时既在这儿也在那儿——它们处于“这儿”和“那儿”两个状态的“叠加态”。这一理论也表明粒子之间可能存在着诡异的联系：其中一个受到作用，另一个就会立刻感受到变化，即使相隔广阔的空间。甚至连这一理论的创始人也觉得这种“纠缠”很费解。

正是这些效应展示出当下的前景：为更多地了解量子世界而改进的技术现在派上了用场。利用叠加和纠缠的小装置性能大大优于现有的设备，还能完成之前被认为不可能的事。

例如，利用纠缠改进原子钟，令其比目前应用在卫星定位上的钟更准确，还能几个数量级地提升导航精度，让自动驾驶汽车更加安全可靠。由于当地重力场的强度会影响时间流动（根据另一个非常成功但与直觉相反的理论——广义相对论），这样的钟还能用来测量重力的微小变化。这样一来，无需挖开路面就能发现地下管道，还能追踪藏匿于深海的潜艇。

量子理论的其他特性还能让信息传递不再担心被窃听。无论用叠加态还是纠缠态粒子编制成信号，都无法被窃听、复制或转递。全世界的公司和政府显然对这一点都兴味十足。中国已经发射了一颗卫星，能接收并在新网络上发送这类信号；最终可能会出现一个无法破解的全球网络。

奇异的量子效应之间有益的相互影响在量子计算机上达到了顶峰。与常规计算采用的0和1不同，量子计算机的比特是二者的叠加，而每个“量子比特”（qubit）之间又互相纠缠。使用以量子方法重新处理问题的算法，量子计算机能够处理现在最好的超级计算机一千年才能完成的计算。高安全性的量子网络正在研发中，而与之相对的担忧是量子计算机最终会淘汰今天基于数学难题的加密技术。

不过，在这一切发生之前，较小的量子计算机会在能源、物流、药物设计及金融等行业里做出其他的贡献。即便是简单的量子计算机也应当可以处理传统机器无法解决各类问题，如优化贸易策略、从科学文献中选出有希望的药物等。谷歌上周称还有五年这样的计算机就能投入商业使用。

IBM已经向公众开放了一台初级量子计算机，本周它宣布了扩展计划。正如本期《科技季刊》所释，大型科技公司和创业公司都在开发软件，探索这些设备不同寻常的能力。一个新的中间生态系统正在显现，它将新硬件与可能受益的行业相匹配。

| 量子的慰藉

这一形势和上世纪90年代初互联网的状况有不少相似之处：科学家们投入数十年时间研究的技术，大体上还处于实验室阶段，但业界正开始预见其更广阔的前景。大公司纷纷买进这一技术，或是自主研发。创业公司正迅速增加。政府也在进行“战略性”投资，已经为基础研究投入了很多年。这

也提醒大家有些东西，比如纯理论的科学研究，不能指望市场来提供。

对量子技术专家来说，幸运的是接下来的挑战大部分是工程技术上的，而不是科学理论上的。今天应用量子技术的装置仅仅只是个开始。量子技术更激动人心之处是它目前尚未开发的潜能。位于变革性技术前沿的专家们在预测所研究技术的很多应用时记录不佳：爱迪生曾经以为他的留声机将用在朗诵课上。20世纪的大部分时间里，“量子”在普罗大众的意识里只代表着“怪异”。在21世纪，它将意味着“更好”。■



Free exchange

Get off of my cloud

Trying to stay above politics, economists risk being not just wrong, but irrelevant

EVERY January more than 10,000 economists meet for the annual conference of the American Economic Association (AEA). This year, the shindig was in balmy Chicago, a stone's throw from its second-tallest building, the name TRUMP stamped in extra-large letters across its base. Most papers had been written months in advance; few sessions tackled the electoral earthquake in November. Yet there was no mistaking the renewed sense, following its failure to foresee the 2007-08 financial crisis, of an academic field in a crisis of its own. The election was seen as a defeat for liberalisation and globalisation, and hence for an economics profession that had championed them. If economists wish to remain relevant and useful, the modest hand-wringing at this year's meetings will need to yield to much deeper self-reflection.

Their theories had always shown that globalisation would produce losers as well as winners. But too many economists worried that emphasising these costs might undermine support for liberal policies. A “circle the wagons” approach to criticism of globalisation weakened the case for mitigating policies that might have protected it from a Trumpian backlash. Perhaps the greatest omissions were the questions not asked at all. Most dismal scientists exclude politics from their models altogether. As Joseph Stiglitz, a Nobel laureate, put it on one star-studded AEA panel, economists need to pay attention not just to what is theoretically feasible but also to “what is likely to happen given how the political system works”.

Researchers on topics of political relevance—from the global effects of dollar appreciation to the economics of the production of fake news—promised in Chicago to produce more timely research. One recent

example: just after the election, David Autor, of the Massachusetts Institute for Technology, and others published a short paper comparing congressional-district election results against data they had previously gathered assessing local-area exposure to Chinese imports. Similarly, Anne Case and Angus Deaton of Princeton University were able to compare their results on recent increases in mortality rates in parts of America with voting patterns.

In a keynote address, Robert Shiller—a Nobel prizewinner, habitual freethinker and outgoing AEA president—suggested that economists should think more broadly about the factors that affect human behaviour. Narratives matter, he argued. Powerful ideas, captured in memorable stories, can spread like epidemics, wreaking economic havoc as they go.

Views such as these, however, are notable for their rarity. Economists in Chicago debated the likely effect of the fiscal expansion expected under the Trump presidency, just as they had in past years debated the need for more of a fiscal boost during the outgoing Obama administration. Hardly discussed at all, however, was why deficit spending that seemed politically impossible then is on the political agenda now. A few years ago it might have boosted an American economy struggling to overcome weak growth and near-zero inflation; now the unemployment rate is just 4.7% and both growth and inflation are accelerating.

Economists seem to feel that such political questions are outside their area of concern. Yet politics helps determine the value of economic-policy recommendations. Many aspects of the stimulus plan passed early in Barack Obama's tenure, such as the money provided to states to plug budget holes and protect public services from large spending cuts, were chosen because they were judged to have a high multiplier effect—ie, each dollar in new government debt generated a more-than-equivalent rise in output. But the spending remained largely invisible to voters, who had little idea as a

result whether (or how) they had benefited from it. That, in turn, made stimulus easy to demonise, hindering subsequent attempts to boost fiscal spending and harming labour markets. Policies that look effective in the absence of political constraints can prove anything but in the real world.

Similarly, economists are rightly beginning to wrestle with the threat artificial intelligence could pose to jobs. But they are doing so in almost purely economic terms, when it is the political impact that may prove most interesting and important. Besides modelling an economy where machines do 100% of the work, it might be worth thinking through the potential political effects of a world in which, say, 20% of working-class adults are deprived of good, meaningful work. Long before the last human worker clears his desk, protectionist or Luddite reactions might anyway have destroyed the path to this brave new world.

| *It's the politics, stupid*

Many economists shy away from such questions, happy to treat politics, like physics, as something that is economically important but fundamentally the business of other fields. But when ignoring those fields makes economic-policy recommendations irrelevant, broadening the scope of inquiry within the profession becomes essential. Some justifiably worry that taking more account of politics could destroy what credibility economists have left as impartial, apolitical experts. Yet politics-free models are no insulation from political pressures—just ask a climate scientist—and nothing would boost economists' reputations more than results which match, and even predict, critical outcomes.

Political and social institutions are much harder to model and quantify than commodity or labour markets. But a qualitative approach might actually be far more scientific than equations offering little guide to how the future will unfold. Donald Trump campaigned (and may well govern) by castigating the uselessness of experts. To prepare for a time when expertise

comes back into fashion, economists should renew their commitment to generating knowledge that matters. ■



自由交流

走下云端

试图脱离政治，经济学家不但有犯错之虞，还有可能变得无足轻重

每年1月都会有一万多位经济学家参加美国经济学会（American Economic Association, AEA）的年会。今年这一盛会在温和宜人的芝加哥举办，在距开会地点一箭之遥的地方是该市第二高楼，大厦底部贴着超大字拼出的名字——特朗普（TRUMP）。此次会议的大多数论文在数月前就已完成，会上也很少有议程是探讨去年11月的选举地震。但在未能预测出2007年至2008年的金融危机之后，这一学术领域再次明确无误地感受到自身的危机。这场选举被视为自由化和全球化的一次失败，因此也是支持这两大思想的经济学界的失败。如果经济学家仍想占据一席之地并且发挥作用，那么在明年的年会上，仅仅有一点焦虑不安已经不够——他们需要更深刻的自我反思。

他们的理论始终都表明，全球化既会产生赢家也会产生输家。但是太多经济学家担心，强调这些代价可能会削弱对自由主义政策的支持。在全球化遭遇批评时，他们闭目塞听的态度削弱了实施缓和政策的必要性，而这些政策本可能保护全球化免受特朗普式的强烈抵制。可能最严重的遗漏是那些根本没有被提出的问题。大多数经济学家都把政治完全排除在他们的模型之外。正如诺贝尔奖获得者约瑟夫·斯蒂格利茨（Joseph Stiglitz）在一个众星云集的AEA专家座谈会上所说，经济学家不仅需要注意理论上的可行性，还要注意“考虑到政治体系的运作方式，可能会发生什么”。

这次在芝加哥，研究政治相关性（从美元升值的全球影响到炮制假新闻的经济学意义）的专家们承诺会产出更多及时的研究成果。最近的一个例子是：就在选举结束之后，麻省理工学院的大卫·奥特尔（David Autor）等人发表了一篇短论文，将各选区的选举结果与他们之前收集的评估当地受中国进口商品影响的数据做了比较。同样，普林斯顿大学的安·凯斯（Anne Case）和安格斯·迪顿（Angus Deaton）则将他们获得的美国部分地区近来死亡率升高的数据与投票模式相比较。

在一场主旨发言中，即将离任的AEA主席、素来都是个自由思想家的诺贝尔获奖者罗伯特·席勒（Robert Shiller）建议，经济学家在思索影响人类行为的因素时思路应更开阔些。他指出，叙事手法很重要。强有力的观点一旦融入到难忘的故事中，会像时疫一样蔓延开来，所到之处令经济遭受严重破坏。

但是，这样的观点之所以值得注意正是因为其罕见。云集芝加哥的经济学家就特朗普总统任期内预期的财政扩张可能造成何种影响争论不休，正如过去数年里他们争论现在已卸任的奥巴马政府是否需要实施更多财政刺激一样。然而为何以前在政治上并不可行的赤字开支政策现在却被列入了政治议程？对此几乎没有任何讨论。放在几年前这一政策也许还能推动美国经济努力克服增长疲软和接近零通胀的问题，但现在失业率仅为4.7%，且增长和通胀都在加速。

经济学家似乎觉得这样的政治问题与他们关注的领域无关。但是政治有助于决定经济政策建议的价值。奥巴马任期之初，刺激经济计划的很多方面之所以得以通过——例如向各州提供资金以填补预算缺口，以及保护公共服务免受大幅削减开支的影响等，是因为官员们判定这些举措有很大的乘数效应，即新政府债务的每一美元都能带来更多的产出增长。但是对于选民来说，开支在很大程度上仍是看不到的，因此他们对自己最终能否（或是怎样）从中受益也知之甚少。这反过来会让刺激政策很容易就被妖魔化，从而阻碍进一步促进财政支出的尝试，并损害劳动力市场。不考虑政治制约而看似有效的政策在现实世界里的结果会全然不同。

同样地，经济学家正开始努力应对人工智能可能对就业产生的威胁，这是对的。但他们几乎纯粹是从经济学的角度考虑问题，然而政治影响可能是更有趣也更重要的。除了模拟一个由机器完成全部工作的经济体外，还有其他问题值得深思：假设世界上20%的工薪阶层都失去了良好且有意义的工作，可能会产生怎样的政治影响。远在最后一个人类劳动者清空自己的办公桌之前，保护主义者或是卢德派的反应可能无论如何都已摧毁了通往勇敢新世界的道路。

| 问题出在政治上，笨蛋

很多经济学家都回避这些问题。他们乐于将政治看做经济上重要但根本上仍属于其他领域的事，就像物理学一样。但如果无视这些领域会让经济政策建议失去意义的话，扩大这一专业所探讨的范围就变得至关重要。有些人担忧，考虑太多政治，经济学家作为公正、无政治偏向的专家尚存的公信力就会被毁掉。这确有其道理。但将政治排除在外的模型并不对政治压力免疫——问问气候学家便知。而且没有什么比符合甚至能预测关键结果的研究成果更能提升经济学家的声誉了。

政治和社会体制的建模和量化比商品或劳动力市场难得多。然而比起对未来如何发展几无指导意义的方程式来说，定性的方式实际上可能要科学得多。特朗普用于竞选的一个招数就是斥责专家的无用，很可能还会以此治理国家。要为专业知识重新流行的那一天做准备，经济学家应重新致力于创造真正有价值的知识。■



Solar energy

Shine on

Do solar cells save more carbon dioxide than is used to create them?

THAT solar panels do not emit greenhouse gases such as carbon dioxide when they are generating electricity is not question. This is why they are beloved of many who worry about the climate-altering potential of such gases. Sceptics, though, observe that a lot of Energy is needed to make a solar panel in the first place. In particular, melting and purifying the silicon that these panels employ to capture and transduce sunlight needs a lot of heat. Silicon's melting point, 1,414 ° C, is only 124 ° C less Than that of iron.

Silicon is melted in electric furnaces and, at the moment, most electricity is produced by burning fossil fuels. That does emit carbon dioxide. So, when a new solar panel is put to work it starts with a “carbon debt” that, from a greenhouse-gas-saving point of view, has to be paid back before that panel becomes part of the solution, rather than part of the problem. Observing this, some sceptics have gone so far as to suggest that if the motive for installing solar panels is environmental (which is often, though not always, the case), they are pretty-much useless.

Wilfried van Sark, of Utrecht University in the Netherlands, and his colleagues have therefore tried to put some numbers into the argument. As they report in *Nature Communications*, they have calculated the energy required to make all of the solar panels installed around the world between 1975 and 2015, and the carbon-dioxide emissions associated with producing that energy. They also looked at the energy these panels have produced since their installation and the corresponding amount of carbon dioxide they have prevented from being spewed into the atmosphere. Others have done life-cycle assessments for solar power in the past. None, though, has accounted for the fact that the process of making the panels has become

more efficient over the course of time. Dr Van Sark's study factors this in.

| *Panel games*

To estimate the number of solar panels installed around the world, Dr Van Sark and his team used data from the International Energy Agency, an autonomous intergovernmental body. They gleaned information on the amount of energy required to make panels from dozens of published studies. Exactly how much carbon dioxide was emitted during the manufacture of a panel will depend on where it was made, as well as when. How much emitted gas it has saved will depend on where it is installed. A panel made in China, for example, costs nearly double the greenhouse-gas emissions of one made in Europe. That is because China relies more on fossil fuels for generating power. Conversely, the environmental benefits of installing solar panels will be greater in China than in Europe, as the clean power they produce replaces electricity that would otherwise be generated largely by burning coal or gas.

Once the team accounted for all this, they found that solar panels made today are responsible, on average, for around 20 grams of carbon dioxide per kilowatt-hour of energy they produce over their lifetime (estimated as 30 years, regardless of when a panel was manufactured). That is down from 400-500 grams in 1975. Likewise, the amount of time needed for a solar panel to produce as much energy as was involved in its creation has fallen from about 20 years to two years or less. As more panels are made, the manufacturing process becomes more efficient. The team found that for every doubling of the world's solar capacity, the energy required to make a panel fell by around 12% and associated carbon-dioxide emissions by 17-24%.

The consequence of all this number-crunching is not as clear-cut as environmentalists might hope. Depending on the numbers fed into the model, global break-even could have come as early as 1997, or might still

not have arrived. But if it has not, then under even the most pessimistic assumptions possible it will do so in 2018. After that, solar energy's environmental credentials really will be spotless. ■



太阳能

继续照耀

太阳能电池减少的二氧化碳排放多过制造这些电池时产生的排放吗？

毫无疑问，太阳能电池板在发电时不会排放二氧化碳等温室气体。正因如此，那些担心温室气体可能改变气候的人很喜欢太阳能。但是怀疑论者认为，制造太阳能电池板本身就需要大量能量。太阳能电池板使用硅来吸收并转换阳光，而硅的熔化和提纯尤其需要大量热量。硅的熔点为 1414°C ，仅比铁低 124°C 。

硅是在电炉中熔化的，而眼下大部分电力都靠燃烧化石燃料产生。这确实排放了二氧化碳。因此，新太阳能电池板甫一投入使用便已背上了“碳债务”。从减少温室气体排放的角度来看，在电池板成为解决方案的一部分（而非问题的一部分）之前，必须要还清碳债务。因为看到这一点，一些怀疑论者甚至说，如果安装太阳能电池板是为了环保（通常都是如此，但也不总是），那么它们几乎没什么用。

因此，荷兰乌特列支大学（Utrecht University）的威尔弗里德·范萨克（Wilfried van Sark）及其同事试着在论证中加入一些数字。正如他们在《自然通讯》（Nature Communications）中报告的那样，他们计算出在1975年至2015年期间全球安装的所有太阳能电池板制造时所需的能量，以及产生这些能量而导致的二氧化碳排放量。他们还研究了这些电池板安装后产生的能量，以及由此减少的排入大气的二氧化碳数量。其他人曾针对太阳能发电的整个寿命周期做过评估，但没人考虑过随着时间推移电池板的生产已变得更高效的事实。范萨克的研究则计入了这个因素。

| 电池板算术

为了估算出全球安装的太阳能电池板数量，范萨克及其团队使用了独立的政府间机构国际能源署（International Energy Agency）的数据。他们从几十篇已发表的研究中收集了有关制造电池板所需能量的信息。一块电池板的制造过程中究竟排放了多少二氧化碳，这取决于它制造的时间与地点。

它减少多少温室气体排放则取决于它安装的地点。例如，中国为制造一块电池板而排放的温室气体几乎是欧洲的两倍。这是因为中国更依赖化石燃料发电。反过来，在中国安装太阳能电池板的环境效益比在欧洲更大，因为它们能产生清洁的电力，不然，发电还会主要依靠煤炭或天然气。

一旦该团队考虑了这些因素，他们发现，目前生产的太阳能电池板在使用期间（按30年估算，无论何时生产）每发一度电会平均排放约20克二氧化碳。而这个数字在1975年是400至500克。同样地，一块太阳能电池板的发电量达到其制造时所消耗能量的时间已从大约20年缩减到两年甚至更短。随着生产的电池板越来越多，制造过程也变得更为高效。该团队发现，世界太阳能装机容量每翻一番，制造电池板的能耗就下降大约12%，由此产生的二氧化碳排放则减少17%至24%。

所有这些数字运算的结果可能并不像环保人士希望的那般清楚明白。根据输入模型的数字的不同，全球平衡点可能早在1997年就已经达到，也可能尚未到来。但即使尚未到来，就算是按照最悲观的假设，到2018年也将达到平衡。在那之后，太阳能的环保资格将真正地无可挑剔。 ■



Renewable energy

A greener grid

China's embrace of a new electricity-transmission technology holds lessons for others

YOU cannot negotiate with nature. From the offshore wind farms of the North Sea to the solar panels glittering in the Atacama desert, renewable energy is often generated in places far from the cities and industrial centres that consume it. To boost renewables and drive down carbon-dioxide emissions, a way must be found to send energy over long distances efficiently.

The technology already exists. Most electricity is transmitted today as alternating current (AC), which works well over short and medium distances. But transmission over long distances requires very high voltages, which can be tricky for AC systems. Ultra-high-voltage direct-current (UHVDC) connectors are better suited to such spans. These high-capacity links not only make the grid greener, but also make it more stable by balancing supply. The same UHVDC links that send power from distant hydroelectric plants, say, can be run in reverse when their output is not needed, pumping water back above the turbines.

Boosters of UHVDC lines envisage a supergrid capable of moving energy around the planet. That is wildly premature. But one country has grasped the potential of these high-capacity links. State Grid, China's state-owned electricity utility, is halfway through a plan to spend \$88bn on UHVDC lines between 2009 and 2020. It wants 23 lines in operation by 2030.

That China has gone furthest in this direction is no surprise. From railways to cities, China's appetite for big infrastructure projects is legendary. China's deepest wells of renewable energy are remote—think of the sun-baked Gobi desert, the windswept plains of Xinjiang and the mountain

ranges of Tibet where rivers drop precipitously. Concerns over pollution give the government an additional incentive to locate coal-fired plants away from population centres. But its embrace of the technology holds two big lessons for others. The first is a demonstration effect. China shows that UHVDC lines can be built on a massive scale. The largest, already under construction, will have the capacity to power Greater London almost three times over, and will span more than 3,000km.

The second lesson concerns the co-ordination problems that come with long-distance transmission. UHVDCs are as much about balancing interests as grids. The costs of construction are hefty. Utilities that already sell electricity at high prices are unlikely to welcome competition from suppliers of renewable energy; consumers in renewables-rich areas who buy electricity at low prices may balk at the idea of paying more because power is being exported elsewhere. Reconciling such interests is easier the fewer the utilities involved—and in China, State Grid has a monopoly.

That suggests it will be simpler for some countries than others to follow China's lead. Developing economies that lack an established electricity infrastructure have an advantage. Solar farms on Africa's plains and hydroplants on its powerful rivers can use UHVDC lines to get energy to growing cities. India has two lines on the drawing-board, and should have more.

Things are more complicated in the rich world. Europe's utilities work pretty well together but a cross-border UHVDC grid will require a harmonised regulatory framework. America is the biggest anomaly. It is a continental-sized economy with the wherewithal to finance UHVDCs. It is also horribly fragmented. There are 3,000 utilities, each focused on supplying power to its own customers. Consumers a few states away are not a priority, no matter how much sense it might make to send them electricity. A scheme to connect the three regional grids in America is

stuck. The only way that America will create a green national grid will be if the federal government throws its weight behind it.

| *Live wire*

Building a UHVDC network does not solve every energy problem. Security of supply remains an issue, even within national borders: any attacker who wants to disrupt the electricity supply to China's east coast will soon have a 3,000km-long cable to strike. Other routes to a cleaner grid are possible, such as distributed solar power and battery storage. But to bring about a zero-carbon grid, UHVDC lines will play a role. China has its foot on the gas. Others should follow. ■



可再生能源

更环保的电网

中国采用电力传输新技术的经验可供他国借鉴

你没法跟大自然谈判。从大西洋北海上的离岸风电场到智利阿塔卡马沙漠中闪烁生辉的太阳能电池板，可再生能源的产生地通常远离消费这些能源的城市和工业中心。为推广可再生能源，减少二氧化碳排放，必须找到长距离高效输送能源的方法。

现在已有这样的技术。目前电力主要以交流电的方式传输，在中短距离范围内运作良好。但长距离传输需要极高的电压，这对交流电系统来说较为困难。特高压直流（UHVDC）连接器更适合这种长距离传输。这些大容量连接不但使电网更环保，而且还通过平衡供电使电网更稳定。举例来说，从远方水力发电厂输出电力的同一条UHVDC线路可以在无需输电时反向输送，把水压回涡轮机的上方。

UHVDC线路的推崇者设想将来会建成一个可环球传输能源的超级电网。这一构想还远不成熟，但有一个国家已经认识到了这些大容量线路的潜力。中国的国有电力公司国家电网计划在2009年至2020年间投资880亿美元建造UHVDC线路，目前项目已推进了一半。公司希望到2030年能有23条线路投入运作。

中国在这条路上走得最远并不稀奇。从修建铁路到建设城市，中国对大型基建项目的胃口众所周知。中国可再生能源最丰富的地区都位置偏远，比如烈日灼人的戈壁沙漠、强风劲吹的新疆平原，以及江河奔流而下的西藏高山峡谷。对于污染的关注更是促使政府把燃煤电厂搬离人口密集的地区。而中国在采用这一技术的过程中有两大经验可供借鉴。第一是示范效应。中国显示出UHVDC线路是可以大规模建设的。目前在建的最大UHVDC线路的供电能力将达到大伦敦地区用电量的近三倍，跨越3000多公里。

第二个经验涉及长距离输电带来的协调问题。UHVDC线路与普通电网一样讲求平衡利益。其建造成本高昂。目前高价售电的电力公司不太可能欢迎可再生能源供应商加入竞争；在可再生能源丰富之地低价购买电力的消费者会担心电价因电力出口外地而上升。所涉及的电力公司越少，调和这些利益就越容易。而在中国，国家电网是垄断企业。

这表明，某些国家会比其他国家更容易追随中国的领先步伐。缺乏成熟电力基础设施的发展中经济体具备优势。在非洲，平原上的太阳能电厂和湍急河流上的水力发电厂可运用UHVDC线路传送能源到新兴城市。印度正在规划两条线路，而且未来应该还有更多。

在富裕世界，情况相对更复杂。欧洲的电力供应商整体合作不错，但跨境UHVDC电网将需要一个协调的监管框架。最为异常的是美国。作为大陆级的经济体，美国拥有足够的资金建造UHVDC线路，但同时市场又极其支离破碎——该国有3000家电力公司，每家公司都专注为自己的客户供电。相隔几个州以外的客户并不受重视，不管向其供电的理由有多么充分。一项连接美国三个地区电网的计划目前停滞不前。美国创建全国性绿色电网的唯一途径是联邦政府插手。

| 火线

建造UHVDC电网不能解决一切能源问题。供电安全仍是难题，即便是在一国境内：如果有人想破坏中国东海岸供电，即将有长达3000公里的电缆供其攻击。还有其他方式打造更清洁的电网，例如分布式太阳能供电及电池存储。但要实现零碳电网，UHVDC线路将发挥作用。中国已经脚踩油门，其他国家也应当奋起直追。■



Cyber-insurance

Hack work

Insurers grapple with hacking that goes beyond data breaches

AS HACKERS wreak havoc with depressing regularity, the insurance industry finds itself forced to contemplate a whole new set of risks. They range from the theft of millions of credit-card numbers from American retailers to the disabling of the power grid, as happened in Ukraine in December 2015. The dedicated “cyber-insurance” policies that companies offer against data breaches have become relatively routine. But the risks they insure under other policies are also affected by cyber-risks—and they are still struggling to understand this so-called “silent” cyber-exposure.

Insurance that protects firms who suffer data breaches has been on offer for around 15 years. It is much harder to put a precise value on, for example, stolen health records than on a property or car. Insurers sidestep the problem by covering only the direct costs that a company incurs from a hack. Typically, these include hiring a specialised forensics firm to work out exactly what was stolen, notifying affected customers (which 47 American states currently require), short-term business interruption and fines.

The industry will be shaken up by new EU data-protection rules, which come into force in 2018 and will impose stricter notification requirements and stiffer fines for data breaches than firms have so far faced in America. Partly because of this, the market for cyber-insurance, which represented only \$2.5bn in global premium revenue in 2014 (90% of which came from American companies), is expected to treble by 2020, according to PwC, a consultancy. That would still leave it tiny in comparison with, say, the \$670bn global motor-insurance market.

Data breaches are, however, for the most part a manageable nuisance rather than a disaster. Despite the hundreds that take place annually, only 90 since 2010 have been reported by American companies to regulators as having had a “material” impact on their business.

The bigger concern is the “silent” exposure: cyber-attacks that cause physical damage or bodily injury and can end up triggering other policies, such as life, home or commercial-property insurance. Often, such policies, though not designed with cyber-risks in mind, do not specifically exclude them either. In some cases the difference may be minor; a burglar who enters a house by hacking a “smart” lock will not necessarily steal more than one who breaks a window. But cases such as the massive damage caused to a steelworks in Germany in 2014 by hackers who messed with a blast furnace, or the hacking of the Ukrainian power grid (blamed by many on Russia), give insurers pause. They have added urgency to efforts to understand, measure and calibrate their exposures to these new threats.

With real-world precedents still too rare to form the basis of any reliable estimates, the industry has turned to using hypothetical scenarios. At the end of last year, for the first time, Lloyd’s of London, an insurance market that specialises in niche and emerging risks, asked its syndicates (groups of insurers and brokers) to come up with “plausible but extreme” cyber-attack scenarios, and report back their estimated total exposure, in what is to be an annual requirement. The exercise follows a cyber-scenario report in May 2015 from the management of Lloyd’s itself on a hypothetical hacker-caused blackout of the entire power grid of the American north-east. It estimated this would cause direct losses to business revenues of \$222bn, and a total dent in GDP of over \$1trn over five years.

Many insurers are turning to outside expertise. Matt Webb of Hiscox, a specialist insurer, describes an “arms race” between analytics firms such as RMS and Symantec, offering their long-standing modelling prowess (RMS

is already well-trusted on hurricane modelling, for example) to help insurers understand their cyber-liabilities.

But even if exposures are better understood, limiting them may prove tricky. Kevin Kalinich of Aon, an insurance-broker, points to the near-impossibility of drawing a line, for example, between cyber-war or cyberterrorism and “normal” hacking. Cyber-crime knows no geographical bounds, unlike, say, a Florida hurricane. Mr Webb reckons that insurance policies will at a minimum need explicitly to recognise that cyber-risks are covered or to exclude them—just as many policies already include exemptions for terrorism or war.

Although insurers are already helping companies with more humdrum data breaches, the industry still lacks a clearly formulated response to a larger-scale cyber-calamity. Inga Beale, CEO of Lloyd’s, is optimistic that the market, thanks to its exacting modelling exercises and its unique risk-sharing structure, is better equipped than most. But only a devastating, real-life cyber-attack would test how effective its preparations have been. ■



网络保险

穷于应付

保险公司努力应对黑客攻击，不止于数据泄露

黑客攻击频繁肆虐，令人沮丧，保险业不得不考虑一系列全新的风险：从美国零售商被盗取数百万个信用卡号码，到电网瘫痪（就像2015年12月在乌克兰发生的那次），不一而足。保险公司提供的专门针对数据泄露的“网络保险”已成为相对常规的险种。但其他险种所防范的风险也受到了网络风险的影响，各家公司仍在费劲地理解这种所谓的“静默的”网络风险。

为数据遭泄露的公司提供的保险已经出15年左右。相对房产或汽车，网络险很难确定标的的精确价值，比如失窃的健康记录。保险公司为了回避这个问题，仅赔偿企业遭黑客袭击所产生的直接损失。通常，这些成本包括聘请专业取证公司确认被盗内容、通知受影响的客户（目前美国47个州有此要求）、短期业务中断的损失和罚款。

将于2018年生效的欧盟数据保护新规将严重影响保险业。相比美国到目前为止所实施的法规，该规定对通知客户将有更严格的要求，对数据泄露的罚款金额也更高。咨询公司普华永道的数据显示，网络保险市场在2014年的全球保费收入仅为25亿美元（其中90%来自美国公司）；一定程度上受欧洲新规的影响，预计到2020年，该市场的规模将是现在的三倍。但与全球6700亿美元的汽车保险市场相比，仍然微不足道。

然而，大部分数据泄露事件并非灾难，而是可管控的麻烦事。尽管每年有数百起数据泄露，但自2010年以来，美国公司向监管机构只报告了90起对业务产生“实质”影响的泄露事件。

更引人担忧的是“静默”的网络攻击，即造成物理损害或身体伤害、最终可能触发人寿险、家庭险或商业财产险等其他险种的网络攻击事件。这些险种在设计之初虽然没有考虑过网络风险，但通常也没有明确排除这些风险。在某些情况下，传统保险和网络保险可能区别并不大，通过破解“智

能”锁入室的窃贼不一定会比破窗而入的小偷窃走更多财物。但有些时候黑客攻击会造成巨大损失，例如2014年德国一家钢铁厂的高炉控制系统被黑客攻击，或乌克兰电网遭黑客攻击事件（许多人认为是俄罗斯干的），这类攻击会让保险公司三思而后行。它们迫切需要努力去了解、衡量和评估这些新威胁所带来的风险。

由于现实中的先例仍然太少，不足以进行任何可靠的估计，保险业已转而使用情景假设。伦敦劳合社（Lloyd's）是一个专注于利基市场和新兴风险的保险市场。去年年底，劳合社要求各成员（由若干保险公司和经纪人组成）提出“合理但极端”的网络攻击情景，并报告它们估计出的总风险，此举今后将成为一项年度工作要求。在此之前，2015年5月劳合社自身的管理层做了一份网络情景报告，假设黑客攻击造成美国东北部整个电网停电。据估计，这会造成2220亿美元的直接营业收入损失，导致未来五年GDP总计减少超过1万亿美元。

许多保险公司都在寻求外部专家的帮助。专业保险公司Hiscox的马特·韦伯（Matt Webb）讲述了RMS和赛门铁克（Symantec）等分析公司之间开展的“军备竞赛”，它们用长期的建模实力（例如RMS在飓风建模方面已获得广泛的信任）来帮助保险公司了解它们所面对的网络风险。

但即使能够更好地理解这些风险，要限制风险可能仍很棘手。怡安集团（Aon）的保险经纪人凯文·卡里宁（Kevin Kalinich）指出，要严格界定网络风险几乎是不可能的，例如网络战争或网络恐怖主义与“一般的”黑客行为就难以区分。网络犯罪不像佛罗里达州的一场飓风那样只波及局部地区。韦伯认为，保单上至少将需要明确指出网络风险是否在承保范围——许多险种已经明确了对恐怖主义或战争的免责。

尽管保险公司已经在帮助企业防范更多频繁发生、令人心烦的数据泄露事件，但保险业仍然缺乏对大规模网络灾难的明确应对机制。劳合社的CEO英格·碧尔（Inga Beale）乐观地认为，由于该市场严密的建模演练和独特的风险分担结构，劳合社比大多数公司更具应对网络风险的能力。但只有真正发生一次破坏力巨大的网络攻击事件，才能检验其准备工作是否有

效。■



Intellectual property

Blockchain of command

The technology underlying bitcoin may be in for a patent war

FOR fans of bitcoin, a digital currency, the year got off to a volatile start. On January 5th one bitcoin changed hands for nearly \$1,150—almost as much as the record set three years ago. It has since dropped by 33%. Elsewhere in the land of monetary bits, things move more slowly but trouble is brewing: a potential patent war looms over the blockchain, a distributed ledger that authenticates and records every bitcoin transaction.

Heated fights over intellectual property are nothing new in promising technology markets. But given that the blockchain is expected to shake up everything from the way precious diamonds are safeguarded to the way shares are traded, the legal fights could be especially fierce.

On the face of it, the blockchain does not lend itself easily to staking out intellectual-property claims. Bitcoin's creator, known only by his pseudonym, Satoshi Nakamoto, published a paper about his invention, coded the first implementation and then disappeared—meaning that the core of the technology is now part of the public domain and only important additions and variations could be patented. And the blockchain's components are widely known. In America court decisions as well as a new law on the granting of patents make it difficult to claim ownership for such financial innovations.

This hasn't stopped firms from trying to get patent protection on meaningful improvements to the blockchain, including security and encryption techniques, says Colette Reiner Mayer of Morrison & Foerster, a law firm. Applications are now becoming public, because America's patent office must release them 18 months after they are filed. A search of

Espacenet, a global database, yields 36 hits; hundreds more are said to be in the pipeline.

Financial firms are among the most assiduous filers: MasterCard, for instance, is seeking four payment-related patents; Goldman Sachs has put in for one outlining a distributed ledger that can process foreign-exchange transactions. Startups, including Coinbase, Chain and 21 Inc, have been busy, too. And then there is Craig Wright, an Australian who claims to be Mr Nakamoto but has failed to provide conclusive proof. He has filed, via an Antigua-registered entity called EITC Holdings, for 73 patents in Britain.

Only a very few patents have been issued so far. And known applicants all say that they intend to use patents only “defensively”, meaning to protect themselves against lawsuits. Still, legal battles look likely: incumbent banks may go after newcomers, and “non-practising entities” (also known as “patent trolls”) may attempt to shake down other firms. It could slow the pace of innovation, warns Brian Behlendorf of Hyperledger, an umbrella group for several blockchain-related projects.

To limit such fights, several startups are opening up their IP. Chain, Digital Asset Holdings and Hyperledger have made their software open-source, so that the underlying recipe is freely available, which also makes it more attractive to users and developers. Some programs even come with a licence that makes it impossible to enforce patents against those who use the organisation’s code. Blockstream, another startup, has signed a “patent pledge”, vowing not to sue others—as long as they don’t use their own patents offensively.

There are also discussions over forming a patent pool, much like the Open Invention Network, created in 2005 to protect member firms against suits for using Linux, the popular open-source operating system. The OIN acquires patents and then licenses them freely to members, which agree

not to assert their own patents.

Whether this strategy of mutual disarmament is sufficient to avoid another patent war will be clear only when and if blockchains have become a multi-billion dollar business. Last month DTCC, a provider of clearing and settlement services, announced that it will base the next generation of its trade-information system on a blockchain, and SWIFT, a payments network, said it was exploring the technology. That might prompt more applications. ■



知识产权

控制区块链

比特币的底层技术可能会陷入专利战

对数字货币比特币的追捧者来说，今年的开局波动剧烈。1月5日，比特币交易价格接近1150美元，几乎达到三年前的历史高位，而那之后已下跌33%。在数字货币的其他领域，变化没那么剧烈，但问题正在酝酿：一场针对区块链（一种分布式分类账，用以认证并记录每一次比特币交易）的专利战即将来临。

新兴技术市场上就知识产权的激战并非什么新鲜事。但区块链有望颠覆诸多领域的操作方式——从珍贵钻石的保护到股票的交易方式，因此相关的法律争端可能尤为激烈。

表面上看，区块链是一种难以申请知识产权保护的技术。比特币的创造者（只知其化名为中本聪）曾就这项发明发表了一篇论文，并编写了首个比特币程序，而后便销声匿迹。这就意味着这一技术的核心如今属于公共数据，只有重大补充和改良才可以获得专利。区块链的构成广为人知。在美国，相关法院裁决以及新的专利授予法令都令人难以对这类金融创新宣称所有权。

但美富律师事务所（Morrison & Foerster）的科莱特·莱纳·迈耶（Colette Reiner Mayer）表示，这并未阻止企业就自己对区块链的重大改良争取专利保护，包括安全及加密技术。现在这些专利申请已经逐渐公开，因为美国专利局必须在申请提交18个月后发布信息。在全球数据库Espacenet上可以搜索到36项相关申请，据说还有几百个这类申请正在处理中。

金融公司位居最积极的申请人之列，例如万事达正在申请四项支付方面的专利，高盛也在就一项用于处理外汇交易的分布式分类账技术提交专利申请。Coinbase、Chain、21 Inc等创业公司也在忙于申请这类专利。然后还

有那位声称是中本聪本人但无法提供确凿证据的澳大利亚人克雷格·怀特（Craig Wright）。他通过在安提瓜注册的名为EITC控股（EITC Holding）的实体，在英国提交了73项专利申请。

迄今为止，只有极少数专利获批。已公开的申请人都说自己只是想“防御性”地使用专利，意思是要保护自己以免惹上官司。然而似乎难免会爆发诉讼战：传统银行可能会阻击新来者，而“非专利实施实体”（即专利囤积商）则可能勒索其他公司。多个区块链项目的协作组织超级账本（Hyperledger）的布莱恩·贝伦多夫（Brian Behlendorf）警告说，这会拖慢创新的速度。

为限制这类争端，一些创业公司正在开放自己的知识产权。区块链创业公司Chain、数字资产控股（Digital Asset Holdings）以及超级账本已把各自的软件开源，让人们能随意获取底层代码，这也吸引了更多的用户和开发者。部分程序甚至附有许可证，因而无法向使用相关代码的人追究专利侵权。另一家创业公司Blockstream也已签署了一份“专利保证书”，承诺只要他人不恶意使用其专利，就不会起诉他们。

此外还有关于成立专利联盟的讨论，类似开源发明网络（Open Invention Network，以下简称OIN）。OIN创建于2005年，目的是保护成员公司免于因使用Linux这一广受欢迎的开源操作系统而遭到诉讼。OIN获取专利，然后授予其成员免费使用许可，成员则同意不主张自己的专利。

这种相互按兵束甲的战略是否足以避免又一场专利战？只有当区块链成长为价值数十亿美元的业务时，答案才会明朗。上月，清算及结算服务提供商美国证券托管结算公司（DTCC）宣布将采用区块链技术构建其下一代交易信息系统，而支付网络环球银行金融电信协会（SWIFT）也表示正在研究该技术。这可能会催生更多的专利申请。■



Internet security

Breaching-point

Incentives need to change for firms to take cyber-security more seriously

IT HAS been a cracking year for hacking. Barack Obama and the CIA accused Russia of electronic meddling in an attempt to help Donald Trump win the presidency. Details emerged of two enormous data breaches at Yahoo, one of the world's biggest internet companies; one, in 2013, affected more than a billion people. Other highlights include the hack of the World Anti-Doping Agency; the theft of \$81m from the central bank of Bangladesh (only a typo prevented the hackers from making off with much more); and the release of personal details of around 20,000 employees of the FBI. The more closely you look at the darker corners of the internet, the more the phrase "computer security" looks like a contradiction in terms.

Why, two decades after the internet began to move out of universities and into people's homes, are things still so bad? History is one reason: the internet started life as a network for the convenient sharing of academic data. Security was an afterthought. Economics matters, too. Software developers and computer-makers do not necessarily suffer when their products go wrong or are subverted. That weakens the incentives to get security right.

Unfortunately, things are likely to get worse before they get better. The next phase of the computing revolution is the "internet of things" (IoT), in which all manner of everyday objects, from light bulbs to cars, incorporate computers connected permanently to the internet. Most of these gizmos are as insecure as any other computer, if not more so. And many of those making IoT products are not computer firms. IT companies have accumulated decades of hard-won wisdom about cyber-security; toaster-makers have rather more to learn.

In November cyber-security researchers revealed a malicious program that could take control of any smart light bulbs within 400 metres. A hacked light bulb does not sound too dangerous. But such unobtrusive computers can be recruited into remotely controlled “botnets” that can be used to flood websites with bogus traffic, knocking them offline. Routers, the small electronic boxes that connect most households to the internet, are already a popular target of bot-herders. Other targets are more worrying. At a computer-security conference in 2015, researchers demonstrated how wirelessly to hack a car made by Jeep, spinning its steering wheel or slamming on its brakes. As the era of self-driving cars approaches, the time to fix such problems is now.

One option is to leave the market to work its magic. Given the damage that cybercrime can do to companies, they have good commercial reasons to take it seriously. If firms are careless about security, they risk tarnished reputations and lost customers. A planned buy-out of Yahoo by Verizon, an American telecoms firm, may be rethought after its hacks. But these incentives are blunted when consumers cannot make informed choices. Most customers (and often, it seems, executives) are in no position to evaluate firms’ cyber-security standards. What is more, the epidemic of cybercrime is best tackled by sharing information. A successful cyber-attack on one company can be used against another. Yet it is tempting for firms to keep quiet about security breaches.

That suggests a role for government. Researchers draw an analogy with public health, where one person’s negligence can harm everyone else—which is why governments regulate everything from food hygiene to waste disposal. Some places are planning minimum computer-security standards, and will fine firms that fail to comply. The IoT has also revived the debate about ending the software industry’s long-standing exemption from legal liability for defects in its products.

| *Neither relax nor chill*

The problem is that regulation is often fragmented. America has a proliferation of state-level rules, for example, when a single, federal regime would be better. Regulation can also go too far. From January financial institutions in New York must comply with a new cyber-security law that many think sets the bar for breach notifications too low. Changing the liability regime for software could chill innovation by discouraging coders from trying anything new.

Rule-makers can, however, set reasonable minimum expectations. Many IoT devices cannot have their software updated, which means that security flaws can never be fixed. Products should not be able to operate with factory usernames and passwords. No software program can be made impregnable, but liability regimes can reflect firms' efforts to rectify flaws once they become apparent. Firms need to be encouraged to take internet security more seriously. But overly detailed prescriptions will just hack everyone off. ■



网络安全

攻破点

需要改变激励措施来刺激企业更加重视网络安全

去年对于黑客而言可谓是个丰收年。奥巴马和中央情报局指斥俄罗斯通过电子入侵干预大选，企图帮助特朗普当选总统。世界上最大的互联网公司之一雅虎两次大规模数据泄露的细节逐渐浮出水面，其中一次发生在2013年，影响了十亿多人。其他广受关注的黑客事件包括：世界反兴奋剂机构遭网络攻击；孟加拉国中央银行被盗8100万美元（如果不是因为一个打字错误，黑客还会盗取更多）；联邦调查局约2万名员工的个人信息泄露。我们越是密切注视互联网的黑暗角落，“计算机安全”这个词看起来就越自相矛盾。

互联网走出大学进入家庭已有20年，为什么网络安全问题还是如此糟糕？一部分是出于历史原因：互联网最初是为了方便共享学术数据，安全是后来才想到的问题。经济原因也很重要。软件开发商和计算机制造商在产品出错或遭到破坏时不一定会蒙受损失，这也就削弱了它们解决安全问题的动力。

不幸的是，情况在获得改善之前可能还会变得更糟。计算革命的下一个阶段是“物联网”（IoT）：从灯泡到汽车，所有日常物品都会含有永久联网的计算部件。这些新玩意大多不会比任何其他计算机更安全。许多物联网产品制造商都不是计算机公司。IT公司经过几十年的摸爬滚打，在网络安全方面已经积累了相当经验，而吐司炉制造商还有更多的东西要学。

去年11月，网络安全研究人员发现了一个恶意程序，可控制400米内的任何智能灯泡。一个被黑客入侵的灯泡听起来没什么危险，但是这些不起眼的计算设备可被加入受远程控制的“僵尸网络”，用虚假流量冲击网站使之掉线。路由器这种把大多数家庭连入互联网的小电子盒子，已经成为“僵尸牧人”热衷于攻击的目标。其他的目标更令人担忧。在2015年的一个计算机安全会议上，研究人员展示了如何通过无线方式入侵一台Jeep公司制

造的汽车，转动其方向盘或急刹车。随着无人驾驶汽车时代的到来，解决这些问题迫在眉睫。

一种做法是留给市场去发挥它的魔力。鉴于网络犯罪会对企业造成重创，企业有充足的商业理由认真对待这一问题。如果企业对网络安全漫不经心，就会面临信誉受损和失去客户的风险。雅虎发生黑客攻击事件之后，美国电信公司威瑞森（Verizon）可能会重新考虑收购雅虎的计划。然而，当消费者无法做出知情选择时，这些动力就会减弱。大多数客户（通常看来都是企业高管）无法评估公司的网络安全标准。此外，解决网络犯罪泛滥的最佳办法是分享信息。成功侵袭了一家公司后，同一种攻击可以被再次施加于另一家公司。然而，企业总会倾向于对安全漏洞保持沉默。

这意味着需要政府发挥作用。研究人员以公共卫生做类比：在这个领域一个人的疏忽可能会伤害其他所有人，因此政府要监管从食品卫生到废物处理等一系列公共事务。一些地方正在计划出台最低计算机安全标准，不达标的公司将面临罚款。长期以来，软件行业对其产品的缺陷都无需承担法律责任，物联网的发展重启了对这一问题的争论。

| 不懈怠，不扫兴

问题在于监管经常是分散的。例如美国有大量由各州制定的规则，而一套联邦层面的单一制度可能会更好。监管也由可能会过度。从1月起，纽约的金融机构必须遵守新的网络安全法，许多人认为此法要求的入侵告知标准太低。改变软件的责任制度可能会阻止程序员做任何新的尝试，从而阻碍创新。

然而，规则制定者可以设定合理的最低预期。许多物联网设备的软件不能更新，致使安全漏洞永远都无法修复。产品不应使用工厂预设的用户名和密码操作。没有任何软件程序坚不可破，但责任制度可以反映公司在软件出现明显漏洞时为矫正问题所做的努力。应当鼓励企业更加重视互联网安全，但管得过细只会惹恼所有人。 ■



Space firms

Eyes on Earth

Planet's satellites offer customers a new world view every day

BUILT by the Indian Space Research Organisation, the Polar Satellite Launch Vehicle threw itself into the sky at 3.58am GMT on February 15th. It took with it a record-breaking 104 satellites—88 of which belonged to a single company, Planet, a remote sensing business based in San Francisco. Planet now has 149 satellites in orbit—enough for it to provide its customers with new moderately detailed images of all the Earth's land surface every single day.

The satellites Planet makes—it calls them “doves”—measure 10cm by 10cm by 30cm. The first doves, launched five years ago, could send back pictures of just 3,000 square kilometres a day. But the satellites have followed a trajectory of improvement much closer to that seen in cell-phones—from which they get some of their components—than the established satellite industry. The latest doves can cover 2.5m square kilometres a day.

The expanded fleet of satellites will send over 3 terabytes of data a day to more than 30 receiver stations spread around the Earth. After processing to remove distortions and to locate each image, the data will be in the cloud and ready for the company's clients within hours.

Planet does not provide many details about its customers, but Will Marshall, the company's CEO, says that it has over 100. Some are spooks, historically the biggest consumers of satellite images. But though Planet has spoken of a big contract with the relevant American outfit, the National Geospatial-Intelligence Agency, Mr Marshall says the NGA is not his biggest customer. Other buyers include mapmakers, financial companies and multinationals—especially those in the energy sector with widespread

assets.

Providing daily updated images of the whole surface of the Earth fulfils one of the goals Planet had at its founding in 2010, since when it has raised capital of \$183m. That does not mean it will stop launching doves; among other things, passing over the same place more than once a day increases the chances of a shot unobscured by cloud. But turning its unique product into an ever bigger earner is the priority.

A key to doing so is processing the images to answer pressing questions: what has changed since yesterday? Is that illegal logging? What does the number of containers in these ports suggest about trade balances? Planet will be providing more such analysis itself, but there are also third parties eager to play. SpaceKnow, a startup which focuses on turning satellite data into analysis the financial community will pay for, has just raised \$4m.

Satellites alone do not make a good business, as illustrated by the fate of an earlier startup, Terra Bella. Formerly known as Skybox, it made SkySat satellites and was bought by Google for \$500m in 2014 amid fanfare. But in recent weeks Google sold the firm to Planet in an equity deal which almost certainly gave Terra Bella a much lower valuation; at the same time, it became a big customer for Planet's data.

This is the second time Planet has snapped up satellites from a rival in trouble, and the deal could work out well. The resolution available from the doves, three to five metres, is a bit coarser than many consumers of satellite data are used to. The larger Terra Bella satellites can pick out features less than a metre across. Mr Marshall says Planet is interested in developing software whereby the new sharper-eyed satellites would automatically take pictures of places where the doves had spotted something change between one day and the next.

Planet is not the only company using small satellites to produce big data; the launch on February 15th also carried up eight ship-tracking satellites owned by Spire, just a couple of streets away from Planet. The companies hope that, as more and more customers come to see the value of an endlessly updated, easily searchable view of the world, insights from satellites will become ever more vital to the data-analysis market. The more normal their wares start to seem, the more spectacular their future may be. ■



航天公司

放眼世界

Planet的卫星每天都为客户提供全球新视野

由印度太空研究组织（Indian Space Research Organisation）建造的极地卫星运载火箭于格林威治时间2月15日凌晨3点58分一飞冲天，共携带有104颗卫星，创造了历史记录。其中88颗卫星为同一家公司所有——位于旧金山的遥感业务公司Planet。Planet现有149颗在轨卫星，足以在每一天都为客户提供清晰度适当、覆盖所有地球陆地表面的新图像。

Planet把自己制造的卫星称为“鸽子”，大小为10厘米×10厘米×30厘米。五年前发射的首批鸽子卫星每天发回的照片只能覆盖3000平方公里的面积。但相较于传统卫星行业，鸽子卫星改进的轨迹与手机的发展要接近得多，而且还用到了一些手机零件。最新的鸽子卫星每天可以覆盖250万平方公里的面积。

不断壮大的卫星群每天向分布于世界各地的30多个接收站发送超过3TB的数据。经过处理去除失真图像并定位每个图像之后，数小时内数据就能上传至云端供客户使用。

Planet不愿透露太多客户信息，但公司CEO威尔·马歇尔（Will Marshall）说公司客户数目过百。有些是间谍机构，它们历来是卫星图像的最大客户。然而，尽管Planet提到已经和美国的重要情报机构国家地理空间情报局（NGA）签订了一份大合同，但马歇尔说，NGA还不是他们最大的客户。其他卫星图像买家包括地图制作公司、金融公司和跨国公司，尤其是能源行业里拥有广泛资产的公司。

Planet已能提供每日更新的覆盖整个地球表面的图像，这实现了公司在2010年成立时设定的目标之一。自那时起，公司已经融资1.83亿美元。这并不意味着它会停止发射鸽子卫星：更多的卫星有其好处，其中之一是可以每天不止一次经过同一地方，从而有更多机会拍摄到无云层覆盖的清晰

图像。但是，让这一独特的产品带来更多收入是公司当前的重中之重。

实现这一目标的关键是处理图像以回答一些紧迫的问题：昨天以来发生了什么变化？那是非法伐木吗？这些港口的集装箱数量显示贸易发生了什么变化？Planet将自己来提供更多这样的分析，但也有第三方希望能从中分一杯羹。创业公司SpaceKnow的主要业务是将卫星数据转化为金融界愿意购买的分析结果，该公司刚刚融资400万美元。

仅靠卫星还不足以成就好公司，早期创业公司Terra Bella的命运就是个例子。Terra Bella原名Skybox，制造了SkySat系列卫星，谷歌在2014大张旗鼓地以5亿美元收购了这家公司。但就在最近几个星期，谷歌通过股权交易把它卖给了Planet，这几乎必然令Terra Bella的估值大打折扣；同时，谷歌成为了Planet数据的大客户。

这是Planet第二次从陷入困境的对手手中将卫星占为己有，这笔交易的结果可能会不错。鸽子卫星成像分辨率在三到五米，比许多卫星数据使用者习惯的分辨率要低，而较大的Terra Bella卫星可以识别出宽度小于一米的物体。马歇尔说，Planet目前有兴趣开发一款软件，当鸽子卫星发现某些地方相比前一天出现变化时，能由分辨率更高的新卫星自动拍摄这些地方的照片。

Planet不是唯一一家利用小卫星产生大数据的公司。2月15日发射的运载火箭上还有8颗Spire公司的船舶跟踪卫星，Spire与Planet仅相隔几条街。这些公司希望，随着越来越多的客户看到不断更新、易于搜索的全球卫星图像所具有的价值，通过卫星获取的洞察对于数据分析市场将变得日益关键。什么时候他们的软硬件看起来越正常，他们的未来可能就越可观。■



Data, financial services and privacy

Like?

Should our bankers be our Facebook friends?

DONALD TRUMP's health-insurance premiums could soon go up, and not just because of his love of burritos. Data-crunchers have found a link between the negativity of someone's tweets and his risk of dying of heart disease. The education levels of your Facebook friends or the activity on your phone can help reveal how likely you are to repay a loan. Money-managers are rummaging ever more curiously through customers' digital lives.

This is all part of an "intensifying data arms-race in finance", says Magda Ramada Sarasola from Willis Towers Watson, a consultancy, which claims that no industry used more big data last year. Banks and insurers used to rely only on what customers and credit agencies told them, but today websites and mobile-banking apps let them get much more close and personal. Less conventional sources are also popular. Social-media profiles, web-browsing, loyalty cards and phone-location trackers can all help. In a trial, FICO, America's main credit-scorer, found that the words someone uses in his Facebook status could help predict his creditworthiness (tip: avoid "wasted"). Even facial expressions and tone of voice are being studied for risk.

Believers say such trawling will get customers cheaper and better products. But consumer advocates accuse the industry of deliberate vagueness about its intentions. Financiers, unlike gamblers, have always used data. But most people, when they accept the terms of a new app or click away that annoying cookie message, have no idea what they give away, to whom and for what purpose. According to the European Commission's statistics agency, Eurostat, 81% of Europeans feel they don't wholly control their

online data; 69% worry that firms may use their data for purposes other than those advertised.

Regulators are taking an interest. In September Britain's Financial Conduct Authority said it worried that big data could price risky clients out of insurance. In May the European Banking Authority warned that the integrity of the financial sector could be at stake if insecure data use eroded trust. In December European regulators listed concerns over privacy and ethical issues. They are now consulting the industry to see if stricter rules are needed.

Data can improve predictions of whether someone will fall ill or drive into a tree. Good algorithms are faster and cheaper than underwriters. Insurers also claim that the better they know customers, the more they can help change bad habits. The industry insists more customer data mean "tailored" products: someone about to bungee jump can be warned that his life policy doesn't cover this, and be offered an add-on. Banks can protect customers against fraud if they follow their whereabouts. These techniques can also help people outside the financial system gain access to finance. For the 64m Americans without sufficient credit history and the 2bn people around the world without a bank account, this would be good news.

But critics fear too much data-crunching could actually increase financial exclusion. The riskiest customers, and those offline, might be priced out. The more the industry relies on complex—and proprietary—algorithms, feeding machines that keep learning, the harder it will be for customers, and regulators, to untangle why they were rejected. And algorithms can be wrong. A bilingual speaker's search-engine entries could look erratic; a social-worker's location-tracker could imply a risky lifestyle. And since it is unclear how judgments are made, says Frederike Kaltheuner, from Privacy International, "you could get stuck in a Kafkaesque situation where you're put in a certain box and can't find out why, and can't get out."

Yet privacy is a fluid concept. A survey last year by EY, a consultancy, found that around half of digitally savvy customers were happy to share more data with their bank, if they got something back. It also depends on context. When Tesco, a British retailer, uses data from loyalty cards to offer shoppers discounts on their favourite treats, few are bothered. But use the same data to help calculate an insurance premium (as it does), and many find it creepy.

Keeping customers happy is not about what is legal, but about what they think is off-limits. People give uninformed consent to all sorts of things online. But users can feel tricked and spied on if they learn their data have been sold or used in unexpected ways. Retailers struggle with this too, but customers expect their bank to respect their privacy more, says Torsten Eistert from A.T. Kearney, a strategy firm.

| *Trading data*

Regulators have a role to play, particularly in dealing with questions of discrimination and exclusion. If using someone's browsing history to exclude them from an offer for a cheap flight is OK, is it also reasonable to use those data to lock them out of health insurance (eg, by assuming that someone who Googles doughnut shops is a bad risk)? Now that Amazon sells loans, Alibaba has a payments business and Facebook has patented a credit-rating system, regulators should be at least as worried about non-traditional financiers and fintech startups, which sometimes escape regulation. The European General Data Protection Regulation, which comes into force next year, covers privacy issues fairly comprehensively. It should help clarify the rules on handling personal data.

Supervisors are slow, however. It is up to the industry to respond to customers' demands well before regulators require it. New businesses that give people more control over data, such as digi.me, which lets users share data only with those they want, hold promise. If such tools help users

become their own data-brokers, they may be willing to share more data with their mortgage lenders or insurers. But trust will truly be earned only if financial firms, old and new, get ahead of the game and start talking to customers about what's really going on behind their screens. ■



数据、金融服务和隐私

点赞？

为我们服务的银行家应该成为我们Facebook上的好友吗？

特朗普的医疗保费可能很快就会上涨，这不仅仅是因为他特别爱吃墨西哥卷饼。数据研究公司已经发现，人们在推特上的负面言论和他们死于心脏病的风险之间存在关联。你Facebook上好友的受教育程度，或是你在手机上的活动，能够帮助判断你偿还贷款的可能性。金融机构正越来越满怀好奇地搜罗客户数字生活的方方面面。

这些都是“加剧的金融业数据军备竞赛”的一部分，咨询公司韦莱韬悦（Willis Towers Watson）的玛格达·罗曼达·萨拉索拉（Magda Ramada Sarasola）表示。该公司称，去年没有哪个行业运用的大数据比金融业更多。银行和保险公司过去通常只依赖客户和征信机构告诉它们的信息，但如今，网站和手机银行应用让它们能更接近客户，获得更多个人信息。不那么传统的信息来源也很流行。社交媒体上的个人信息、网络浏览、会员卡、电话定位跟踪都能发挥作用。在一次试验中，美国的主要信用评级机构FICO发现某人在Facebook状态中使用的词语能帮助预测他的信用度（提示：避免出现“大醉”字眼）。甚至表情和语调也可以用来研究风险。

信赖此道的人们认为如此网罗数据将能让客户以更低的价格得到更好的产品。但消费者权益保护组织指责这一行业故意模糊自己的意图。金融家和赌徒不一样，他们总是使用数据。但大多数人在他们接受新应用的条款或者点击关闭烦人的cookie信息时，并不知道他们向谁泄露了什么信息，以及这些信息将被用于何处。根据欧盟委员会的统计机构欧盟统计局的数据，81%的欧洲人感觉他们的在线数据并非完全由自己控制；69%的欧洲人担心各家公司可能会将他们的数据用于已公告的用途之外。

监管机构对此表示关切。去年9月，英国金融市场行为监管局（Financial Conduct Authority）表示，它担心大数据可能导致对高风险客户开价过高，让他们无力购买保险。去年5月，欧洲银行管理局（European

Banking Authority) 警告，如果不安全的数据使用侵蚀了信任，金融业的诚信就可能面临风险。在12月，欧洲监管机构列举了对于隐私和道德问题的担忧。它们如今正在与金融界商议，看是否要出台更严格的规则。

数据能够改进预测，比如预测某人是否会生病或开车撞上大树。好的算法比核保人员更快速且低价。保险公司也宣称它们对客户了解越多，就越能帮助它们改变坏习惯。保险业坚称有了更多的客户数据就能提供“定制化”产品，例如可向准备蹦极的人发出警告，告知其寿险保单并不涵盖这一项目，并向他提供附加保险项目。如果银行去跟踪客户的行踪，就能保护他们免受欺诈。这些技术还能帮助金融体系之外的人获得金融服务。对于6400万没有充足信用记录的美人，以及全世界约20亿没有银行账户的人来说，这会是个好消息。

但是批评者担心过度的数据分析实际上会加剧金融体系对一些人的排斥。风险最高的客户，还有那些不上网的人，可能会被金融体系以高价拒之门外。这一行业对复杂和专有的算法（输入给持续学习的机器）依赖越多，客户和监管机构就越难搞清楚为什么客户会被拒绝。而且算法可能会出错。双语人士的搜索历史可能看起来难以捉摸，社会工作者的位置跟踪可能显示出一种高风险的生活状态。此外，国际隐私组织（Privacy International）的弗雷德里克·凯休纳（Frederike Kalthener）称，既然不清楚判断是如何做出的，“你可能就会陷入卡夫卡式的困境，被随意归入一类，既不知道原因也无法脱身。”

然而隐私是一个不断变化的概念。去年咨询公司安永的调查显示，如果能得到一些回报，大约有一半熟练操作数字通信的客户都乐意和银行分享更多数据。这也取决于具体情况。当英国零售商乐购根据会员卡数据向购物者提供折扣，供他们购买心仪之物时，没什么人对此感到困扰。但使用同样的数据来计算保费时（它确实也这样做了），很多人都感到骇人。

要让客户满意，关键并不在于行为合法，而在于了解哪里是他们所认为的“禁区”。在网上，人们在不知情的情况下对一切事情表示同意。但如果用户知道自已的数据被出售或者用于意料之外的方面，他们就会有受骗以及

被窥视之感。零售商也在努力应对这一问题，但客户希望银行能更尊重他们的隐私，战略咨询公司科尔尼（A.T. Kearney）的托尔斯滕·艾斯特（Torsten Eistert）说。

| 数据交易

监管机构可以发挥作用，尤其是在处理歧视和排斥的问题上。如果根据某人的上网浏览记录决定不向他们出售廉价机票是可以接受的话，那么使用这些数据来拒绝向他们提供医疗保险（例如，假定用谷歌搜索甜甜圈店的人是高风险客户）也合情合理吗？既然亚马逊提供贷款，阿里巴巴拥有支付业务，Facebook已经就信用评级系统申请了专利，监管机构至少应当同样担忧非传统金融机构和金融科技创业公司——它们有时会逃避监管。

《欧洲一般数据保护条例》（European General Data Protection Regulation）将于明年生效，相当全面地涵盖了隐私问题的各个方面。这应该有助于澄清处理个人数据的规则。

然而监管机构行动迟缓，在它们提出要求之前，还得靠行业自身去回应客户的需求。一些新企业如digi.me给予客户更多的数据控制权，让他们只和自己愿意与之分享的人共享数据。这些企业的前景看好。如果这些工具帮助用户成为自己的数据代理，用户可能会乐于和抵押贷款机构或保险公司分享更多数据。但只有当金融公司不分新老都先行一步，开始告诉客户在他们的屏幕后面实际做了什么，它们才能真正赢得信任。■



Urban planning

Listen to the music of the traffic in the city

Places, like people, have pulses—if only you know how to measure them

THE Rockefeller Centre sprawls across 89,000 square metres of midtown Manhattan. Curiously, Alcatraz, in San Francisco Bay, the island home of America's most famous former prison (see picture), has exactly the same area. That coincidence aside, few might imagine the manicured roof gardens and art deco office buildings of the one have much in common with the brutal crags and blockhouses of the other. But they do. For research by Claudio Silva of New York University and his colleagues suggests that the two have a striking resemblance when it comes to the daily ebb and flow of tourists, as judged from the level of activity on Flickr, a photo-hosting site. Dr Silva thinks the peaks and troughs of Flickr activity that his research has discovered in this and other cases are a measure of an area's "urban pulse". If so, the Rockefeller Centre and Alcatraz share a pulse.

On October 25th, at a meeting of the Institute of Electrical and Electronics Engineers in Baltimore, Dr Silva plans to present the idea that, like real pulses, urban pulses have useful diagnostic and prognostic properties. He thinks his system to analyse them might help urban planners and architects identify footfall and other patterns that emerge from past developments, and make better choices in future.

At the moment, when such planners try to understand patterns of activity in a district, they do so by conducting surveys, counting the number of people passing important road junctions and measuring traffic volumes. This, though, takes years. One way to speed up the process is to use the reams of data now available from social-media platforms. Flickr, for example, records the location and time of every photograph uploaded to the site. It is especially popular with holidaymakers. Thus, by using the

Flickr data as a surrogate measure of their activity, Dr Silva's program can show in minutes how tourists are moving through a district, and may also highlight areas of activity that conventional methods have missed.

Dr Silva's work is part of a broader trend, dubbed "smart cities" by some, towards using the vast amounts of data generated by the inhabitants of urban areas to make them better places to live. Carlo Ratti and his colleagues in the Senseable City laboratory at the Massachusetts Institute of Technology (MIT), for example, used mobile-phone records, and also traffic data from 500 pressure sensors on roads, to help guide construction of the new metro system in Saudi Arabia's capital, Riyadh. And César Hidalgo and Elisa Castañer, who work at MIT's Media Lab, last year published an algorithm to recommend which types of new business were needed in particular districts, based on the locations of over 1m cafés, bars, shops, schools and so on in 47 American cities.

Dr Silva says that what distinguishes his work from these and other studies is the speed with which he and his team can analyse large data sets such as those from Flickr. The conventional approach is to break such data into chunks for analysis—dividing them up geographically on a grid, for example, or temporally, into days. Researchers then search for patterns by comparing these chunks with each other. The problem is that more detailed analysis requires more such chunks, and the computing time needed to calculate the relationships between them thus spirals.

To avoid this, Dr Silva turned to computational topology—a field that finds algorithms to describe complicated shapes and surfaces as simply as possible. (In this context, "shapes" and "surfaces" are wider ranging than a layman might think, because they can have more than three dimensions.) These algorithms let computers create, analyse and manipulate such multidimensional shapes quickly.

Computational topology is already employed in tasks as diverse as loading goods at dockyards and studying the way protein molecules fold, so many topological algorithms already exist. To take advantage of this trove, Dr Silva's team had to represent their Flickr data as a topological shape. They did so by calculating, from the number of photos taken there, the level of "activity" at each point in an area of interest. They plotted the results on a grid, to create a three-dimensional representation of tourist activity across a city at a given moment—then added a fourth dimension by repeating the process for every hour of data available. The result was a topological surface whose peaks, troughs, furrows and holes—which could be identified by their algorithms—corresponded to changes in activity over time and space.

This approach means not only that Dr Silva's programs whizz along much faster than conventional software, but also, because they do not have to filter the data or use a small subset of it, they see patterns that might otherwise slip through the net. Users can compare years' of Flickr data from whole cities in minutes, thus taking their urban pulses. Indeed, Dr Silva hopes to make these pulses still more accurate, and also extend their analysis beyond tourism, by tapping other sources of information, such as Twitter and Instagram.

Social pulse-taking is not mere theory. Kohn Pedersen Fox Associates (KPF), a firm of architects based in New York, is collaborating with Dr Silva on several as-yet-undisclosed projects. KPF's past work includes the Shanghai World Financial Centre, the World Bank's headquarters in Washington, DC, and a recent revamping of Covent Garden, an old fruit and vegetable market, in London. Whether the algorithms of computational topology would show any similarities between those locales is an intriguing question. ■



城市规划

人潮的乐章

和人一样，每个地方也都有脉搏——只要你知道如何测量

洛克菲勒中心位于曼哈顿中城，占地达8.9万平方米。旧金山湾内的阿尔卡特拉斯岛（俗称恶魔岛）曾是美国最著名监狱（见图）的所在；有趣的是，它的面积正好与前者相同。除却这个巧合，也许很少有人能想得到，前者精心打理的屋顶花园、装饰艺术风格的办公楼与后者荒蛮的峭壁和堡垒有什么共同点——但它们确实有。纽约大学的克劳迪欧·席尔瓦

（Claudio Silva）及同事的研究表明，从图片托管网站Flickr的活跃度来判断，两者日常客流的变化有着惊人的相似之处。席尔瓦博士认为，他在研究这一及其他案例时所发现的Flickr活跃度起伏变化可用来测量一个区域的“城市脉搏”。如果真是这样，洛克菲勒中心和恶魔岛就有着一样的脉搏。

席尔瓦计划在10月25日电气和电子工程师协会（IEEE）于巴尔的摩举行的一场会议上提交这一想法：像真正的脉搏那样，城市脉搏也具备有用的诊断和预兆特性。他认为，自己用来分析城市脉搏的系统也许可以帮助城市规划者及建筑设计师识别过往建设工作所产生的客流量及其他规律，并帮助他们在将来做出更好的选择。

目前，规划者若试图了解某区域内的活动模式，他们会开展调查，计算重要路口通过的人数以及测量交通流量。然而，这些工作需耗时数年。加速该过程的一个方法是利用可从社交媒体平台上获得的大量数据，例如Flickr——它会记录上传至网站的每张照片的拍摄时间和地点。该网站尤其受到度假者的欢迎。由此，将Flickr的数据用作测量度假者活跃度的替代指标，席尔瓦的项目便能以分钟来显示一个区域内游客的活动情况，还可着重显示常规方法所遗漏的那些活动区域。

席尔瓦所做的工作代表了更为广泛的一种趋势，即利用城市居民产生的海量数据让城市变得更加宜居——有些人将这一趋势称为“智慧城市”。例

如，麻省理工学院“感知城市实验室”（Senseable City laboratory）的卡洛·拉蒂（Carlo Ratti）及同事就利用移动电话记录以及来自道路上500个压力传感器的数据，帮助指导沙特阿拉伯首都利雅得新地铁系统的建设。而在麻省理工学院媒体实验室（Media Lab）工作的塞萨尔·伊达尔多（César Hidalgo）及艾丽莎·卡斯塔涅（Elisa Castañer）去年则发布了一个算法，根据美国47座城市中超100万家咖啡馆、酒吧、商店、学校等场所的位置，可以就某一特定区域最需要何种新业务做出推荐。

席尔瓦称，他的工作与上述及其他研究的区别在于，他和团队可以快速地分析例如来自Flickr的庞大数据集。常规方法是将数据分割成小块来分析——例如根据地理位置在一幅网格上将其分割成小区块，或依据时间将之分割成天。随后，研究人员会将这些块彼此进行比对，从中寻找规律。这种方法的问题在于，越详尽的分析，所需的数据块就越多。如此一来，测算它们之间关系所需的计算时间也急剧增加。

为避免这种情况，席尔瓦转向了计算拓扑学——这个领域寻找算法来尽可能简单地描述复杂形状及表面。（在这种语境中，“形状”、“表面”的范围要比外行人以为的要广，因为它们可以有不止三个维度。）这些算法能使计算机快速地创建、分析并操作这样的多维形状。

计算拓扑学已被用于处理多种任务，如在码头装载货物，以及研究蛋白质分子的折叠方式。因此，很多拓扑算法已经存在。为了利用这些资源，席尔瓦的团队须将他们的Flickr数据描绘成一个拓扑形状。他们的做法是，通过在该地所拍摄照片的数量，计算出他们感兴趣的地区每个点的“活跃”水平。他们将结果绘制在网格上，创建出特定时间内全城游客活动的三维展示，然后对每个小时的可用数据都重复这一计算过程，由此增加了第四个维度。这样做的结果就是一个拓扑表面，其高峰、低谷、沟壑和孔洞（这些都可通过他们的算法来识别）与随着时间和地点而变化的活跃度相对应。

这种方法不仅意味着席尔瓦的项目要比采用常规软件进行得更快，由于他们并不需要过滤数据或使用小的数据子集，还可发现原本也许会被漏掉的

规律。用户在几分钟内就可以将整个城市几年的Flickr数据进行比对，并以此测量出城市的脉搏。事实上，席尔瓦希望能使测量结果更加精确，还希望通过发掘其他信息来源（如Twitter和Instagram），将分析范围扩展至旅游业之外。

利用社交网络测量城市脉搏并未只停留在理论层面。总部位于纽约的KPF建筑事务所（Kohn Pedersen Fox Associates）目前正与席尔瓦就若干尚未披露的项目展开合作。KPF过往的项目包括上海环球金融中心、华盛顿特区的世界银行总部，最近还负责翻新了伦敦的考文特花园（Covent Garden，从前是个果蔬市场）。计算拓扑学的算法能够从这些场所之间发现什么相似之处？这是个有趣的问题。■



Smart weapons

The vision thing

Bombs that can recognise their targets, rather than relying on satellites to steer them, are back in fashion

IT IS easy to forget, given the ubiquity of satellite-navigation devices in cars and mobile phones, that the Global Positioning System (GPS) of orbiting satellites on which they rely was originally—and, indeed, remains—a military technology. The system is, for instance, relied upon by the JDAM (joint direct-attack munition) kits that America's air force attaches to its free-fall bombs to turn them into smart weapons that can be guided with precision to their targets.

But JDAM and similar systems work only when they can receive signals from GPS satellites. And such signals are weak—approximately as powerful as a standard television transmission would be if the transmitter were five times as far away as the Moon is. They are thus easily jammed. For obvious reasons, details of the capabilities of jammers are hard to come by, but a Russian system called Pole-21, for instance, may be able to suppress GPS signals as much as 80km (50 miles) away.

One way to get around this—and to guide weapons automatically to their targets without relying on satellites—is to give weapons a map. That has been done in the past. The cruise-missile guidance systems which came to public attention in 1991, during the first Gulf war, worked in this way. But it was the Gulf war that also saw the first large-scale use of GPS by ground troops, and it is GPS, cheaper and simpler than map-based guidance, that has subsequently dominated the business of automatic navigation. Until now, that is. For the world's armed forces are looking again at giving their bombs and missiles map-reading capabilities.

| *Where the hell are we?*

America's original map-based cruise-missile guidance system came in two parts. The first, Terrain Contour Matching or TERCOM, took a missile to the general area of its target using a radar altimeter and a series of digital maps that showed the elevation of the ground under sections of the planned route. By comparing the missile's actual altitude above this terrain with its expected altitude, TERCOM could follow contours and find its way. Once it was close to the target, a second system, the Digital Scene Matching Area Correlator (DSMAC), compared the view from a video camera with a set of stored images, in order to locate the bullseye.

Such a combined system was awkward and expensive, but at least it was the best available before GPS. Now, though, huge improvements in electronics have turned the tables. Israel is in the forefront, with a system which it calls Spice. Like JDAM, Spice is an add-on kit that turns unguided bombs into smart ones. It is designed and built by Rafael Advanced Defense Systems, an Israeli weapons company, and comes into service in December 2016.

Spice contains an "electro-optical scene matching system" that resembles DSMAC's in as much as its memory is loaded with pictures of the target area, taken beforehand by aircraft (piloted or unpiloted) or by satellite. Spice's pictures, though, are of much higher resolution than those of DSMAC. On top of this the cameras that generate the real-time images with which those pictures are compared as the bomb falls towards its target work both in the visible and the infra-red parts of the spectrum. That means Spice can operate in darkness, and can penetrate smoke and fog. Moreover, unlike DSMAC, Spice stores enough data to cover the entire route to a target. It has no need of an accompanying system similar to TERCOM. Instead, it picks out and compares, en route, features like roads and buildings to find its way.

Spice's claimed performance is impressive. Rafael says it can guide a bomb

released 100km from a target to a strike point within two metres of that target. The firm says, too, that its device is not confused by minor changes in the scenery around a target, which it can find even if some nearby areas have been obscured—say, by camouflage. Spice also has the advantage over GPS-guided weapons of working when a target's exact position is unknown, or if the co-ordinates have been misreported. All you need is a picture of what is to be hit, and an approximate location, for Spice to find and hit it.

Other countries, in particular America, are following Israel's lead. Last January, America's air force signed a contract with Scientific Systems, a firm in Woburn, Massachusetts, to develop what that company calls its Image-Based Navigation and Precision Targeting (ImageNav) system. Like Spice, this is a bolt-on system that works by comparing images from a camera with those in a database on board. If all goes well, development and testing should be completed by January 2018 and the result will, its makers hope, be able to strike within three metres of its intended target. The initial plan is to fit ImageNav to the air force's Small Diameter Bomb, a free-fall weapon at present guided by GPS. If this is successful, deployment on cruise missiles and drones will follow.

Meanwhile Lockheed Martin, the world's biggest aerospace firm, is working on an optical-navigation system called Northstar. This is based on a piece of non-military software called Hydra Fusion, which was developed by Lockheed Martin's Canadian subsidiary. Hydra Fusion creates a high-resolution, three-dimensional terrain map from ordinary video, by comparing successive frames of that video in light of information about how fast the vehicle carrying the camera was travelling. Though this is a trick which has been managed in the past, Hydra can do it on the fly, on a laptop computer. Previous systems have required hours of processing on high-end machines.

Once an area has been mapped, Northstar provides precise navigation

information for bombs or missiles (or, indeed, for manned or unmanned aircraft). Crucially, the intelligence can be fresh because of the system's rapid processing time.

Fitting bombs and missiles with vision in this way thus looks like the future. That does not mean GPS will not be used as well—a belt-and-braces approach is often wise in war. But bombs that can see their targets, rather than blindly following their noses to a set of co-ordinates, are always likely to have the edge. ■



智能武器

远见卓识

能够识别目标而不依赖卫星引导的炸弹重返潮流

卫星导航设备被广泛应用于汽车及智能手机之中，有鉴于此，人们很容易就会忘记，这种设备所依赖的在轨卫星全球定位系统（GPS）最初其实是（实际上现在仍是）一种军事技术。举例来说，美国空军会将联合直接攻击弹药（joint direct-attack munition，简称JDAM）组件装配在自由落体式炸弹上，使之成为可精确制导的智能武器。JDAM组件所依赖的正是GPS。

但JDAM与其他类似系统只能在可接收GPS卫星信号时才能工作，而这种信号又很微弱——如果发射机距地球的距离是月球距地球距离的五倍，那么所发出的信号强度大概就和标准电视传输相近。因而这类系统很容易遭到干扰。出于某些显而易见的原因，关于干扰器能力的细节并不容易获取，不过俄罗斯所采用的一个名为Pole-21的系统或许能抑制80公里（50英里）之外的GPS信号。

要绕过这一问题，以及实现不依赖卫星就能自动导引武器对目标进行攻击，一个方法是为武器提供地图。这种方法过去已被采用过。1991年第一次海湾战争期间，巡航导弹制导系统引起公众关注，该系统就是以这种方式工作的。不过，地面部队首次大规模应用GPS也是在海湾战争期间。与基于地图的制导相比，GPS更为经济和简单，随后更是主导了自动导航这一产业。但今后情况也许会发生变化。因为世界各地的武装部队正重新考虑赋予自己的炸弹与导弹看地图的能力。

| 我们到底是在哪儿？

美国基于地图的巡航导弹制导系统最初是由两部分构成。首先是地形匹配导航系统（Terrain Contour Matching，或TERCOM）。该系统利用雷达高度计以及记录了计划飞行路线各个区段地面海拔高度的一系列电子地图，将导弹带至目标物所在的大致区域。将导弹距地面的实际高度与导弹距离

目标物的预期高度进行比对，TERCOM便可利用等高线找寻自己的路径。一旦接近目标，另一个系统即数字式景象匹配区域相关制导系统（Digital Scene Matching Area Correlator，简称DSMAC）便会将视频摄像头拍到的景象与预先储存的一组图像进行比对，以确定目标物的位置。

这种组合系统既笨拙又昂贵，但起码在GPS出现之前是最佳选择。不过，由于电子技术取得的巨大进步，如今形势已发生扭转。走在前沿的是以色列，它将其拥有的一个系统命名为Spice。与JDAM相似，Spice也是一个附加组件，可令未制导炸弹变身为智能炸弹。它由以色列的武器公司拉斐尔先进防御系统公司（Rafael Advanced Defense Systems）设计并制造，已于2016年12月服役。

Spice包含一个“光电景象匹配制导系统”，其存储设备中存有大量目标区域的图片，这一点与DSMAC类似。图片由飞行器（有人驾驶或无人驾驶）或卫星预先拍摄。不过，Spice存储的图片的分辨率要比DSMAC的高得多。Spice的摄像头会生成实时图像，炸弹坠向目标物时这些图像会与所存图片进行比对。除此之外，它的摄像头在光谱的可见光部分和红外部分均能工作，这就意味着Spice既可在黑暗中操作，也能穿透烟雾。另外，与DSMAC不同的是，Spice所存储的数据足以覆盖整个去往目标物的路线，因而无需TERCOM这样的附带系统。相反，在飞行途中Spice就可以对道路及建筑等特征进行识别和比对，来找寻路线。

据称Spice的表现令人惊叹。拉斐尔称，由Spice制导的炸弹可在100公里之外向目标发起攻击，且误差不超过两米。该公司还称，即使目标周围的景物发生了微小的变化，也不会对Spice的设备造成干扰。即使目标附近部分区域已被遮掩（例如采取了伪装），Spice的设备也能找到目标。当目标的确切位置不明，或坐标被误报时，Spice还会比GPS制导的武器更具优势：想炸什么东西，只需一张目标物的图片以及大概位置，Spice就会找到并摧毁它。

其他国家也都在效仿以色列，尤其是美国。去年1月，美国空军与位于马萨诸塞州沃本市（Woburn）的公司Scientific Systems签订了合同，开发

该公司称之为“基于图像的导航及精确瞄准（ImageNav）”的系统。和Spice一样，这也是个附带系统，通过将摄像头获取的图像与弹上数据库中的图像进行比对来工作。如果一切顺利，开发及测试工作将于2018年1月完成。其制造者希望爆炸点离预定目标的误差能保持在三米之内。初步的计划是为空军的小直径炸弹（一种目前由GPS制导的自由落体炸弹）装配ImageNav系统。如果成功，接下来巡航导弹及无人机也会部署这一系统。

世界最大的航空航天制造商洛克希德·马丁（Lockheed Martin）正致力于开发一个名为“北极星”（Northstar）的光电导航系统。该系统以一款名为Hydra Fusion的非军用软件为基础。此软件由洛克希德·马丁的加拿大子公司开发，能够利用普通的视频创制出高分辨率的3D地形图，方法是对视频的连续画面，并将搭载摄像头的飞行物的速度计算在内。虽然这种方法在过去已被实施过，但Hydra可在飞行途中在笔记本电脑上运行。以往的系统得在高端机器中进行数小时的处理。

一个地区的地图一经创制完毕，“北极星”便会为炸弹或导弹（或者有人或无人驾驶的飞行器）提供精确的导航信息。极为重要的一点是，系统快速的处理能力能保证情报是最新的。

如此看来，以这种方式赋予炸弹及导弹“视觉”似乎会是未来的趋势，但这并不意味着GPS就再无用处——在战争中，追求万无一失的策略总归是明智之举。不过，盲目地去探寻一组坐标的炸弹和能识别目标的炸弹相比，具备优势的可能永远都会是后者。■



Free exchange

Mad maximum

Notions of full employment need some updating

“IT IS fair to say the economy is near maximum employment,” said Janet Yellen, chairman of the Federal Reserve, in recent comments preparing markets for rate rises to come. But “maximum employment”, like pornography, is in the eye of the beholder. American adults, of whom only about 69% have a job, seem less than maximally employed. In previous eras, governments of countries scarred by economic hardship set themselves the goal of “full” employment. Today, the target is termed “maximum”. But it is the same concept. It needs a bit of updating.

Ms Yellen has a particular definition of maximum employment in mind, built on the economic experience of the past half-century. In the 1960s and 1970s a consensus (or, at least, what passes for one in macroeconomics) emerged that government efforts to boost demand could push unemployment only so low. Below that “natural rate”, it would soon start climbing again and inflation would accelerate. So now central bankers take a guess at the natural rate and at how quickly unemployment that is “too low” will spark inflation. Maximum employment, in their view, is the sweet spot: the labour market is as tight as it can be without runaway price rises. But there is more art than science to such guesses. Indeed, rich-world natural rates have moved around over time—from below 5% after the second world war to much higher levels in the 1970s and 1980s, and back to lower levels more recently—leaving economists scratching their heads at each turn.

It is thought that the natural rate depends mostly on what economists label “frictional unemployment”. Unemployment rates may wiggle only a bit from month to month, but beneath that calm, labour markets are a roiling

mess. Each month millions of workers leave their jobs and millions more find new ones. For a portion of the workforce there is a gap between one and the other—frictional unemployment. A background hum of joblessness reflects the delay in matching jobseekers with jobs.

The hum varies in pitch. Some factors gum up the works and increase friction. The higher frictional rate of the 1970s and 1980s was partly the result of a change in the nature of employment: good jobs in industries like manufacturing dwindled, while low-wage service employment exploded. The psychological and economic pain associated with this shift meant that workers losing good jobs would stay unemployed for longer, in the hope that better, high-wage opportunities would eventually turn up. Barriers to job switching, like occupational licensing, can also push up the natural rate. So can unions, by protecting the status of employed workers, or by pushing up wages so that hiring more people becomes uneconomical. Other factors grease the gears. The lower natural rate of the 1990s might have been the result of more efficient hiring thanks to information technology, or of the growth of temporary-help jobs, which sponged up some workers facing career transitions.

The boundary between that sort of long-term structural unemployment and the temporary, cyclical kind is anything but clear-cut. In the 1980s and 1990s economists argued that short-term unemployment could become long-term unemployment under the right (ie, wrong) circumstances. This “hysteresis” could emerge as employed workers negotiated favourable conditions for themselves, deterring firms from hiring new workers. Or laid-off workers might find their skills and links with the labour force eroding over time, making it harder to find new jobs as good as their old ones.

But hysteresis also works in reverse, at least to some degree. As America’s unemployment rate has fallen below 5%, wage growth has at long last

begun to accelerate. As pay rises, people who had given up hope of a worthwhile job begin to look for work again. As firms find it harder to hire new workers, firms might offer existing workers more hours, or convert part-time or temporary posts to full-time or permanent positions. They might even try to raise output per worker, by investing in training or in new equipment.

The rub is that policymakers cannot know how much slack remains in the system until they see inflation accelerating—the very thing they want to stop. That suggests one reason workers in advanced economies are not as fully employed as they should be is an excessive aversion to inflation. Another is government's failure to tackle obstacles—of geography, education or regulation—standing between would-be workers and would-be employers.

| *Help wanted*

If the goal of full employment, however, is a happy society, policymakers must pay attention to the quality as well as the quantity of jobs on offer. Employment rates in subsistence societies are extremely high. More people would be in work were governments to withdraw unemployment benefits and repeal the minimum wage. Yet society would be worse off for it.

Technological change complicates matters. A scarcity of workers could drive investment in machines, allowing each worker to produce more. Yet it might also encourage full automation. In a new paper, Daron Acemoglu and Pascual Restrepo, of the Massachusetts Institute of Technology, find that ageing economies, with shrinking workforces, do not seem to grow more slowly than younger economies, as many economists assume they should. Instead, automation picks up. Yet if robots can compensate for high retirement rates, how many younger workers might also be superfluous?

An age of mass technological unemployment is not upon us. But the

definition of maximum employment should consider more than inflection points in inflation charts. Rather, governments need to consider the options available to workers: not just how easily they can find jobs they want, but also how readily they can refuse jobs they do not. By lifting obstacles to job changes and giving workers a social safety net that enables them to refuse the crummiest jobs, societies can foster employment that is not just full, but fulfilling. ■



自由交流

疯狂的最大就业

充分就业的观点有待更新

“公允地说，目前美国经济已接近最大就业。”美联储主席耶伦近期为未来加息向市场吹风道。但“最大就业”如同色情文学，并没有绝对的判别标准。美国成年人的就业比例仅约为69%，似乎未达到充分就业。在从前，受经济困境所伤的各国政府会设定实现“充分”就业的目标。今天，这样的目标被称为“最大”就业。但这仍是同一个概念，且需要一些更新。

对于最大就业，耶伦心中自有定义。她的定义是以过去半世纪的经济发展经验为基础。上世纪六七十年代出现一个共识（起码在宏观经济学中可算作一个共识），那就是政府促进需求的努力只能把失业率降低到某个有限的水平。低于这一“自然失业率”时，失业率很快会开始攀升，通货膨胀也将加速。于是，现在央行官员会估算自然失业率，然后推测“过低”的失业率多快会引发通胀。在他们看来，最大就业是一个最佳点：在这一水平上，劳动力市场供给足够紧张，但有没有到导致物价失控飞涨的地步。不过这类猜测更像是艺术，而非科学。事实上，富裕世界的自然失业率一直在变化——从二战后的不足5%升至七八十年代高得多的水平，最近又回落到较低水平——每一次转向都让经济学家们挠头。

人们认为自然失业率主要取决于经济学家们所谓的“摩擦性失业”。失业率每月也许只有轻微的波动，但在平静的表象下，劳动力市场动荡纷乱。每个月都有数百万劳动者离职，又有数百万人找到新工作。其中一部分人在新旧工作转换之间有一定的间隔时间，此即为摩擦性失业。一片“失业”的喧嚷之声其实反映了求职者与工作之间的匹配滞后。

这喧嚷声时高时低。一些因素给就业市场带来麻烦，加剧了摩擦。上世纪七八十年代的摩擦性失业率较高，原因之一是就业性质的转变：制造业等行业的好工作萎缩，低薪服务行业就业激增。随之而来的心理及经济痛楚意味着失去好工作的劳动者为等待更好的高薪机会而宁愿待业更长时间。

职业资格许可这类工作转换的门槛也可能推高自然失业率。工会保护在职员工地位或推高工资的举动导致聘用更多员工变得不经济，也会使自然失业率上升。另一些因素则有润滑作用。上世纪九十年代自然失业率较低可能是因为信息技术令招聘更为高效，或是由于临时辅助职位的增长吸收了部分面临职业转换的劳动者。

长期结构性失业与暂时周期性失业之间的界限绝非那么泾渭分明。上世纪八九十年代，经济学家们认为，在特定（即糟糕的）的情形下，短期失业会变为长期失业。随着在职人士为自己争取有利条件、令公司打消了雇用新员工的念头，这种“滞后”便有可能出现。失业工人也可能会发现自己的技能日渐过时，与劳动力大军的联系也日渐脱节，因而难以找到称心如前的新工作。

但“滞后”也会反向作用，至少在一定程度上是这样。随着美国失业率下降到5%以下，工资增长终于开始加速。而随着工资上升，原本对找到称心工作心灰意冷的求职者便又开始重新寻觅工作。公司越来越难以聘用新员工，因而可能向现有职员提供更多工时的工作，或者把兼职或临时职位转为全职或长期职位。它们甚至还有可能投资于培训或新设备，以此提高员工的人均产出。

问题在于，在看到通胀加速前，政策制定者并不清楚失业率还有多少下压空间，而通胀加速恰恰是他们想要防止的。这表明，发达经济体中劳动者未如理想般充分就业，原因之一就是通胀的过度规避。另一原因是政府未能打破横亘在求职者和未来雇主之间的障碍。这些障碍包括地域、教育或监管等方面。

| 需要帮手

但是，假如充分就业的目标是造就幸福社会，决策者必须注意，除了供应的职位数量，其质量也很重要。生存型社会的就业率非常高。假如政府取消失业救济并废除最低工资，就会有更多人重回就业。但社会将因此而退步。

技术变革使问题变得更为复杂。劳动者稀缺会推动对于机器的投资，从而提高个人产出。但这也可能促进全面自动化。在一篇新文章中，麻省理工学院的达隆·阿齐莫格鲁（Daron Acemoglu）和帕斯夸尔·雷斯特雷波（Pascual Restrepo）发现，老龄化的经济体尽管劳动力萎缩，但增长似乎不比年轻经济体慢多少，这与许多经济学家的猜想不符。相反，自动化进程反而加快了。然而，假如机器人能弥补高退休率，多少年轻劳动者也会因而变得冗余？

大规模技术性失业的时代尚未来临。但对最大就业的定义不应只考虑通胀图表上的拐点。相反，政府需要考虑劳动者有多大的选择空间：不仅是他们有多容易找到理想工作，也要看他们是否可以轻易拒绝不理想的工作。消除劳动者转换工作的阻碍，为他们提供社会安全网，令他们可以拒绝最糟糕的工作，社会不仅可以促成充分就业，而且能实现称心就业。■



Bathymetry

In an octopus's garden

Researchers have a plan to chart in detail the depths of the ocean floor

THREE billion dollars sounds a lot to spend on a map. But if it is a map of two-thirds of Earth's surface, then the cost per square kilometre, about \$8.30, is not, perhaps, too bad. And making such a map at such a cost is just what an organisation called the General Bathymetric Chart of the Oceans (GEBCO) is proposing to do. GEBCO, based in Monaco, has been around since 1903. Its remit, as its name suggests, is to chart the seabed completely. Until now, it has managed less than a fifth of that task in detail. But means of mapping the depths have improved by leaps and bounds over recent decades. So, with the aid of the Nippon Foundation, a large, Japanese philanthropic outfit, GEBCO now proposes to do the job properly. It plans to complete its mission by 2030.

The area of Earth's ocean is two and a half times the area of Mars—and it is often claimed that Mars's surface is the better recorded of the two. It took mere hours to find the crash site of *Schiaparelli*, an ill-fated Mars-bound space craft. By contrast, the resting place of MH370, an airliner that disappeared over the Indian Ocean in 2014, remains unknown.

In large part, this is because peering through Mars's thin atmosphere from an orbiting satellite is easier than peering through hundreds or thousands of metres of water from an equivalent satellite in orbit around Earth. Despite water's apparent transparency, the sea absorbs light so well that anywhere below 200 metres is in pitch darkness. Radio waves (and thus radar) are similarly absorbed. Sound waves do not suffer from this problem, which is why sonar works for things like hunting submarines. But you cannot make sonic maps from a satellite. For that, you have to use the old-fashioned method of pinging sonar from a ship. Which is just what GEBCO

plans to do.

| *Ping me when you're ready*

Sailors have taken soundings since time immemorial, to avoid running aground. Their equipment was a plumb line—a piece of cord with a lead weight at the bottom. The term “sounding” has nothing to do with noise, echoes or anything like that (it comes from the old English *sund*, meaning a sea or strait), but the coincidence is a neat one, for the modern version of swinging the lead is “echo sounding”, using sonar reflected from the seabed. Marie Tharp and Bruce Heezen of Columbia University, in New York, pioneered the technique in the 1950s and 1960s by using technology developed during the second world war. With it, they mapped part of the Mid Atlantic Ridge, an underwater mountain chain.

Tharp and Heezen employed single-beam sonar, which yielded a fairly fuzzy image. These days, sounding sonars broadcast a fan-shaped series of beams. This means a wider strip of the seabed can be mapped during a single pass. It also increases accuracy, because signals from neighbouring beams, which overlap to a certain extent, can be compared with one another. That, plus the invention of special housings fitted onto platforms under sounding-ships' bows, which stop bubbles generated as the vessel rides the waves interfering with the signal, means mapping can be done to a far higher standard than it was in the past.

Such mapping has not, however, been well co-ordinated. Cable-laying companies, oil firms, academic oceanography laboratories, national hydrographic surveys and the world's navies all have oodles of sounding data. One of GEBCO's jobs is to gather this existing information together and sew it into a new database, to create a coherent portrayal of the known ocean floor.

The organisation is also keen to include data collected by helpful

volunteers. A new digital platform overseen by America's National Oceanic and Atmospheric Administration encourages the crowdsourcing of bathymetric data, letting mariners upload their findings easily. Recent political initiatives, such as a deal made in Galway in 2013 between America, Canada and the European Union to support transatlantic floor-mapping, will also boost efforts. National icebreakers are gathering information in parts of the ocean too frozen for other vessels to reach. And GEBCO is trying to persuade governments and companies with proprietary data on the sea floor to share them. One such firm, a cable-laying outfit called Quintillion, has already agreed to do so.

The other, larger job that GEBCO faces is filling in the blanks. Larry Meyer of the University of New Hampshire, who is helping co-ordinate this task for the organisation, estimates it would take a single research vessel 200 years to do so. A simple calculation therefore suggests hitting the target of 2030 requires a few more than a dozen such vessels working simultaneously, which does not sound unreasonable. GEBCO hopes to co-opt shipping companies and other waterborne industrial concerns, together with various academic groups, into contributing to an ad hoc fleet to do this. These manned vessels will be joined by an array of robots that will include sea gliders (underwater drones requiring minimal propulsion) which have been kitted out with multi-beam sonar, and also unmanned barges steered by satellite. Such robots could prove particularly helpful in places with little shipping, like the South Pacific. And there is hope for improvement. New deep-sea technologies for mapping are part of this year's Shell Ocean Discovery XPRIZE. The winner of this will scoop \$4m and the runners up will share another \$3m.

Mere curiosity aside, an accurate map of the seabed may help open this unknown two-thirds of Earth's surface to economic activity. How quickly Davy Jones's locker yields anything valuable will depend on the technological difficulty, and therefore the expense, of bringing useful

discoveries back to dry land. But the sort of data that will contribute to GEBCO's map should help spot petroleum and natural gas seeps, and may point to ore-bearing geological formations. The world's navies (or, at least, those among them with submarine capability) will also take an interest—for an accurate seabed map will both show good places for their boats to hide and suggest where their rivals' vessels might be secreted. Whether they will welcome GEBCO making this information public is a different question. ■



海洋测深学

在章鱼的花园里

研究人员计划详细测绘深海洋底

为一幅地图花费30亿美元似乎有些铺张。但假如这是地球三分之二表面的地图，那么每平方公里的绘制成本就约为8.30美元。这样看来，成本好像又不算太高。以如此费用制作这样一幅地图正是全球海洋通用制图指导委员会（General Bathymetric Chart of the Oceans，简称GEBCO）这一机构目前提出的计划。GEBCO成立于1903年，总部位于摩纳哥。如其名称所示，该机构的任务是全面测绘海底地势。到目前为止，这一任务仅完成了不到五分之一。但近几十年来，深海测绘技术发展一日千里。因此，在得到日本大型慈善机构日本基金会（Nippon Foundation）的资助后，GEBCO正打算着力推进这项工作，并计划在2030年前完成任务。

地球海洋面积是火星面积的两倍半，而且通常的说法是，两者中，人们对火星表面地形掌握得要更清晰。火星探测器斯基亚帕雷利号（Schiaparelli）在降落时失联，而其坠毁地点仅几个小时后便被查探出来。相比之下，2014年在印度洋上空消失的马航MH370客机至今仍下落不明。

这很大程度上是因为，火星轨道卫星透过稀薄大气探测火星地形比地球轨道卫星探视水面几千米以下的海床更为容易。海水虽看似透明，但吸收了大量光线，因此水面200米以下其实到处是一片漆黑。无线电波同样会被吸收，雷达也就无法运作。而声波则不然，所以声纳技术会被用于探测潜艇等诸如此类的工作。但靠卫星并不能制作出声波地图，还是得采用老办法，在船上用声纳来探测。这正是GEBCO计划要去做。

| 准备好就“Ping”我

水手们自古以来就已运用测深技术避免船只搁浅。其设备是铅垂线——一根底部挂着铅锤的绳子。“Sounding”（水深测量）一词原本与噪音、回声或任何类似概念并无关联，而是源于古英语sund，意为海或海峡，但巧合

的是，现代替代铅垂线测深的正是“回声探测”技术，即利用从海底反射的声波。上世纪五六十年代，纽约哥伦比亚大学的玛丽·撒普（Marie Tharp）和布鲁斯·希曾（Bruce Heezen）运用二战期间发展起来的科技率先打造了这项技术。利用该技术，他们绘制了海底山脉“大西洋洋中脊”的一部分。

撒普和希曾当年采用的是单波束声纳，形成的图像较为模糊。现在，探测声纳器发射的是扇形的系列波束。这就意味着单次通行期间可测绘更宽广的海床带。精度也得到了提高，因为相邻波束有一定程度的重叠，其信号可用以相互比较。另外，安装在探测船船头下方平台上的特殊外壳可防止船身破浪前行时产生的气泡干扰信号，这些都令测绘精度远超以往。

然而，这类测绘行动一直缺乏协调。电缆敷设公司、石油公司、海洋学研究实验室、国家水文测量和世界各国海军都拥有大量的海洋探测数据。GEBCO的一项职责就是汇集现有信息，将其整合到一个新的数据库中，从而对已知的洋底建立连贯一致的图像。

该机构还有意整合热心志愿者收集的数据。美国国家海洋和大气管理局（America's National Oceanic and Atmospheric Administration）属下一个新型数字平台鼓励以众包的方式汇聚测深数据，让海洋业人员得以轻松上传信息。近期一些政治举动也将为这方面的努力提供助力，比如2013年美国、加拿大和欧盟在爱尔兰戈尔韦（Galway）签署协议，支持跨大西洋海底测深行动。政府的大型破冰船正在其他船只难以到达的一些高度冰封的海域收集信息。GEBCO也在试图说服拥有专有海底数据的政府及公司分享信息。其中一家名为Quintillion的电缆敷设公司已同意分享数据。

GEBCO面临的另一更大任务是要填补空白。新罕布什尔大学的拉里·梅耶（Larry Mayer）正协助GEBCO统筹这项任务，他估计，如果只用一艘船来收集数据，要200年才能完成任务。简单算下来，也就是说必须派出十几艘这类测量船同时作业才能在2030年前达到目标，但这并非不可行。GEBCO希望集合航运公司、其他海上从业机构及各类学术团体的力量，组成一支专设船队来完成这项任务。除了这些载人探测船，一系列机器人设

备也会加入，包括装备多波束声纳的水下滑翔机（只需极少推进力的水下无人机）以及由卫星控制的无人驳船。这类机器人设备在南太平洋等航船不多的海域尤其能发挥作用。而且技术还有望得到改进。今年的壳牌海洋探索X大奖赛（Shell Ocean Discovery XPRIZE）设有深海测绘新技术的竞赛项目。冠军可获得400万美元，其余优胜者则可瓜分300万美元的奖金。

除了纯粹满足好奇心，精确的海底地图还可能有助开启这未知的地球三分之二的表面，为经济活动服务。海底测绘能多快创造价值取决于技术难度以及把有用发现带回陆地的成本。而有助绘制GEBCO地图的那些数据也会帮助人们发现石油和天然气渗漏，并可能为发掘含矿地质构造提供线索。世界各国海军（或至少是那些有潜艇部队的海军）也会感兴趣——精准的海底地图既能让自己的舰船找到藏身佳处，也显示了敌方船只可能隐匿的地点。但它们是否欢迎GEBCO公开这些信息则另当别论。 ■



New media

#Twittertrouble

Is there life for technology firms beyond Wall Street?

FOR months Twitter, the micro-blogging service, has received the kind of free attention of which most companies can only dream. Politicians, corporate bosses, activists and citizens turn to the platform to catch every tweet of America's new president, who has become the service's de facto spokesman. "The whole world is watching Twitter," boasted Jack Dorsey (pictured), the company's chief executive, as he presented its results on February 9th. He has little else to brag about.

But Donald Trump has not provided the kind of boost the struggling firm really needs. It reported slowing revenue growth and a loss of \$167m. User growth has been sluggish, too: it added just 2m users in that period. Facebook added 72m. The day of the results, shares in Twitter dropped by 12%. Because news outlets around the world already report on Mr Trump's most sensational tweets, many do not feel compelled to join the platform to discover them. Others are put off by mobs of trolls and reams of misinformation.

And not even Mr Trump could change the cold, hard truth about Twitter: that it can never be Facebook. True, it has become one of the most important services for public and political communication among its 319m monthly users. It played an important role in the Arab spring and movements such as Black Lives Matter. But the platform's freewheeling nature makes it hard to spin gold from. In fact, really trying to do so—by packing Twitter feeds with advertising, say—would drive away users.

| *Business as unusual*

Twitter's latest results are likely to encourage those who think it should

never have become a publicly listed company, and want it to consider alternate models of ownership, such as a co-operative. They view Twitter as a kind of public utility—a “people’s platform”—the management of which should concern public interests rather more than commercial ones. If the company were co-operatively owned by users, it would be released from short-term pressure to please its investors and meet earnings targets.

Though some co-ops have shown themselves resilient, they are generally thought to be less dynamic—a shortcoming of democratic governance. Yet Sasha Costanza-Chock, an activist who teaches at the Massachusetts Institute of Technology, believes that Twitter users could also come up with features that would rescue it from its most toxic elements, such as harassment and hate speech. Others envision a futuristic co-op—or, inevitably, “co-op 2.0”—in which responsibility is split between idealistic entrepreneurs, who control product innovation, and users, who have the say on such matters as data protection. Even if such models could be made to work, Twitter is unlikely to become a co-op soon: its market capitalisation still exceeds \$12bn, an amount users can hardly dream of scraping together. Yet the debate about what to do with the service has stoked another, long-simmering discussion in the startup world: whether firms should always aim to go public. “We have become very myopic about what it means to be a corporation,” explains Albert Wenger, a partner at Union Square Ventures, a technology-investment firm. Armin Steuernagel, founder of Purpose Capital, a consultancy, says he sees more and more start-ups questioning whether they should opt for conventional ownership structures.

Options abound. Online, Etsy, Kickstarter and Wikipedia, among others, have pursued set-ups that allow them to keep their social benefit front-and-centre. But old media outlets can offer lessons too: many publications in Europe, including *The Economist*, have ownership structures that isolate them to some degree from commercial interests.

As for Twitter, it is likely to be snapped up once its value is low enough. Although the most likely buyer is another tech firm, surprises cannot be excluded. Users should start thinking like a traditional labour union, says Mr Wenger. If they stage a virtual walkout, they might have the bargaining power to change its governance structure. #Squadgoals. ■



新媒体

#推特烦恼

科技公司能否在华尔街之外觅得生机？

数月来，微博服务商推特不花一文就得到了密切关注，大多数公司只能望洋兴叹。政客、企业老板、活动家和普罗大众纷纷转向这一平台，紧追美国新总统的每一条推文。这位总统已然成为该服务实际上的代言人。2月9日，公司首席执行官杰克·多西（Jack Dorsey，见下图）在发布财报时夸口道：“全世界都在关注推特。”别的他也没什么好吹嘘了。

但这家苦苦挣扎的公司并未从特朗普那里得到它真正需要的推动。推特的财报显示收入增长放缓，亏损达1.67亿美元。用户增长也已放缓：这一期间用户数仅增加了200万。Facebook则增加了7200万。公布财报的当日，推特的股票下跌了12%。由于世界各地的新闻媒体都已经报道了特朗普最具爆炸性的推文，很多人觉得没必要再到这一平台去查看了。其他人则是因大批的网络喷子和大量虚假信息而对推特失去兴趣。

即便是特朗普也无法改变这样一个冷酷无情的事实：推特永远也无法成为Facebook。诚然，对每月3.19亿活跃用户来说，它已是进行公共和政治交流最重要的服务之一。在阿拉伯之春和像“黑人生命不容忽视”（Black Lives Matter）这样的运动中，推特扮演了重要的角色。但是这个平台随心所欲的本质让人很难从中掘金。实际上，真试图这么做的话，例如将推特订阅跟广告捆绑，反而会把用户赶走。

| 不寻常的生意

有些人认为推特原本就不该成为上市公司，推特最新的财报可能会让他们更有底气，并要求公司考虑其他所有权模式，例如合作企业。他们将推特视为一种公共设施——一个“大众平台”，认为它的管理应当以公共利益为重，而非商业利益。如果这家公司由用户合作共有，它就能免受取悦投资者、达到盈利目标的短期压力。

尽管有些合作企业显示出了自身的韧性，但一般说来人们仍认为这类企业欠缺活力，这是民主治理的缺点。但在麻省理工学院任教的活动家萨沙·科斯坦萨-乔克（Sasha Costanza-Chock）相信，推特用户还能另外想出一些功能，将它从骚扰、仇恨言论等为害最甚的问题中解救出来。也有人设想出一种带有未来主义色彩的合作企业，或者说免不了会叫“合作企业 2.0”，由理想主义的企业家和用户分担责任：企业家掌控产品创新，而用户则在数据保护之类的事情上拥有话语权。即便这样的模式能够推行，推特也不可能短期内就成为一个合作企业：它的市值仍然超过120亿美元，用户做梦也无法凑齐这样一笔巨款。然而关于如何处理这一服务的辩论已在创业公司界激起了另一场酝酿已久的讨论：公司是不是永远都要追求上市。科技投资公司Union Square Ventures的合伙人艾尔伯特·威戈（Albert Wenger）解释说，“成为一个公司意味着什么，我们对此已经变得非常目光短浅。”咨询公司Purpose Capital的创始人阿民·施托伊纳格尔（Armin Steuernagel）说，他看到越来越多的创业公司都在质疑是否应该选择传统的所有权结构。

选择多种多样。Online、Etsy、Kickstarter、维基百科等公司已经选择了允许它们将社会效益放在首要位置的架构。而老式媒体公司也可以提供经验：欧洲很多出版机构，包括《经济学人》在内，都有着一定程度上将自己与商业利益隔离开来的所有权结构。

至于推特，一旦市值足够低，它就有可能成为抢手货。尽管最有可能的买家是另外一家科技公司，但也不排除有意料之外的结果。威戈认为，用户们应该开始像传统的工会那样思考。如果开展一场虚拟的罢工，他们或许会获得讨价还价的能力，从而改变推特的治理架构。#团队目标 ■



Inequality in China

The Great Divide of China

A new paper charts China's widening income gaps

JUST as China's GDP has converged towards America's, levels of inequality have also been catching up. That is one of the conclusions of research* from five authors, including Thomas Piketty, a French economist famous for his work on wealth and inequality. Their new paper compares the evolution of inequality in China, America and France over four decades.

Inequality has soared since China opened the door to private enterprise and growth took off. In 1978 the highest-earning tenth in China received just over a quarter of overall income before tax, significantly below the proportion in America and France at the time. By 2015, however, those top 10% of Chinese earners were paid two-fifths of total income—above the share in France, but still just below that in America (47%). Wealth, too, is concentrated in fewer hands: the richest 10% own nearly 70% of private wealth in China, up from 40% in 1995 (and not far below the American level of nearly 80%).

Rises at the top mean that the share of pre-tax income going to the poorest half of the Chinese population has shrunk dramatically and is now, at 15%, not much higher than the American equivalent. In both countries, the shares have fallen by nearly half since 1978 (see chart). Compare that with France, where the share is higher and has changed little, buoyed perhaps by labour-market policies, such as a more generous minimum wage.

Greater disparity between rich and poor in the West may well have driven anti-establishment sentiment. It might seem no less palatable in China, where the government still calls itself communist. But there the pain has been soothed by rapid growth: it has lifted all boats. Income for the poorer

half of the population fell by 1% in America between 1978 and 2015. In China it quintupled. Another comfort is that measures suggest that in recent years income inequality has no longer been rising. This form of catch-up growth, at least, is on hold.

* “Global inequality dynamics: new findings from WID.world”, by Facundo Alvaredo, Lucas Chancel, Thomas Piketty, Emmanuel Saez and Gabriel Zucman, National Bureau of Economic Research Working Paper 23119. ■



中国的不平等

中国的巨大鸿沟

一篇新论文绘制出中国扩大的收入差距

中国的GDP已趋近于美国的水平，其不平等程度也在迎头赶上——在一项由五位作者开展的研究*中，这是结论之一。他们当中的一位是以研究财富与不平等而著称的法国经济学家托马斯·皮凯蒂（Thomas Piketty）。在这篇新论文中，作者们比较了四十多年来不平等在中国、美国以及法国的演变。

自从中国准许设立私营企业、经济得以迅速发展以来，不平等的状况也愈演愈烈。1978年，中国收入前10%人群的所得仅占总税前收入的四分之一多一点，远低于当时美国和法国的这一比例。但到了2015年，中国收入前10%的人包揽了总收入的五分之二。这比法国的比例高，但仍略低于美国47%的水平。财富也日益集中在少数人手中：如今中国最富有的10%的人坐拥近70%的私人财富，相较美国将近80%的水平低不了多少。而这一占比在1995年还只是40%。

顶层的人飞黄腾达，令最穷的半数中国人在税前总收入中的占比急剧缩水，如今降至15%，并没比美国的数字高出许多。自1978年以来，这一占比在中美两国差不多都降低了一半（见图表）。而在法国，这个比例则要高些，而且几乎没有变化。这可能要归功于该国的劳动市场政策（例如更慷慨的最低工资标准）的提振作用。

西方国家贫富差异的扩大很有可能助长了反建制的情绪。在政府仍自称共产主义者的中国，这种情绪似乎同样有滋生的可能。不过，中国的快速增长缓解了不平等之痛：经济飞速发展令所有人都受益。1978年到2015年间，美国相对贫穷的那一半人口收入下降了1%，而在中国，对应人群的收入提高至原有水平的五倍。另一个可令人聊以慰藉的情况是，调查显示，近年来该国收入不均并没有进一步加剧。起码在这一领域的追赶上，中国已暂时止步。

*“全球不平等动态：世界财富与收入数据库的新发现”。作者：法昆多·阿尔瓦雷多（Facundo Alvaredo）、卢卡斯·尚塞尔（Lucas Chancel）、托马斯·皮凯蒂（Thomas Piketty）、伊曼纽尔·赛斯（Emmanuel Saez）和加布里埃尔·祖克曼（Gabriel Zucman）。美国国家经济研究局工作论文，编号23119。 ■



Inequality

A minivan of Mammon

Are eight men as wealthy as half the world's population?

EVERY ten minutes, black Volkswagen shuttle vans ferry delegates from their hotels in Davos, Switzerland, to this year's World Economic Forum, held from January 17th to 20th. If you could squeeze the world's eight richest men into one of these vans, they might feel cramped. But they could comfort themselves with an extraordinary statistic: according to Oxfam, a charity, they own as much wealth (\$426bn) as half the world's population combined (\$409bn).

To make this striking calculation, the charity draws on data from *Forbes* magazine, which lists the wealth of the billionaires, and Credit Suisse, which estimates the smaller holdings of everyone else, thanks to painstaking work by three scholars of wealth, Anthony Shorrocks, Jim Davies and Rodrigo Lluberas.

Pedants can nonetheless criticise Oxfam's headline-grabbing comparison for its handling of debt, the dollar, labour and data. The world's least wealthy include over 420m adults whose debts exceed their assets, leaving them with negative net worth. Most of this net debt is owed by people in high-income countries. There are, for example, over 21m Americans with a combined wealth of minus \$357bn. Only people with relatively good prospects, by global standards, can be so poor; the wretched of the earth could never borrow so much. If all of the people with sub-zero wealth are excluded from the comparison, the poorest half of the remaining population would have a combined wealth equivalent to the richest 98 billionaires.

The Credit Suisse team converts the world's wealth into dollars at market

rates. But the dollar stretches further in poor countries. So studies of global poverty typically make currency conversions at “purchasing-power parity” (PPP) instead. Wealth data also exclude the poor’s biggest asset: their labour or “human capital”. The returns on that asset—such as wages—do however appear in income statistics. So whereas the bottom half of the global population have a negligible share of global wealth (only 0.15% at market exchange rates, according to Credit Suisse), they have a bigger share of global income (10.6% at PPP in 2013, the latest number available, according to Christoph Lakner of the World Bank).

In valuing the poor’s wealth at \$409bn, Oxfam also seems to have committed a rounding error. The figure should be just \$384bn, according to Mr Shorrocks (although the data are too patchy to allow much precision). For what it’s worth, \$384bn is less than the wealth of the world’s seven richest men. There would be no need to squeeze Michael Bloomberg, the world’s eighth-richest person, into the minivan. That would leave room for the magnificent seven to stretch their legs. ■



不平等

一车财神抵半球

八个男人的身家抵得上全世界一半人口的财富？

今年的世界经济论坛于1月17日至20日举行，每隔10分钟，黑色的大众摆渡车就把与会代表从瑞士达沃斯的酒店送往会场。如果你能把世界上最富有的八位男士全部塞进一辆商务车，他们可能会觉得挤。不过，如果告诉他们一个非同寻常的统计数据，他们可能会觉得舒适不少：慈善机构乐施会（Oxfam）的研究表明，这八个人的身家（4260亿美元）相当于世界一半人口的财富总和（4090亿美元）。

为了得出这一惊人的计算结果，乐施会采用了《福布斯》杂志和瑞信的数据，前者统计富豪们的财富，后者估算其他所有人较为逊色的财富。在瑞信的统计中，三位财富研究领域的学者安东尼·夏洛克斯（Anthony Shorrocks）、吉姆·戴维斯（Jim Davies）和罗德里戈·鲁博拉斯（Rodrigo Lluberás）付出了艰巨的劳动。

尽管如此，学究们仍能从这组夺人眼球的对比中找出毛病，称乐施会对债务、美元、劳动力和数据等的处理有问题。世界上最不富有的人包括数量超4.2亿的成年人，他们的债务超过了资产，故其财富净值为负。大部分净债务是由高收入国家的人们欠下的。例如，美国有2,100多万人的财富总和为负3,570亿美元。按照全球标准，只有前景相对较好的人才能穷到如此地步——世界上的穷苦大众永远也借不到这么多钱。如果将所有负资产人群从对比中剔除，剩余人群里最贫穷的那一半人的财富总和就相当于前98位富豪的财富总额。

瑞信团队按市场汇率将全世界的财富转换为美元。但美元在贫穷国家的价值更高。因此，对全球贫困的研究通常都是按“购买力平价”来进行货币转换。财富数据还排除了穷人的最大资产：他们的劳力或“人力资本”。不过，这一资产的回报（如工资）却出现在收入统计中。所以，尽管全球接近底层的一半人口占全球财富的份额可以忽略不计（根据瑞信的数据，按

市场汇率计仅为0.15%)，但他们占全球收入的份额却更大些——世界银行的克里斯托夫·雷克纳(Christoph Lakner)表示，根据可获得的最新数据，2013年按购买力平价计算占10.6%。

在估计穷人财富为4090亿美元时，乐施会似乎还犯了一个四舍五入的误差。夏洛克斯表示，这个数字应该只有3840亿美元(不过数据太过零碎，无法做到很精确)。暂且信其为真，那么3840亿美元还不及世界前七大富翁的财富之和。那就没必要让世界排名第八的富翁迈克尔·布隆伯格(Michael Bloomberg)也挤上那辆车了，这样那七位大人物就有空间伸伸腿了。■



Asian trade

Bouncing back

The world's export dynamos shrug off the threat of a trade war, for now

IT IS easy to be downcast about the state of global trade. It has faced stiff headwinds in recent years: in 2016, for the first time in 15 years, it grew more slowly than the world economy. Regional and global trade deals are going nowhere, slowly. And America's new president has promised to protect his country from trade-inflicted "carnage".

Amid all this gloom, optimism seems foolhardy. But in Asia's export dynamos, trade is picking up steam. In January, Chinese exports rose year-on-year for the first time in ten months; South Korean shipments have increased for three months in a row. Surveys reveal strong export pipelines in Japan, Singapore and Taiwan. Healthy order books for Asia's manufacturers normally bode well for global trade and indeed the global economy. It is too soon to declare a definitive upturn in global trade, but it looks like more than a blip (see chart).

The simplest explanation for the rebound is that global demand is itself on solid ground. Global growth is still slower than before the financial crisis of 2008, but is heading in the right direction. Both the IMF and the World Bank think it will speed up a bit this year. Investors have turned more bullish: the MSCI all-world index, which covers 46 different markets, hit a record high last week. The rebound in Asian exports is more reason for bullishness.

Structural changes may also be at play in Asia. A much-cited factor behind the slowdown in global trade in recent years has been China's tightening grip on complex supply chains. As more production takes place inside a single country, fewer cross-border transactions are needed to produce final

goods. Yet this consolidation within China is starting to meet more friction. China is still aiming for a bigger share of high-tech industries, but less-developed countries in Asia are scooping up more of its low-end manufacturing, and wealthier markets are also fighting back. Over the last nine months of 2016, China's export performance trailed the rest of Asia.

Nevertheless, there are good reasons to restrain the optimism. The rebound in exports from Asia's commodity producers such as Indonesia and Malaysia is mainly the result of higher prices for oil and metals. Growth in their trade volumes has been much slower. For Asia's high-tech economies, the rebound's durability hinges on the fickle tastes of consumers. Both Samsung and Apple are expected to launch shiny new gadgets this year. Semiconductor makers around the region have gone into overdrive in anticipation. If demand falls short of expectations, exports of electronics will quickly dive again.

And looming large over all these trends is Donald Trump. Fears that he might declare China a currency manipulator in his first few days in office came to naught. But his threats during the election campaign to slap heavy tariffs on Chinese products still linger in the background. A trade war would be unwelcome at any time. If it came just when the world was breaking free from a long slump in global trade, the irony would be all the more cruel. ■



亚洲贸易

正在反弹

世界出口引擎暂时摆脱贸易战威胁的影响

人们很容易对全球贸易的状况感到悲观。近几年，全球贸易面临巨大阻力：2016年，其增长15年来首次落后于世界经济增速。地区及全球贸易协定正逐渐停滞不前。美国的新总统已承诺要保护自己的国家免遭贸易的“屠杀”。

在这一片阴郁之中，乐观情绪似乎与愚勇无异。但在亚洲出口大国，贸易正在回升。1月，中国出口十个月来首次出现同比增长；韩国的出口量连续三个月实现增长。调查显示，日本、新加坡和台湾也都出口势头强劲。亚洲制造商的订单状况良好通常都是全球贸易乃至全球经济的好兆头。现在断言全球贸易已明确好转尚为时过早，但现在的状况看起来并非昙花一现（见图表）。

对这一反弹最简单的解释是，全球需求本身就有着坚实的基础。全球经济的增速仍然慢于2008年金融危机前的水平，但正朝着正确的方向发展。国际货币基金组织和世界银行都认为今年的增长会加快一些。投资者已变得更加乐观：上周，涵盖46个不同市场的MSCI全球指数创下历史新高。亚洲出口的反弹让他们更有理由看涨。

结构性变化也可能在亚洲发挥了作用。近年来全球贸易增长放缓，经常被提及的一个因素就是中国加强了对复杂供应链的控制。由于更多的生产都在一个国家内部进行，制造最终产品所需的跨境贸易就减少了。然而这种在中国内部的整合开始遭遇更多阻力。中国仍然希望在高新技术产业取得更大的份额，不过亚洲欠发达国家正更多地从中国的低端制造业里分得一杯羹，而发达市场也开始反击。2016年的后九个月里，中国的出口表现一直落后于亚洲其他地区。

然而，仍有充分的理由克制乐观情绪。印尼和马来西亚等亚洲大宗商品生

产国的出口反弹主要是石油和金属价格上涨所致。它们贸易量的增长则要缓慢得多。对亚洲的高科技经济体来说，反弹的持久性取决于消费者多变的喜好。预计三星和苹果今年都将推出闪亮的新产品。为此这一地区的半导体制造商已经进入超负荷生产状态。但如果需求达不到预期，电子产品的出口将很快再度锐减。

笼罩在这些趋势之上的阴影是唐纳德·特朗普。人们曾担心他可能甫一上任就宣布中国为汇率操纵国，这并未成真。但他在竞选期间放言要对中国产品征收高额关税，这一威胁仍挥之不去。贸易战在任何时候都不受欢迎。而如果在世界刚刚摆脱全球贸易长期低迷之时就爆发贸易战，这种讽刺就更加残酷了。 ■



Free exchange

Better than a wall

Understanding NAFTA, a disappointing but under-appreciated trade deal

THE North American Free Trade Agreement (NAFTA) has long been a populist punchbag. In the American presidential campaign of 1992, Ross Perot—an oddball Texas billionaire and independent candidate—claimed to hear a “giant sucking sound” as Mexico prepared to Hoover up American jobs. Since its enactment, right-wing conspiracy theorists have speculated that NAFTA is merely a first step towards “North American Union”, and the swapping of the almighty dollar for the “amero”. Donald Trump, who plans to renegotiate (or scrap) the deal, mined a rich vein of anti-NAFTA sentiment during his campaign, calling it “the single worst trade deal ever approved in this country”. Even NAFTA’s cheerleaders (a more reticent bunch) might concede that the deal has fallen short of their expectations. But it is in none of the signatories’ interests to rip it up or roll it back.

America and Canada opened talks on a free-trade area with Mexico in 1990, shortly after securing their own bilateral deal, and it was bringing in Mexico that proved so contentious in America. When NAFTA took effect in 1994, it eliminated tariffs on more than half of its members’ industrial products. Over the next 15 years the deal eliminated tariffs on all industrial and agricultural goods. (The three economies would have further liberalised trade within the Trans-Pacific Partnership, which Mr Trump scotched in one of his first acts as president.)

Americans hoped lower trade barriers would foster growth in cross-border supply chains—a “Factory North America”—to rival those in Europe and Asia. By moving parts of their supply chains to Mexico, where labour costs were low, American firms reckoned they could cut costs and improve their global competitiveness. American consumers might also benefit from

cheaper goods. For its part, Mexico sought improved access to America's massive market, and sturdier positions for its firms within those North American supply chains. Both countries hoped the deal would boost Mexico's economy, raising living standards and stanching the flow of migrants northward.

NAFTA was no disaster. Two decades on, North America is more economically integrated. Trade between America and Mexico has risen from 1.3% of combined GDP in 1994 to 2.5% in 2015 (see chart). Mexico's real income per person, on a purchasing-power-parity basis, has risen from about \$10,000 in 1994 to \$19,000. The number of Mexicans migrating to America has fallen from about half a million a year to almost none. And yet the deal has disappointed in many ways. Mexican incomes are no higher, as a share of those in America, than they were in 1994. (Chinese incomes rose from about 6% of those in America to 27% during that time.) Estimates suggest that the deal left Americans as a whole a bit better off. But the gains have proved too small, and too unevenly distributed, to spare it continued criticism.

The sniping is unfair. Unexpected shocks prevented the deal from reaching its full potential. Both the peso crisis of 1994-95 and the global financial crisis dealt blows to trade between the two countries. So did the American border controls introduced after the attacks of September 11th 2001, which raised the cost of moving goods and people. The rapid, disruptive growth of China also interfered with North American integration. The Chinese economy, accounting for more than 13% of global exports and around 25% of global manufacturing value-added, exerts an irresistible pull on global supply chains.

Nor is NAFTA chiefly responsible for the woes of the American worker. In a recent essay Brad DeLong, an economic historian at the University of California, Berkeley, reckoned NAFTA might be blamed for net job losses of

the order of 0.1% of the American labour force—fewer jobs than the American economy adds in a typical month. Even without NAFTA, manufacturing jobs would have dwindled. The strong dollar and better transport and communications technology made it more attractive to produce abroad. Automation hastened the persistent long-term decline in industrial employment that is familiar in all rich economies—even in export powerhouses such as Germany.

| *Beggar my neighbour*

Most important, the failure to agree a trade deal with Mexico would not have altered North American geography. Mexico shares a 3,200km-long border with the world's largest economy. It is almost inevitable that America will be Mexico's largest trading partner (America currently accounts for more than 70% of Mexican exports and more than 50% of its imports). Deep familial and cultural ties across the border shrink the distance between them even more. Mexico cannot help but be critically dependent on its neighbour's economy. And America unquestionably benefits when Mexico, which has the world's tenth-largest population and 15th-biggest economy, is more prosperous.

A richer Mexico would buy more American goods and services and provide more ideas, talent and innovation. It would also be better placed to manage migration, and a stronger diplomatic partner. Eliminating tariffs on Mexico would not instantly transform it into Canada, but the notion that higher trade costs between the two economies would serve American interests better is, at best, short-sighted. No wall can insulate America against events to its south, and Americans' own well-being is intimately linked to the welfare of their around 125m Mexican neighbours.

It is hard to blame Americans for seeing globalisation as a zero-sum affair. Stagnant pay, rising inequality and government complacency as industrial regions suffered long-term decline have obscured the benefits of trade and

created fertile ground for populists. As a result Americans feel let down by NAFTA. Yet NAFTA has itself been let down by American leaders, who neither made the case that higher living standards are a positive-sum game, nor allowed the benefits of growth to be broadly shared. If the upshot is the disintegration of the North American economy, those on both sides of the Rio Grande will be worse off. ■



自由交流

好过修墙

探讨《北美自由贸易协定》，一项有负所望却又被低估的贸易协定

《北美自由贸易协定》（以下简称NAFTA）长期以来都是民粹主义者的出气筒。在1992年的美国总统竞选活动中，独立候选人、性情古怪的德州亿万富翁罗斯·佩罗（Ross Perot）声称，随着墨西哥准备抢走美国的工作岗位，他听到了“巨大的吸食声”。自NAFTA制定以来，右翼阴谋论者一直猜测该协定仅是迈向“北美联盟”、以“北美元”（amero）取代强大美元的第一步。计划重新谈判（或废除）该协议的特朗普在竞选期间煽动了强烈的反NAFTA情绪，称其为“美国通过的最糟糕的贸易协议”。连NAFTA的支持者（一个较为沉默的群体）可能也承认该协议并未达到他们期望的效果。但撕毁或重订协议对各签署国来说并无好处。

美国和加拿大在谈妥双边协议后不久，在1990年与墨西哥就设立自由贸易区展开谈判。纳入墨西哥的举动在美国引发了诸多争议。NAFTA于1994年生效，免除了成员国超过一半工业产品的关税。在接下来的15年里，协议逐步免除了区内所有工业品和农产品的关税。本来这三个经济体将在《跨太平洋伙伴关系协定》（TPP）内进一步实现贸易自由化，但特朗普上任后首批政令之一就是退出TPP。

美国人希望降低贸易壁垒能推动跨境供应链的发展，使这个“北美工厂”能够匹敌欧洲和亚洲的供应链。美国公司认为，通过将供应链的一部分转移到劳动力成本低廉的墨西哥，它们可以降低成本并提升自身的全球竞争力。美国消费者可能也会因为更便宜的商品而受益。而墨西哥则希望进一步打入美国的巨大市场，巩固墨西哥公司在北美供应链中的地位。两国都希望NAFTA能推动墨西哥的经济增长，从而提升国民生活水平，并遏制墨西哥人北迁的移民潮。

NAFTA并非灾难。二十年之后，北美经济更为一体化。美国和墨西哥之间的贸易从1994年占两国总GDP的1.3%上升至2015年的2.5%（见图表）。按

购买力平价计算，墨西哥的实际人均收入已从1994年的10,000美元左右上升至19,000美元。移居美国的墨西哥人数量从每年的约50万下降至几乎为零。然而，NAFTA在许多方面都令人失望。墨西哥人的收入 and 美国人收入的比率相较1994年时的水平并无提升。而同一时期，中国人的收入已从占美国人收入的6%上升至27%。据估计，美国人总体上从NAFTA中有所获益，但收益实在太小，分布也极不均匀，因此该协议难免持续遭受批评。

这些抨击其实并不公平。意外的冲击阻碍了该协议全面开花结果。1994年至1995年间的比索危机以及之后的全球金融危机打击了两国之间的贸易。美国在2001年9月11日遭袭后实施边境管制，导致货物和人员流动成本上升，这也阻碍了贸易往来。中国快速而具颠覆性的增长也干扰了北美一体化的进程。中国经济占全球出口总额13%以上，占全球制造业附加值的约25%，对全球供应链施加了不可抗拒的拉力。

NAFTA也不是造成美国工人困境的罪魁祸首。加州大学伯克利分校的经济史学家布拉德·德隆（Brad DeLong）在近期一篇文章中表示，大约仅0.1%美国劳动力的净失业可归咎于NAFTA，数量少于美国经济通常一个月新创造的职位。即便没有NAFTA，制造业工作也会减少。美元强势，运输改善，通讯技术发展，这一切使得厂商更愿意把生产转移到国外。自动化加速了所有富裕经济体中都常见的工业就业长期持续衰退，连德国这样的出口大国也难以幸免。

| 以邻为壑

最重要的是，即使未能与墨西哥达成贸易协议，也不会改变北美的地理形势。墨西哥与世界最大经济体共享3200公里的边界。美国几乎必然会是墨西哥最大的贸易伙伴（美国目前在墨西哥出口中占比超过70%，在其进口中占比50%以上）。国境两侧深厚的亲缘及文化关系进一步缩小了两国的距离。墨西哥别无选择，只得严重依赖邻国的经济。作为世界第10大人口大国及第15大经济体，墨西哥如果变得更为繁荣，美国无疑也将从中获益。

更富裕的墨西哥将购买更多的美国商品和服务，带来更多的想法、人才及

创新，也将更有效地管理移民，成为更强大的外交伙伴。对墨西哥免除关税不会让它立即变成加拿大，但如果认为提高墨西哥和美国之间的贸易成本会更有利于美国，这至少也是短视的。没有任何围墙可以让美国隔绝来自南面邻国事件的影响，美国人自身的福祉与其约1.25亿人的墨西哥邻居密切相连。

美国人把全球化视为一种零和博弈，这也很难怪责他们。国内工业重镇长期衰退，造成薪酬停滞不前，不平等加剧，而政府又满足于现状，这掩盖了贸易的好处，并为民粹主义者的滋生提供了肥沃的土壤。结果便是美国人对NAFTA感到失望。但其实美国的领导人一直都辜负了该协议，他们既没有阐明生活水平的提高是一种正和博弈，也没有让人们广泛分享增长之利。假如北美经济区最终解体，美国和墨西哥将两败俱伤。■



Schumpeter

Snaptrap

Snap's IPO is part of a wider trend towards corporate autocracy

DEMOCRACY is in decline around the world, according to Freedom House, a think-tank. Only 45% of countries are considered free today, and their number is slipping. Liberty is in retreat in the world of business, too. The idea that firms should be controlled by diverse shareholders who exercise one vote per share is increasingly viewed as redundant or even dangerous.

Consider the initial public offering (IPO) of Silicon Valley's latest social-media star, Snap. It plans to raise \$3-4bn and secure a valuation of \$20bn-25bn. The securities being sold have no voting rights, so all the power will stay with Evan Spiegel and Bobby Murphy, its co-founders. Snap's IPO has echoes of that of Alibaba, a Chinese internet giant. It listed itself in New York in 2014, in the world's largest-ever IPO, raising \$25bn. It is worth \$252bn today and is controlled by an opaque partnership using legal vehicles in the Cayman Islands. Its ordinary shareholders are supine.

Optimists may dismiss the two IPOs as isolated events, but there is a deeper trend towards autocracy. Eight of the world's 20 most valuable firms are not controlled by outside shareholders. They include Samsung, Berkshire Hathaway, ICBC (a Chinese bank) and Google. Available figures show that about 30% of the aggregate value of the world's stockmarkets is governed undemocratically, because voting rights are curtailed, because core shareholders have de facto control, or because the shares belong to passively managed funds that have little incentive to vote.

Cheerleaders for corporate governance, particularly in America, often paint a rosy picture. They point out that fewer bosses are keeping control through legal skulduggery, such as poison pills that prevent takeovers.

Unfortunately, these gains have been overwhelmed by three bigger trends. The first is that technology firms can dictate terms to infatuated investors. Young and with a limited need for outside capital, many have come of age when growth is scarce. Google floated in 2004 with a dual voting structure expressly designed to ensure that outside investors would have “little ability to influence its strategic decisions”. Facebook listed in 2012 with a similar structure and in 2016 said that it would issue new non-voting shares. Alibaba listed in New York after Hong Kong’s stock exchange refused to countenance its peculiar arrangements. Undaunted, American investors piled in.

At the same time there has been a drift away from the model of dispersed ownership in emerging economies, with 60% of the typical bourse being closely held by families or governments, up from 50% before the global financial crisis, according to the IMF. One reason has been lots of IPOs of state-backed firms in which the relevant government retains a controlling stake. Hank Paulson, a former boss of Goldman Sachs, helped design many of China’s privatisations in the early 2000s. “The Chinese could not surrender control,” his memoirs recall. Mr Paulson hoped that the government would eventually take a back seat, but that has not happened. Other emerging economies, including Brazil and Russia, copied the Chinese strategy of partial privatisation. And across the emerging world, tightly held family firms, such as Tata in India and Samsung in South Korea, are bigger than ever.

Voter apathy is the third trend, owing to the rise of low-cost index funds that track the market. Passive funds offer a good deal for savers, but their lean overheads mean that they don’t have the skills or resources to involve themselves in lots of firms’ affairs. Such funds now own 13% of America’s stockmarket, up from 9% in 2013, and are growing fast. A slug of the shareholder register of most listed firms is now comprised of professional snoozers.

For many in business the decay of shareholder democracy is irrelevant. After all, they argue, investors own lots of other securities—bonds, options, swaps and warrants—that don't have any voting rights and it doesn't seem to matter. At well-run firms such as Berkshire, shares with different voting rights trade at similar prices, suggesting those rights are not worth much. Some managers go further and argue that less shareholder democracy is good, because voters are myopic. Last year Mark Zuckerberg, Facebook's boss, pointed out that with a normal structure the firm would have been forced to sell out to Yahoo in 2006.

It doesn't take a billionaire to poke holes in this logic. For economies, toothless shareholders are damaging. In China and Japan firms allocate capital badly because they are not answerable to outside owners, and earn returns on equity of 8-9%. A study in 2016 by Sanford C. Bernstein, a research firm, got Wall Street's attention by calling passive investing "the silent road to serfdom". Without active ownership, it said, capitalism would break down.

| *Democratic deficit*

At the firm level, voting rights are critical during takeovers, or if performance slips. At Viacom, a media firm with dual-class shares, which ran MTV in its heyday but which has stagnated for the past decade, outside investors are helpless. Control sits with the patriarch, Sumner Redstone, aged 93, who has 80% of its votes but only 10% of its shares. Yahoo (once as sexy as Snap) has lost its way, too. But because it has only one class of shares, outsider investors have been able to step in and, using their voting power, force the firm to break itself up and return cash to its owners.

The system may be partially self-correcting. Some passive managers, such as BlackRock, are stepping up their engagement with companies. If index funds get too big, shares will be mispriced, creating opportunities for active managers. If shares without votes are sold for inflated prices, their owners

will eventually be burned, and won't buy them again. And if fashionable young firms miss targets, they will need more cash and will get it on worse terms. But in the end shareholder democracy depends on investors asserting their right to vote in return for providing capital to risky firms. If they don't bother, shareholder democracy will continue to decline. That is something to think about as fund managers queue up for Snap's IPO. ■



熊彼特

Snap陷阱

Snap的IPO体现了走向专制型公司的大趋势

智库自由之家（Freedom House）称民主在全球范围内都在衰落。如今只有45%的国家被视为自由国度，而且数量还在下降。在商业世界，自由也在节节败退。认为公司应当由不同的股东控制、每股可投一票的观念越来越被视作多余甚至危险。

以硅谷最新的社交媒体之星Snap的IPO为例。它计划募集30亿至40亿美元，并争取到200亿至250亿美元的估值。它出售的股票没有表决权，因此一切权力仍将属于联合创始人埃文·斯皮格尔（Evan Spiegel）和鲍比·墨菲（Bobby Murphy）。Snap的IPO和中国互联网巨头阿里巴巴的IPO相似。阿里巴巴2014年在纽约上市，募资250亿美元，为全球有史以来最大的IPO。目前它的市值为2520亿美元，由不透明的合伙人团体通过注册于开曼群岛的法律实体加以控制。它的普通股东完全不插手管理。

乐观主义者对此可能会不屑一顾，觉得这两次IPO只是孤立事件，但如今公司治理已呈现出更深入的专制趋势。全球市值最高的20家公司中有八家不是由外部股东控制，其中包括三星、伯克希尔·哈撒韦（Berkshire Hathaway）、中国工商银行和谷歌。已有的数据显示，全球股票市场总价值中大约有30%是以非民主的形式管理，原因或是表决权被剥夺，或是核心股东享有实际控制权，或是由于股票属于基本没有动力表决的被动管理型基金。

为公司治理摇旗呐喊者常常描绘出一幅美好的画面，在美国尤其如此。他们指出，现在老板们采用法律上的花招来保持控制权的情形（如采用防止被收购的毒丸计划）已在减少。不幸的是，这些成就已经被三个更大的趋势压倒。其一是科技公司可以对为它们神魂颠倒的投资者发号施令。很多公司很年轻而且对外部资金需求有限，在整个市场增长乏力时进入成熟期。谷歌2004年上市时采用了双重股权结构，并明确其目的是为了确保护外

部投资者“无法影响其战略决策”。Facebook在2012年上市时也采用了类似的结构，并在2016年称将发行新的无表决权的股票。阿里巴巴在香港联交所拒绝了其特殊的股权安排之后，选择在纽约上市。大无畏的美国投资者蜂拥而至。

与此同时，新兴经济体中也已显现出逐渐偏离分散型所有权模式的趋势。国际货币基金组织（IMF）的数据显示，有代表性的证交所中，60%的市值是由家族或政府紧密控制，较之全球金融危机前的50%有所上升。原因之一是大批获政府支持的公司IPO，其中相关政府保有控股权。高盛的前老板汉克·保尔森（Hank Paulson）在本世纪初帮助策划了许多中国公司的私有化。他在回忆录中写道，“中国人不可能放弃控制权。”保尔森曾希望政府最终能退居二线，但这并未实现。巴西和俄罗斯在内的其他新兴经济体照搬了中国部分私有化的策略。而在整个新兴世界，被牢牢控制的家族企业，如印度的塔塔和韩国的三星，比以往任何时候都更强大。

享有表决权的股东对公司运营漠不关心是第三个趋势，原因是追踪市场的低成本指数基金的崛起。被动型基金为储户提供了合算的交易，但低廉的管理费说明它们没有能力或资源参与到许多公司的事务中去。这类基金从2013年占美国股市的9%升至现在的13%，并且还在迅猛增长。如今，大多数上市公司的股东名册上都躺着一群“职业瞌睡虫”。

很多商界人士都觉得股东民主制的衰落无关紧要。他们认为，投资者毕竟还持有大量的其他证券——债券、期权、掉期交易和认股权证等，这些证券没有任何表决权，而这似乎也并不要紧。在运作良好的公司，如伯克希尔，表决权不同的股票交易价格却相近，表明这些权利的价值并不高。一些基金经理更进一步提出，股东民主制减弱会更好，因为投票人都目光短浅。去年Facebook的老板扎克伯格指出，如果按照正常结构，公司可能在2006年就被迫卖给了雅虎。

就算不是亿万富翁也能找出这种逻辑的漏洞。对经济体而言，股东人微言轻是有破坏性的。在中国和日本，公司的资本配置非常糟糕，原因就是它们无需对外部所有者负责，而它们获得的股本回报率为8%至9%。研究公

司盛博（Sanford C. Bernstein）2016年开展的一项研究引起了华尔街的注意。该研究将被动型投资称作“通往奴役的沉默之路”。研究认为，没有了积极所有权，资本主义将会分崩离析。

| 民主赤字

在公司层面，表决权在收购或是业绩下滑时至关重要。采取双重股权结构的媒体公司维亚康姆（Viacom）在全盛时期曾运营MTV电视网，但过去十年一直停滞不前，该公司的外部投资者却无能为力。公司的控制权掌握在93岁高龄的掌门人萨默·雷石东（Sumner Redstone）手中，他有80%的表决权，但却只持有10%的股票。雅虎（曾经和Snap一样引人入胜）也迷失了发展方向。但因为它只有一类股票，外部投资者能够介入。通过行使表决权，他们迫使公司拆解并将资金返还给公司所有者。

这一体系可能正在一定程度上自我修正。一些被动型基金管理公司如贝莱德集团（BlackRock）正加强对公司事务的参与。如果指数基金规模太大，股票会被错误定价，这就为积极型基金管理公司创造了机会。如果无表决权的股票被以虚高价格卖出，它们的持有者最终会遭受损失，不会再买这样的股票。而如果时髦的新公司未能达到业绩目标，它们会需要更多现金，并必须接受更苛刻的条件以获得融资。但最终，股东民主制取决于投资者坚持他们的表决权，作为为高风险公司提供资金的回报。如果他们不愿费心，那么股东民主制将继续衰落。当基金经理们排着长队等待Snap的IPO时，该思考一下这个问题。■



Buttonwood

Zombies ate our growth

Investors should be aghast at the trend towards a more active industrial policy

EQUITY markets have shrugged off the Brexit and Trump votes. Indices in London and New York have reached new highs. But individual stocks and industries have had the odd wobble, not least when they have been the subject of a hostile tweet from the incoming president. “You’ve been fired at” may turn out to be a dominant meme of the next four years.

Indeed, what seems to be emerging on both sides of the Atlantic is a new version of industrial policy, in which Brexit negotiations, tax laws and trade talks are used as a way to favour some industries and punish others. And that ought to be cause for real investor concern.

The standard criticism of industrial policy is that it is all about “picking winners”. But the real problem is that it is more about protecting the position of established corporations—cosseting losers, in other words.

Which companies are most likely to get protected? The obvious answer is incumbent groups that possess lobbying clout. Many companies have expressed concern about Brexit, but it is to Nissan, a Japanese car giant, that the British government has made an undisclosed commitment. Startups are unlikely to be afforded the same courtesy. The danger is that this cements in place the existing structure of the corporate sector and prevents the emergence of more efficient firms that can drive forward productivity improvements. This has been called the “zombie company” phenomenon.

A new paper* from the OECD finds a link between the proportion of zombie firms surviving in an economy and declining productivity. Specifically, a

3.5% increase in the zombie share is associated with a 1.2% decline in labour productivity across industries.

The paper defines zombie firms as those aged ten years or older with an interest-coverage ratio (the ratio of operating income to interest expenses) of less than one in each of the preceding three years. In a harsher age, their creditors might have finished them off. But today the zombies shuffle on, discouraging more efficient firms from investing and making it harder for rivals to earn increased profits and gain market share. Worse still, the decline in new business formation may be partly caused by the suffocating impact of zombies.

Europe, for example, often gets criticised for its economic inflexibility—particularly in the labour market, where the difficulty of firing workers makes companies reluctant to hire them in the first place. But the OECD study suggests that the problem of corporate ossification may be even more widespread.

The issue may also help to explain why the productivity performance of the global economy has been so disappointing. Figures released by the US Conference Board, a research group, in January showed that total factor productivity (TFP) globally fell in 2015 and had been flat in the previous two years. (TFP is that element of growth that cannot be explained by the use of increased labour or capital.)

The new versions of industrial policy are likely only to exacerbate this problem. They look worryingly like the “Latin American” model of the 1960s and 1970s (ie, an import-substitution policy). If a company makes an investment decision on the back of a tax break or a threatening presidential tweet, then it is probably not making the most efficient use of its capital. It may seem like good news in the short term for the workers who keep their jobs. But it is not good in the long run. The companies they work for will be

less competitive in international markets; and, as consumers, workers will either pay higher prices or buy inferior goods. Instead of an inflexible labour market, you get an inflexible corporate market.

It all adds up to a double problem for equity investors. For now the market may be benefiting from a couple of sugar highs: in Britain, the impact of a falling pound on the overseas earnings of multinationals; and in America, the hopes for fiscal stimulus and lower corporate taxes. But in the long run, a more interventionist government policy is likely both to weigh on economic growth and to make equities riskier. Who knows, after all, which sectors will fall out of favour?

Imagine the reaction of investors if left-wing leaders were in charge. If President Bernie Sanders were berating American companies on Twitter, or Jeremy Corbyn was pledging unquantified British government support to manufacturers, markets would be plunging.

* “The Walking Dead: Zombie Firms and Productivity Performance in OECD Countries” by Mûge Adalet McGowan, Dan Andrews and Valentine Millot ■



梧桐

僵尸企业吞噬增长

面对更积极的产业政策倾向，投资者应该会感到惊恐

股票市场已经摆脱了英国脱欧和特朗普当选的影响。伦敦和纽约的股指都创下新高。但个别股票和行业却离奇地震荡不定，尤其是在推特上遭新总统攻击的时候。“你已经被喷了”可能会成为未来四年的一个热梗。

实际上，一种新的产业政策似乎正在大西洋两岸显现，具体表现是英国脱欧谈判、税法和贸易谈判被用以偏袒某些行业而惩罚另一些行业。而这才是投资者真正应该担心的原因。

产业政策通常遭到的批评是它完全是在“挑选赢家”。但真正的问题是，它更多的是在保护现有企业的地位，换言之，就是在宠溺输家。

哪些公司最有可能受到保护？显而易见，是那些具备游说力量的传统集团。很多公司都对于英国脱欧表示了担忧，但日本汽车巨头日产却从英国政府那里得到了一份秘密承诺。创业公司则不太可能得到同样的优待。危险在于，这固化了企业界的现有结构，阻碍了更有效率的公司崛起推动提高生产率。这种情况被称作“僵尸公司”现象。

经合组织的一份新报告*发现，经济体中存在的僵尸企业的比例和生产率下降之间存在联系。具体来说，僵尸企业比例每提高3.5%，各行业的劳动生产率就下降1.2%。

这份报告把僵尸企业定义为成立十年或以上、过去三年内每年的利息覆盖率（营业收入与利息支出的比率）都小于1的公司。在更艰难的年代，这些企业的债权人可能已经让它们破产了。但现在，僵尸企业却仍在蹒跚而行，阻碍更有效率的公司投资，并令竞争对手难以增加利润和扩大市场份额。更糟糕的是，新成立企业的减少在一定程度上是受到了僵尸企业的遏制。

例如，欧洲经常被批评经济缺乏弹性，尤其是劳动力市场。难以解雇员工让企业在一开始就不愿雇人。但经合组织的研究发现，企业僵尸化的情况可能还要更为普遍。

这一问题也许还有助于解释为何全球经济的生产率表现如此令人失望。研究机构美国世界大型企业联合会（US Conference Board）1月公布的数字显示，2015年全要素生产率在全球范围内下滑，之前两年则持平。（全要素生产率是指不能用增加的劳动力或资本投入来解释的那部分增长。）

新的产业政策只可能加剧这一问题。它们看上去像上世纪六七十年代的“拉美”模式（一种进口替代政策），令人担忧。如果一家公司是在一项税收减免政策推出后或者总统在推特上放出威胁后决定投资，那么它可能并不是在最有效地利用资本。对于保住了饭碗的工人而言，这在短期内可能是个好消息，但在长期则不然。这些工人所效力的公司在国际市场的竞争力将削弱；而作为消费者，工人要么得支付更高的价格，要么只得购买次等的商品。取代无弹性劳动力市场的会是无弹性的企业市场。

所有这些汇集起来，对股票投资者构成了一把双刃剑。目前，市场可能会从若干短暂的利好中获益：在英国是英镑贬值对跨国公司海外收益的影响；在美国是对推出财政刺激政策和降低公司税的指望。但在长期，更倾向干涉的政府政策可能既让经济增长承压，也让股市更添风险。毕竟，谁知道哪个行业会失宠呢？

想象一下如果左翼领导人掌权，投资者的反应会如何。如果“总统”伯尼·桑德斯（Bernie Sanders）在推特上斥责美国公司，或者（英国工党领袖）杰里米·科尔宾（Jeremy Corbyn）承诺英国政府对制造业给予支持，却又不明确支持有多大，市场可能会跳水。

*《行尸走肉：经合组织国家中的僵尸企业和生产率表现》，穆热·阿达莱特·麦高恩、丹·安德鲁斯及瓦伦丁·米约著 ■



Student loans

Grading education

A fintech startup treats student loans as serious investments

IN AN old factory building in lower Manhattan a fintech startup is seeking answers to a question that has tormented teachers and students for decades: what is the value of a given course, teacher or institution? Climb Credit, with just two dozen employees, provides student loans. The programmes it finances bring returns far higher than can be expected from even highly rated universities.

Climb does not claim to nurture billionaires, nor to care much about any of the intangible benefits of education. Rather, it focuses on sharp, quantifiable increases in earnings. The average size of its loans is \$10,000 and it normally finances programmes of less than a year. The subjects range from coding to web design, from underwater welding to programming robots for carmakers (which has the highest rate of return). Some students have scant formal education; others advanced degrees. The rate of return they get is calculated as the uplift in earnings after the course of study, minus its cost (which includes that of servicing the loan, and takes account of the absence of earnings during the course).

Climb's results so far are hardly conclusive. It has released only the number of loan applications: just 10,000 since its founding in 2014. Many institutions it works with do not offer the four-year and two-year courses eligible for federal funding, which account for 19m students. Instead, its market for now is among the 5m studying in more focused programmes.

Past efforts to rank education providers based on the financial return they offer have struggled. The data are often drawn from patchy surveys. It is hard to compare different courses over different time spans. Climb tracks

every loan it makes, along with data such as subject area, teacher, institution, job offers and salaries. Its interest rates average 9% a year, roughly double the government rate, and can be as high as 15%. It shuns some fields, such as acting or modelling, altogether, if there is no evidence that a course delivers a return. So far, the firm's approach has worked: its default rates are in the low single digits.

Climb's credit offering covers 70 institutions; another 150 are being vetted. As many as 3,000 may eventually qualify. Climb's attraction is obvious: an expanded student base. But many will balk at the tough provisions Climb imposes. Students must be given a drop-out period, when they can leave without any loan obligation. (A review of data on conventional student loans suggested that those most likely to default had begun classes, taken on debt and then quit the course before they had acquired any new skills.) If a student does default, the school is usually responsible for more than 20% of the unpaid debt. That gives it an incentive to pick students carefully and train them well.

In conventional student loans, interest and principal accumulate silently. On graduation, the monthly repayment bill comes as a shock. Climb students start making tiny payments as soon as they take out a loan (refunded if they drop out fast). Climb hopes to make its success-rate data public, to help both students and lenders. It already makes good use of its network of education providers: it has hired three former students from institutions within it. ■



助学贷款

给教育评级

一家金融科技创新公司将助学贷款视作正经投资

曼哈顿下城区的一栋老厂房里，一家金融科技创新公司正在探寻一个困扰了众多师生几十年的问题：某一门课程、某位老师，或是某间学府究竟价值几何？仅有24名员工的Climb Credit提供助学贷款，它资助的课程所带来的回报甚至远高于颇负盛名的大学所能给予的。

Climb并没有宣称要培养亿万富翁，也不太关心教育带来的任何无形的益处。相反，它关注的是急剧的、可量化的收入增长。它发放的贷款平均额度为一万美元，资助的课程通常不超过一年。所覆盖的课题有编程、网页设计、水下焊接、为汽车制造商的机器人编程（这门课的回报率最高），等等。有些学生只接受过极有限的正规教育，有些则拥有高等学位。他们获得的回报率是这么计算的：修完课程后收入的提升减去上课的成本（包括偿还贷款以及在上上课期间损失的收入）。

Climb的业绩如何目前尚难定论。它只披露了贷款的申请数量：自2014年公司成立以来仅有一万笔。与它合作的很多院校并不提供有资格获得联邦资助的四年期和两年期课程（这种资助覆盖1,900万名学生）。而它目前的市场是学习更有针对性课程的500万名学生。

曾经也有人尝试根据教育机构提供的财务回报来为它们评级，但一直难以成功。数据常常来自零散的调查结果。很难在不同时间跨度里比较不同的课程。Climb追踪它发放的每笔贷款，也记录包括专业领域、教师、学校、工作机会和薪资等数据。它的年利率平均为9%，大约是政府资助利率的两倍，而且最高可达15%。如果没有证据表明某门课程会产生回报，它就会避开这些领域，比如表演和模特。截至目前，该公司的方法颇见成效：它的违约率只是很低的个位数。

Climb的贷款服务覆盖了70家院校，另有150家院校正在审核中。最终合格

的可能多达3,000家。Climb对院校的吸引力是显而易见的——它帮助扩大了学生基数。但很多院校会因Climb提出的苛刻条款而迟疑不决。它们必须给予学生一个退学期限，在这段时间里允许他们退学而不承担任何贷款责任。（对传统助学贷款数据的回顾表明，学生最有可能违约的情况是，他们已经开始上课并承担了债务，却在掌握新技能之前就退出了课程。）如果学生真的违约，那么学校通常需承担超过20%的未偿贷款。这就让学校更有理由谨慎选择学生并且好好培养他们。

传统的助学贷款中，利息和本金总是悄悄地累积。等到毕业时，收到的每月还贷账单会让人震惊。Climb资助的学生从领到贷款时就开始小额还贷（如果他们很快退学，则会获得退款）。Climb希望公布其就业成功率数据，以同时帮助学生和贷款机构。它已经充分利用了自己的教育机构网络：从所覆盖的院校中聘用了三位毕业生。■



The role of employers

Cognition switch

Companies are embracing learning as a core skill

A STRANGE-LOOKING SMALL room full of vintage furniture—an armchair, a chest of drawers, a table—was being built in the middle of Infosys’s Palo Alto offices when your correspondent visited in November. Tweed jackets hung from a clothes rack; a piano was due to be delivered shortly. The structure was rough and unfinished. And that, according to Sanjay Rajagopalan, was largely the point.

Mr Rajagopalan is head of research and design at the Indian business-services firm. He is a disciple of “design thinking”, a problem-solving methodology rooted in observation of successful innovators. His goal is an ambitious one: to turn a firm that built a global offshoring business by following client specifications into one that can set the terms of its projects for itself.

Design thinking emphasises action over planning and encourages its followers to look at problems through the eyes of the people affected. Around 100,000 Infosys employees have gone through a series of workshops on it. The first such workshop sets the participants a task: for example, to improve the experience of digital photography. That involves moving from the idea of making a better camera to considering why people value photographs in the first place, as a way of capturing memories. As ideas flow, people taking part in the workshops immediately start producing prototypes with simple materials like cardboard and paper. “The tendency is to plan at length before building,” says Mr Rajagopalan. “Our approach is to build, build, build, test and then plan.”

That baffling structure in Palo Alto was another teaching tool. Mr

Rajagopalan had charged a small team with reimagining the digital retail experience. Instead of coming up with yet another e-commerce site, they were experimenting with technologies to liven up a physical space. (If a weary shopper sat in the chair, say, a pot of tea on an adjacent table would automatically brew up.) The construction of the shop prototype in Infosys's offices was being documented so that employees could see design thinking in action.

Infosys is grappling with a vital question: what do people need to be good at to succeed in their work? Whatever the job, the answer is always going to involve some technical and specific skills, based on knowledge and experience of a particular industry. But with design thinking, Infosys is focusing on “foundational skills” like creativity, problem-solving and empathy. When machines can put humans to shame in performing the routine job-specific tasks that Infosys once took offshore, it makes sense to think about the skills that computers find harder to learn.

David Deming of Harvard University has shown that the labour market is already rewarding people in occupations that require social skills. Since 1980 growth in employment and pay has been fastest in professions across the income scale that put a high premium on social skills (see chart).

Social skills are important for a wide range of jobs, not just for health-care workers, therapists and others who are close to their customers. Mr Deming thinks their main value lies in the relationship between colleagues: people who can divide up tasks quickly and effectively between them form more productive teams. If work in future will increasingly be done by contractors and freelancers, that capacity for co-operation will become even more important. Even geeks have to learn these skills. Ryan Roslansky, who oversees LinkedIn's push into online education, notes that many software engineers are taking management and communications courses on the site in order to round themselves out.

| *Building a better learner*

Another skill that increasingly matters in finding and keeping a job is the ability to keep learning. When technology is changing in unpredictable ways, and jobs are hybridising, humans need to be able to pick up new skills. At Infosys, Mr Rajagopalan emphasises “learning velocity”—the process of going from a question to a good idea in a matter of days or weeks. Eric Schmidt, now executive chairman of Alphabet, a tech holding company in which Google is the biggest component, has talked of Google’s recruitment focus on “learning animals”. Mark Zuckerberg, one of Facebook’s founders, sets himself new personal learning goals each year.

An emphasis on learning has long been a hallmark of United Technologies (UTC), a conglomerate whose businesses include Pratt & Whitney, a maker of aircraft engines, and Otis, a lift manufacturer. Since 1996 UTC has been running a programme under which its employees can take part-time degrees and have tuition fees of up to \$12,000 a year paid for them, no strings attached. Employers often balk at training staff because they might leave for rivals, taking their expensively gained skills with them. But Gail Jackson, the firm’s vice-president of human resources, takes a different view. “We want people who are intellectually curious,” she says. “It is better to train and have them leave than not to train and have them stay.”

Such attitudes are becoming more common. When Satya Nadella took over as boss of Microsoft in 2014, he drew on the work of Carol Dweck, a psychology professor at Stanford University, to push the firm’s culture in a new direction. Ms Dweck divides students into two camps: those who think that ability is innate and fixed (dampening motivation to learn) and those who believe that abilities can be improved through learning. This “growth mindset” is what the firm is trying to encourage. It has amended its performance-review criteria to include an appraisal of how employees have learned from others and then applied that knowledge. It has also set up an internal portal that integrates Lynda, the training provider bought by

LinkedIn (which Microsoft itself is now buying).

AT&T, a telecoms and media firm with around 300,000 employees, faces two big workforce problems: rapidly changing skills requirements in an era of big data and cloud computing, and constant employee churn that leaves the company having to fill 50,000 jobs a year. Recruiting from outside is difficult, expensive and liable to cause ill-feeling among existing staff. The firm's answer is an ambitious plan to reskill its own people.

Employees each have a career profile that they maintain themselves, which contains a record of their skills and training. They also have access to a database called "career intelligence", which shows them the jobs on offer within the company, what skills they require and how much demand there is for them. The firm has developed short courses called nanodegrees with Udacity, the MOOC provider, and is also working with universities on developing course curriculums. Employees work in their own time to build their skills. But AT&T applies both carrot and stick to encourage them, by way of generous help with tuition fees (totalling \$30m in 2015) for those who take courses and negative appraisal ratings for those who show no interest.

As continued learning becomes a corporate priority, two questions arise. First, is it possible for firms to screen candidates and employees on the basis of curiosity, or what psychologists call "need for cognition"? Getting through university is one very rough proxy for this sort of foundational skill, which helps explain why so many employers stipulate degrees for jobs which on the face of it do not require them.

| *Curiouser and curiouser*

More data-driven approaches are also being tried. Manpower, a human-resources consultancy, is currently running trials on an app that will score individuals on their "learnability". Knack, a startup, offers a series of apps

that are, in effect, gamified psychological tests. In Dashi Dash, for example, participants play the part of waiters and are asked to take the orders of customers on the basis of (often hard to read) expressions. As more and more customers arrive, the job of managing the workflow gets tougher. Every decision and every minute change in strategy is captured as a data point and sent to the cloud, where machine-learning algorithms analyse players' aptitudes against a reference population of 25,000 people. An ability to read expressions wins points for empathy; a decision always to serve customers in the order in which they arrive in the game, for example, might serve as an indicator of integrity. Intellectual curiosity is one of the traits that Knack tests for.

The second question is whether it is possible to train people to learn. Imaging techniques are helping unlock what goes on in the mind of someone who is curious. In a study published in 2014 in *Neuron*, a neuroscience journal, participants were first asked to rate their curiosity to learn the answers to various questions. Later they were shown answers to those questions, as well as a picture of a stranger's face; finally, they were tested on their recall of the answers and given a face-recognition test. Greater curiosity led to better retention on both tests; brain scans showed increased activity in the mesolimbic dopamine system, a reward pathway, and in the hippocampus, a region that matters for forming new memories.

It is too early to know whether traits such as curiosity can be taught. But it is becoming easier to turn individuals into more effective learners by making them more aware of their own thought processes. Hypotheses about what works in education and learning have become easier to test because of the rise of online learning. MIT has launched an initiative to conduct interdisciplinary research into the mechanics of learning and to apply the conclusions to its own teaching, both online and offline. It uses its own online platforms, including a MOOC co-founded with Harvard University called edX, to test ideas. When MOOC participants were required

to write down their plans for undertaking a course, for example, they were 29% more likely to complete the course than a control group who did not have to do so.

Information about effective learning strategies can be personalised, too. The Open University, a British distance-learning institution, already uses dashboards to monitor individual students' online behaviour and performance. Knewton, whose platform captures data on 10m current American students, recommends personalised content to them. Helping people to be more aware of their own thought processes when they learn makes it more likely they can acquire new skills later in life. ■



雇主的角色

认知开关

公司开始将学习视为一种核心技能

一个奇怪的小房间，里面摆满了复古家具——扶手椅、五斗橱、桌子——2016年11月，记者访问印孚瑟斯公司（Infosys）位于加州帕洛阿尔托的办公楼时，他们正在楼中建造这个小房间。花呢夹克挂在大衣架上，很快还会送来一台钢琴。房间的结构十分粗糙，未经装修。而按照桑杰·拉贾戈帕兰（Sanjay Rajagopalan）的说法，这一点恰是精髓所在。

拉贾戈帕兰是这家印度商业服务公司的研究与设计负责人。他是“设计思考”的信徒——这种解决问题的方法论植根于对成功创新者的观察。他的目标十分宏大：把这家亦步亦趋按客户要求建立起全球离岸外包业务的企业，转变成一家能够自己设定项目条件的公司。

“设计思考”强调行动胜于计划，并鼓励其信徒站在被影响者的角度看问题。约有10万名印孚瑟斯员工参加了相关的系列研讨会。第一场研讨会给参与者分配了一个任务，比如改进数码摄影的体验。这需要转变思路，不是去考虑如何制造更好的相机，而是追溯源头，思考人们为什么会喜欢用照片来捕捉记忆。随着灵光闪现，研讨会的参与者立即开始用硬纸板和纸等简单材料制作原型。“人们习惯在构建之前要规划很久，”拉贾戈帕兰说，“而我们的方法是构建、构建、构建、测试，然后才计划。”

帕洛阿尔托的那座让人莫名其妙的小房间是另一个教学工具。拉贾戈帕兰请一个小团队重新构思数字零售体验。他们并没有再搞出来一个电子商务网站，而是尝试利用技术让物理空间更有生趣。（比如说，如果有一位疲倦的顾客坐在椅子上，他旁边桌上的茶壶会自动开始煮茶。）印孚瑟斯办公楼中商店原型的建设都有记录，以便让员工看到“设计思考”如何付诸实践。

印孚瑟斯在与一个重要的问题斗争：人们需要擅长什么才能在工作中获得

成功？不管是什么工作，答案总是会涉及一些技术和具体技能，它们基于某个特定行业的基础知识和经验。但在设计思考中，印孚瑟斯则把目光聚焦在创造力、解决问题和同理心等“基础技能”上。既然在执行日常的、与特定工作相关的具体任务时（印孚瑟斯一度迁往离岸的那些工作），机器已经能让人类相形见绌，那么思考那些电脑较难掌握的技能便顺理成章。

哈佛大学的大卫·戴明（David Deming）已证明，在需要社交技能的职位上，劳动力市场已为从业者带来回报。自1980年以来，就业和工资增长最快的一直是那些非常需要社交技能的职业，无论是哪个收入级别（见图表）。

社交技能对于许多工作都非常重要，而不仅限于医疗工作者、治疗师和接近客户的人员。戴明认为，其主要价值在于同事之间的关系：能够在同事间快速高效分配任务的人可以组建生产力更高的团队。如果未来有越来越多的工作由承包商和自由职业者完成，这种合作的能力将变得愈发重要。即使是极客也要学习这些技能。负责领英进军在线教育的瑞安·罗斯兰斯基（Ryan Roslansky）指出，许多软件工程师在网站上学习管理和沟通课程来让自己变得更加全面。

| 打造更好的学习者

为了寻找和保住工作，另一项日益重要的技能是不断学习的能力。技术变化难以捉摸，工作也变得愈发混杂，人们需要能够获取新的技能。印孚瑟斯公司的拉贾戈帕兰强调“学习速度”——在几天或几周之内就能把问题变成一个好点子的过程。高科技控股公司Alphabet（谷歌是其最大子公司）的现任执行董事长埃里克·施密特（Eric Schmidt）曾谈到谷歌的招聘关注那些“学习动物”。Facebook的创始人之一马克·扎克伯格每年都为自己设定新的个人学习目标。

对学习的强调一直是联合技术公司（UTC）的特色。该企业集团的业务包括飞机发动机制造商普惠（Pratt&Whitney）以及电梯制造商奥的斯（Otis）。自1996年以来，UTC一直开展着一个项目，其员工可以兼职攻读学位，公司每年最多为其支付12,000美元的学费而不附带任何条件。用

人单位往往对培训员工心存顾虑，因为他们可能会带着成本不菲的技能跳槽到竞争对手那里。但该公司的人力资源副总裁盖尔·杰克逊（Gail Jackson）则持不同看法。“我们想要那些有求知欲的人，”她说，“员工在培训之后走了，总好过没有培训却留了下来。”

这种想法正变得越来越流行。萨蒂亚·纳德拉（Satya Nadella）在2014年接任微软老板后，运用斯坦福大学心理学教授卡罗尔·德维克（Carol Dweck）的研究，将公司文化引向一个新的方向。德维克把学生分成两类：一类认为能力是天生而固定的（学习动力不断衰减），另一类则相信能力可以通过学习提高。这种“成长思维模式”正是微软想要鼓励的。微软已经修正了它的绩效考核标准，开始评估员工向他人学习并应用所学知识的情况。公司还设立了一个内部门户网站，整合了领英（现在本身正在被微软收购）收购的培训供应商Lynda。

拥有约30万员工的电信和媒体公司AT&T面临着两个重大的劳动力问题：在大数据和云计算时代，技能需求迅速变化加上员工不断流失，导致公司每年要填补5万个工作岗位。外部招聘十分困难并且昂贵，还容易造成现有员工的不满。该公司的解决办法是一个让自己的人员学习新技能的宏伟计划。

每个员工都有一套自行维护的个人职业资料，其中包含了他们的技能和培训记录。他们也可访问一个名为“职业情报”的数据库，列出了公司内部提供的就业机会、所需的技能以及需求的人数。该公司与大规模在线课程（MOOC）供应商优达学城（Udacity）联手推出了名为“纳米学位”（nanodegree）的短课程，并与大学合作开发课程内容。员工可在业余时间打磨自己的技能，但AT&T也挥舞着胡萝卜加大棒来鼓励员工学习，为参与课程的员工慷慨赞助学费（2015年总计支付3,000万美元）。而漠然处之的员工则会得到负面评级。

随着持续学习成为企业的重要事项，两个问题出现了。首先，企业有没有可能根据求知欲（或心理学家所谓的“认知需求”）来筛选应聘者 and 员工？要衡量此类基础技能，“读完大学”是一个非常粗糙的衡量指标，这也有助

于解释为什么这么多的雇主都为那些表面上看来并不需要学位的职位规定了学位要求。

| 求知再求知

人们也在尝试更多基于数据的方法。人力资源顾问公司万宝盛华（Manpower）目前正在测试一个能对人们的“学习能力”打分的应用。创业公司Knack提供的一系列应用实际上是游戏化的心理测试。以“Dash Dash”为例，参与者扮演服务员，并需要根据（往往很难解读的）顾客的表情来给他们下单。随着顾客越来越多，驾驭工作流程也变得越来越难。每一个决定和每个细微的策略变化都会被捕获为数据点并发送到云端，在那里机器学习算法会比对一个25,000人的群体来分析玩家的能力。阅读表情的能力会赢得同理心点数，而始终先为游戏中先来的顾客提供服务也许可以作为诚信的指标。求知欲是Knack测试的特质之一。

第二个问题是，是否有可能培训人们如何学习。成像技术正帮助我们揭开好奇者的头脑中在想些什么。在2014年发表于神经科学期刊《神经元》（Neuron）的一份研究中，参与者首先被要求给自己想知道各种问题的答案的好奇心打分。然后他们会看到这些问题的答案以及一个陌生人的面部图片。最后会测试他们对于答案的回忆，并进行面部识别测试。更强的好奇心会让他们在这两个测试中表现出更好的记忆力，而脑扫描则显示中脑缘的多巴胺系统（奖励通路）以及海马区（与形成新记忆有关的区域）的活动增加了。

判断求知欲这样的特质是否可以教授还为时过早。但通过让人们进一步了解自己的思维过程，使其学习更为高效正变得越来越容易。随着在线学习的兴起，关于教育和学习方法的假设也越来越容易检验。麻省理工学院发起了一项动议来进行针对学习机制的跨学科研究，并将其结论用于自己的在线和离线教学。它使用自有的网络平台（包括与哈佛大学共同创立的MOOC平台edX）来检验想法。比如，在要求MOOC学员写下自己对于课程的计划后，他们的课程完成率比没有此类要求的对照组提升了29%。

关于有效学习策略的信息也可以个性化。英国远程学习机构开放大学

（Open University）已经使用仪表盘来监控每个学生的网上行为和表现。Knewton的平台记录了1000万美国在读学生的数据，并为其推荐个性化内容。帮助人们进一步了解自己学习时的思维过程，可以让他们更有机会在日后获得新技能。 ■



Upstarts and incumbents

The return of the MOOC

Alternative providers of education must solve the problems of cost and credentials

THE HYPE OVER MOOCs peaked in 2012. Salman Khan, an investment analyst who had begun teaching bite-sized lessons to his cousin in New Orleans over the internet and turned that activity into a wildly popular educational resource called the Khan Academy, was splashed on the cover of Forbes. Sebastian Thrun, the founder of another MOOC called Udacity, predicted in an interview in Wired magazine that within 50 years the number of universities would collapse to just ten worldwide. The New York Times declared it the year of the MOOC.

The sheer numbers of people flocking to some of the initial courses seemed to suggest that an entirely new model of open-access, free university education was within reach. Now MOOC sceptics are more numerous than believers. Although lots of people still sign up, drop-out rates are sky-high.

Nonetheless, the MOOCs are on to something. Education, like health care, is a complex and fragmented industry, which makes it hard to gain scale. Despite those drop-out rates, the MOOCs have shown it can be done quickly and comparatively cheaply. The Khan Academy has 14m-15m users who conduct at least one learning activity with it each month; Coursera has 22m registered learners. Those numbers are only going to grow. FutureLearn, a MOOC owned by Britain's Open University, has big plans. Oxford University announced in November that it would be producing its first MOOC on the edX platform.

In their search for a business model, some platforms are now focusing much more squarely on employment (though others, like the Khan Academy, are not for profit). Udacity has launched a series of nanodegrees

in tech-focused courses that range from the basic to the cutting-edge. It has done so, moreover, in partnership with employers. A course on Android was developed with Google; a nanodegree in self-driving cars uses instructors from Mercedes-Benz, Nvidia and others. Students pay \$199-299 a month for as long as it takes them to finish the course (typically six to nine months) and get a 50% rebate if they complete it within a year. Udacity also offers a souped-up version of its nanodegree for an extra \$100 a month, along with a money-back guarantee if graduates do not find a job within six months.

Coursera's content comes largely from universities, not specialist instructors; its range is much broader; and it is offering full degrees (one in computer science, the other an MBA) as well as shorter courses. But it, too, has shifted its emphasis to employability. Its boss, Rick Levin, a former president of Yale University, cites research showing that half of its learners took courses in order to advance their careers. Although its materials are available without charge, learners pay for assessment and accreditation at the end of the course (\$300-400 for a four-course sequence that Coursera calls a "specialisation"). It has found that when money is changing hands, completion rates rise from 10% to 60%. It is increasingly working with companies, too. Firms can now integrate Coursera into their own learning portals, track employees' participation and provide their desired menu of courses.

These are still early days. Coursera does not give out figures on its paying learners; Udacity says it has 13,000 people doing its nanodegrees. Whatever the arithmetic, the reinvented MOOCs matter because they are solving two problems they share with every provider of later-life education.

The first of these is the cost of learning, not just in money but also in time. Formal education rests on the idea of qualifications that take a set period to complete. In America the entrenched notion of "seat time", the amount of

time that students spend with school teachers or university professors, dates back to Andrew Carnegie. It was originally intended as an eligibility requirement for teachers to draw a pension from the industrialist's nascent pension scheme for college faculty. Students in their early 20s can more easily afford a lengthy time commitment because they are less likely to have other responsibilities. Although millions of people do manage part-time or distance learning in later life—one-third of all working students currently enrolled in America are 30-54 years old, according to the Georgetown University Centre on Education and the Workforce—balancing learning, working and family life can cause enormous pressures.

Moreover, the world of work increasingly demands a quick response from the education system to provide people with the desired qualifications. To take one example from Burning Glass, in 2014 just under 50,000 American job-vacancy ads asked for a CISSP cyber-security certificate. Since only 65,000 people in America hold such a certificate and it takes five years of experience to earn one, that requirement will be hard to meet. Less demanding professions also put up huge barriers to entry. If you want to become a licensed cosmetologist in New Hampshire, you will need to have racked up 1,500 hours of training.

In response, the MOOCs have tried to make their content as digestible and flexible as possible. Degrees are broken into modules; modules into courses; courses into short segments. The MOOCs test for optimal length to ensure people complete the course; six minutes is thought to be the sweet spot for online video and four weeks for a course.

Scott DeRue, the dean of the Ross School of Business at the University of Michigan, says the unbundling of educational content into smaller components reminds him of another industry: music. Songs used to be bundled into albums before being disaggregated by iTunes and streaming services such as Spotify. In Mr DeRue's analogy, the degree is the album, the

course content that is freely available on MOOCs is the free streaming radio service, and a “microcredential” like the nanodegree or the specialisation is paid-for iTunes.

How should universities respond to that kind of disruption? For his answer, Mr DeRue again draws on the lessons of the music industry. Faced with the disruption caused by the internet, it turned to live concerts, which provided a premium experience that cannot be replicated online. The on-campus degree also needs to mark itself out as a premium experience, he says.

Another answer is for universities to make their own products more accessible by doing more teaching online. This is beginning to happen. When Georgia Tech decided to offer an online version of its masters in computer science at low cost, many were shocked: it seemed to risk cannibalising its campus degree. But according to Joshua Goodman of Harvard University, who has studied the programme, the decision was proved right. The campus degree continued to recruit students in their early 20s whereas the online degree attracted people with a median age of 34 who did not want to leave their jobs. Mr Goodman reckons this one programme could boost the numbers of computer-science masters produced in America each year by 7-8%. Chip Paucek, the boss of 2U, a firm that creates online degree programmes for conventional universities, reports that additional marketing efforts to lure online students also boost on-campus enrolments.

| *Educational Lego*

Universities can become more modular, too. EdX has a micromasters in supply-chain management that can either be taken on its own or count towards a full masters at MIT. The University of Wisconsin-Extension has set up a site called the University Learning Store, which offers slivers of online content on practical subjects such as project management and

business writing. Enthusiasts talk of a world of “stackable credentials” in which qualifications can be fitted together like bits of Lego.

Just how far and fast universities will go in this direction is unclear, however. Degrees are still highly regarded, and increased emphasis on critical thinking and social skills raises their value in many ways. “The model of campuses, tenured faculty and so on does not work that well for short courses,” adds Jake Schwartz, General Assembly’s boss. “The economics of covering fixed costs forces them to go longer.”

Academic institutions also struggle to deliver really fast-moving content. Pluralsight uses a model similar to that of book publishing by employing a network of 1,000 experts to produce and refresh its library of videos on IT and creative skills. These experts get royalties based on how often their content is viewed; its highest earner pulled in \$2m last year, according to Aaron Skonnard, the firm’s boss. Such rewards provide an incentive for authors to keep updating their content. University faculty have other priorities.

Beside costs, the second problem for MOOCs to solve is credentials. Close colleagues know each other’s abilities, but modern labour markets do not work on the basis of such relationships. They need widely understood signals of experience and expertise, like a university degree or a baccalaureate, however imperfect they may be. In their own fields, vocational qualifications do the same job. The MOOCs’ answer is to offer microcredentials like nanodegrees and specialisations.

But employers still need to be confident that the skills these credentials vouchsafe are for real. LinkedIn’s “endorsements” feature, for example, was routinely used by members to hand out compliments to people they did not know for skills they did not possess, in the hope of a reciprocal recommendation. In 2016 the firm tightened things up, but getting the

balance right is hard. Credentials require just the right amount of friction: enough to be trusted, not so much as to block career transitions.

Universities have no trouble winning trust: many of them can call on centuries of experience and name recognition. Coursera relies on universities and business schools for most of its content; their names sit proudly on the certificates that the firm issues. Some employers, too, may have enough kudos to play a role in authenticating credentials. The involvement of Google in the Android nanodegree has helped persuade Flipkart, an Indian e-commerce platform, to hire Udacity graduates sight unseen.

Wherever the content comes from, students' work usually needs to be validated properly for a credential to be trusted. When student numbers are limited, the marking can be done by the teacher. But in the world of MOOCs those numbers can spiral, making it impractical for the instructors to do all the assessments. Automation can help, but does not work for complex assignments and subjects. Udacity gets its students to submit their coding projects via GitHub, a hosting site, to a network of machine-learning graduates who give feedback within hours.

Even if these problems can be overcome, however, there is something faintly regressive about the world of microcredentials. Like a university degree, it still involves a stamp of approval from a recognised provider after a proprietary process. Yet lots of learning happens in informal and experiential settings, and lots of workplace skills cannot be acquired in a course.

| *Gold stars for good behaviour*

One way of dealing with that is to divide the currency of knowledge into smaller denominations by issuing "digital badges" to recognise less formal achievements. RMIT University, Australia's largest tertiary-education

institution, is working with Credly, a credentialling platform, to issue badges for the skills that are not tested in exams but that firms nevertheless value. Belinda Tynan, RMIT's vice-president, cites a project carried out by engineering students to build an electric car, enter it into races and win sponsors as an example.

The trouble with digital badges is that they tend to proliferate. Illinois State University alone created 110 badges when it launched a programme with Credly in 2016. Add in MOOC certificates, LinkedIn Learning courses, competency-based education, General Assembly and the like, and the idea of creating new currencies of knowledge starts to look more like a recipe for hyperinflation.

David Blake, the founder of Degreed, a startup, aspires to resolve that problem by acting as the central bank of credentials. He wants to issue a standardised assessment of skill levels, irrespective of how people got there. The plan is to create a network of subject-matter experts to assess employees' skills (copy-editing, say, or credit analysis), and a standardised grading language that means the same thing to everyone, everywhere.

Pluralsight is heading in a similar direction in its field. A diagnostic tool uses a technique called item response theory to work out users' skill levels in areas such as coding, giving them a rating. The system helps determine what individuals should learn next, but also gives companies a standardised way to evaluate people's skills.

A system of standardised skills measures has its own problems, however. Using experts to grade ability raises recursive questions about the credentials of those experts. And it is hard for item response theory to assess subjective skills, such as an ability to construct an argument. Specific, measurable skills in areas such as IT are more amenable to this approach.

So amenable, indeed, that they can be tested directly. As an adolescent in Armenia, Tigran Sloyan used to compete in mathematical Olympiads. That experience helped him win a place at MIT and also inspired him to found a startup called CodeFights in San Francisco. The site offers free gamified challenges to 500,000 users as a way of helping programmers learn. When they know enough, they are funnelled towards employers, which pay the firm 15% of a successful candidate's starting salary. Sqore, a startup in Stockholm, also uses competitions to screen job applicants on behalf of its clients.

However it is done, the credentialling problem has to be solved. People are much more likely to invest in training if it confers a qualification that others will recognise. But they also need to know which skills are useful in the first place. ■



新贵与旧族

MOOC归来

非传统的教育提供者必须解决成本和认证的问题

大规模开放式在线课程（MOOC）的热潮在2012年达到巅峰。萨尔曼·可汗（Salman Khan）登上了《福布斯》杂志的封面。他是一名投资分析员，开始是在网上制作了一些短小的课程来远程辅导新奥尔良的表妹学习，之后把这种方式发展成了一项广受欢迎的教育资源：可汗学院（Khan Academy）。同年，另一个MOOC平台优达学城（Udacity）的创始人塞巴斯蒂安·特龙（Sebastian Thrun）在接受《连线》杂志（Wired）采访时预言，50年内全世界大学院校将锐减至仅剩十所。《纽约时报》称2012年为MOOC之年。

早期的一些MOOC课程吸引人们蜂拥而至。以当时的参与人数来看，一个公开获取、完全免费的全新大学教育模式似乎已触手可及。而如今，对MOOC持怀疑态度的人已经多过它的信徒。尽管仍有很多人在报名上课，辍学率却奇高。

然而，MOOC确实指向了某种重大变革。和医疗一样，教育是一个复杂又碎片化的产业，因而难以形成规模。尽管辍学率飙高，MOOC已经展示了教育可以迅速而相对廉价地完成。可汗学院拥有1400万到1500万名每月至少上一次课的用户；Coursera拥有2200万名注册用户。这些数字只会继续增加。英国开放大学（Open University）旗下的MOOC“未来学习”（Future Learn）有着宏大的计划。牛津大学去年11月宣布将在edX平台上开设该校首门MOOC课程。

在探索商业模式的过程中，一些平台如今径直对准了就业需求（虽然诸如可汗学院等其他平台并非牟利性质）。优达学城已经在一些技术类课程（程度涵盖从入门到前沿）中推出一系列“纳米学位”。它为此还与雇主合作。一门安卓操作系统课程是和谷歌共同开发；一个自动驾驶汽车的纳米学位由来自奔驰和英伟达（Nvidia）等企业的人士授课。学生们每月支付

199到299美元直至一门课结束（通常持续六至九个月），而如果他们能在一年内修完这门课，便可获得50%的退款。优达学城还为其纳米学位提供了“加强版”：学生每月多支付100美元，如果拿到学位后六个月内找不到工作可获退款。

Coursera的教学内容主要来自大学而非专家，其涉猎要广泛得多。而且除了短课程外，它也提供完整的学位（计算机科学和MBA）。但它同样把重点转向了辅助就业。Coursera的老板里克·莱文（Rick Levin）曾任耶鲁大学校长，他援引调查称，该平台的一半学生是为谋求职业发展而来。虽然学生们可以免费上课，但如果要在课程结束时参加评估以及获得认证就需要付费。比如，要获得一个由四门系列课程组成的“微专业”证书（specialisation），就要支付三四百美元。Coursera发现，当学生需要付费时，其完成率从10%上升到了60%。该平台与企业的合作也日益频繁。如今企业可以将该平台整合进自己的学习网站，追踪员工的参与度，为他们提供想要的课程组合。

这一切还只是刚开始。Coursera未对外透露其付费用户的数量。优达学城称有1.3万人正在攻读它的纳米学位。而不论人数多少，这类经过改良的MOOC课程很重要，因为它们正在解决所有再教育提供者面对的两大问题。

第一个问题是学习成本，不止金钱，还有时间。正规教育是基于这样的理念：需要一段固定的时间才能达成某种资质。在美国，“学堂时间”（即学生和学校老师或大学教师在一起的时间）这一深入人心的概念可以追溯到安德鲁·卡内基（Andrew Carnegie）。在一开始它其实是一个针对教师的要求：教师如果要从卡内基为大学教职人员所创设的退休金计划中领到退休金，需要达到一定的“学堂时间”。二十岁出头的学生更容易付出一段较长的时间，因为他们没什么其他的负担。虽然千百万人都在日后想方设法边工作边读书或远程学习（乔治城大学教育和劳动力中心的统计显示，美国目前在职学生中有三分之一年龄年在30岁到54岁之间），但要平衡学习、工作和家庭生活可能会带来巨大的压力。

此外，职场日益要求教育系统能迅速反应，为人们提供雇主所需的资质。举一个就业市场分析公司Burning Glass提供的例子：2014年，美国将近五万个招聘广告都要求应聘者持有CISSP网络安全证书，而该国只有6.5万人持有这种证书，并且要拿得该证书需要五年的相关经历，因此这种招聘要求将难以被满足。即便要求不那么高的专业职位也设置了巨大的准入门槛。如果你想在新罕布什尔州成为一名持证美容师，需要完成累计1500小时的培训。

MOOC的对策是把自己的内容变得尽可能易于吸收和更为灵活。学位被拆解成模块，模块被拆解成课程，课程又被拆解成短小的章节。MOOC测试出了确保人们念完课程的最合理时长：网络视频的最佳长度是六分钟，一门课的最佳长度是四周。

密西根大学罗斯商学院的院长斯科特·德吕（Scott DeRue）说，将教学内容拆解成更小的部件让他想到了另一个产业：音乐。过去，歌曲被打包成专辑发行，后来又被iTunes和Spotify等流媒体服务拆分。在德吕的类比中，学位等同专辑，MOOC平台上可免费获得的内容等同免费的流媒体广播服务，而纳米学位或微专业这种“微型证书”就是付费iTunes。

大学该如何回应这种颠覆？德吕的回答再一次借用了来自音乐产业的教训。面对互联网引发的颠覆，音乐产业转向了现场音乐会，这种形式所提供的优质体验无法在网上复制。他说，校内学位同样也需要把自己打造成一种优质体验。

另一个办法是大学通过更多网上教学让自己的产品变得更易获取。这正在发生。当佐治亚理工学院（Georgia Tech）决定给它的计算机科学硕士学位打造一个低成本的在线版本时，许多人都很吃惊，因为这看上去有可能侵蚀它自己的传统学位。但据报读了该课程的哈佛大学的乔舒亚·古德曼（Joshua Goodman）说，这一决定已被证明是明智的。校内学位继续招收二十岁出头的学生，而在线学位吸引到的人中位年龄在34岁，他们不愿意辞职来学习。古德曼认为，单单这一个在线专业就将把美国每年产出的计算机硕士人数增加7%到8%。2U公司为传统大学创造在线学位课程，其

老板奇普·鲍赛克（Chip Paucek）称，为吸引在线学生而展开的额外营销也提高了在校就读的人数。

| 教育乐高

大学也可能变得更加模块化。EdX平台提供的一个供应链管理微硕士学位既可以独立攻读，也可以作为获取麻省理工学院完整学位的一个步骤。威斯康星大学扩展教育部已经开设了一个名叫“大学学习商店”的网站，上面提供项目管理和商业写作等实用课题的在线碎片化内容。热衷MOOC的人谈论着一个“可堆叠认证”的世界：各种资质证书可以像乐高积木那样拼搭在一起。

然而，大学会在这条路上走多远、走多快尚不明朗。人们仍然非常看重学位，而社会比以往更加重视批判性思考和社交技能这一点也从许多方面提升了学位的价值。“校园、终身教职等模式并不那么适合短课，”General Assembly的老板杰克·施瓦茨（Jake Schwartz）补充道，“出于补偿固定成本这种经济考量，他们不得不把课程弄长。”

学术机构也很难提供真正快速变化的内容。Pluralsight使用一个类似图书出版的模式，雇用了一千名专家来为其IT和创造性技能视频库制作并更新内容。这些专家会基于自己的内容被观看的次数获得版权费。据该公司老板亚伦·斯科纳德（Aaron Skonnard）称，其中赚的最多的专家去年收入200万美元。这种奖赏给予了作者们不断更新内容的动力。但大学老师还有其他工作要优先处理。

除了成本，MOOC要解决的第二个问题是认证。一起工作的同事了解彼此的能力，但现代劳工市场的运转并不基于这样的关系。它们需要被普遍理解的经验和专长指标——比如大学学位，无论它可能多么不完美。而在职场内部，职业资格也起到同样的作用。MOOC为此提供了纳米学位和微专业这样的微型证书。

但雇主仍需要确信这类证书承诺的技能是真实的。比如，用户常常用领英的“技能认可”（endorsements）来随便认可自己并不认识的人拥有他们本

没有的技能，以期对方回报而推荐自己。2016年该公司把这一功能变得更为严格，但是要达到恰当的平衡并非易事。认证需要恰到好处的阻力：要有足够的阻力来值得信任，但又不能太大以至于阻碍了转行。

大学在赢得信任方面毫无困难：许多大学都可以依赖几百年的历史和声名。Coursera依赖大学和商学院获得大部分内容，这些机构的名称就骄傲地写在Coursera颁发的证书上。有些雇主可能也有足够的声望来“担保”认证的真伪。谷歌参与颁发了安卓纳米学位，这说服了印度电商平台Flipkart未见真人就直接雇用了优达学城的毕业生。

无论内容来自哪里，学生的学习成果通常需要被适当地验证，才能让证书成为可信之物。当学生人数有限时，批作业这件事可以由教师完成。但在MOOC的世界里，这个数字可能急剧上升，从而使得教师们不可能完成所有评定。自动化可以提供帮助，不过在复杂的作业和课程中它又败下阵来。优达学城让学生们通过托管网站GitHub把编程作业提交给一个机器学习专业的毕业生网络来批改，几个小时内就能拿到反馈。

不过，即便这些问题能被克服，在微型证书的世界里仍隐约有一些倒退的部分。和大学学位一样，它仍然是在一个专营的过程之后由被认可的供应商给出一个认可标识。但大量学习是在非正式的和体验式的环境中发生，且许多职场技能并不能在一门课程中习得。

| 奖赏小红花

这个问题的一个解决办法是把知识的货币兑换成较小的面额：颁发“数字奖章”来认可不那么正式的成就。澳大利亚最大的高等教育院校皇家墨尔本理工大学正和数字证书平台Credly合作颁发奖章，针对的是在考试中不会出现而企业却看重的技能。皇家墨尔本理工大学副校长贝琳达·泰南（Belinda Tynan）举了这样一个例子：一批工程学学生开展的一个项目建造了一辆电动车，参加比赛并获得了赞助。

数字奖章的问题在于它们会大量繁殖。仅伊利诺伊州立大学一所大学就在2016年启动和Credly的合作项目时创造了110种奖章。加上MOOC证书、领

英的学习课程、能力本位教育、General Assembly等等，创造知识新货币的创意似乎更像在酝酿恶性通胀。

创业公司Degreed的创始人戴维·布莱克（David Blake）希望通过充当证书央行来解决这一问题。他想要发放标准化的技能评估，无论人们通过何种渠道达到某一技能层级。他计划打造一个课题专家网络来评估员工的技能（比如文字编辑或者信贷分析），并使用统一的、对任何地方的任何人都意义一致的评级语言。

Pluralsight正在自己的领域里谋求同样的目标。一套诊断工具运用名为“项目反应理论”（IRT）的方法来分析出用户在编程等领域里的技能级别，并给予评估。这套系统帮助个体确定下一步该学什么，同时也为企业提供了一个评估员工技能的标准方式。

不过，这类标准化的技能测量系统也有其自身的局限。依靠专家来评估能力引发了一个循环问题：专家自身的能力如何认证？而且，IRT理论难以评估主观性技能，如构造一段论证的能力。IT等领域里的专门化、可测量的技能更适合使用这种方法。

实际上确实是非常地适合，这类技能甚至可被直接测试。亚美尼亚少年季格兰·斯洛扬（Tigran Sloyan）曾参加奥林匹克数学竞赛，这帮助他考入了麻省理工学院，并给予他灵感在旧金山创办了名为编码战

（CodeFights）的创业公司。该网站给50万名用户提供设计成游戏的挑战来帮助程序员学习编程。当他们学到足够多的技能后，就会被推荐给雇主，雇主以被录用员工起薪的15%偿付该公司。斯德哥尔摩的创业公司Sqore同样用竞赛来代表其客户筛选应聘者。

无论使用何种方式，认证的问题都需要解决。一旦一种培训提供了其他人都认可的资格认证，人们投资的意愿会高得多。不过他们首先还得知晓哪些技能是有用的。■



Schumpeter

Silicon Valiant

Technology firms' stand on immigration will draw attention to their hypocrisies

EARLY in 2016 Schumpeter went to a dinner with one of Silicon Valley's luminaries, a man of towering intelligence and negligible humility. Asked about the upcoming election, he scoffed: it didn't matter who America's president was. Politics had become irrelevant, he said. Technology firms, and their leaders, would carry on fashioning brilliant products and generally carrying out God's work on Earth, regardless of who occupied the White House. Cue smirks and more Hawaiian Kampachi all round.

Now Silicon Valley has thrust itself into a presidential stink. Technology groups were the first among big firms to slam Donald Trump's executive order of January 27th, which temporarily bans people from seven mainly-Muslim countries in the Middle East from entering America. Tim Cook, Apple's boss, criticised it to employees. Mark Zuckerberg at Facebook said he was "concerned". Sundar Pichai, CEO of Google, told staff he was "upset" on the day of the order, and a day later the firm's co-founder, Sergey Brin, was spotted among hundreds of protesters at San Francisco airport.

Just a month earlier all these technology firms and more had paid tribute at Trump Tower, their leaders laughing for the cameras while Mr Trump promised: "I'm here to help you folks." The honeymoon has now abruptly ended because immigrants are so important to the technology industry. But the sector's liberal tendencies—it has few of the instinctive Republicans who populate most boardrooms—also play a part.

Attracting hyper-brainy people from around the world is at the heart of the tech business model. Mr Brin was born in Moscow, Mr Pichai in Tamil Nadu and Satya Nadella, the head of Microsoft, in Hyderabad. The biological

father of the late Steve Jobs was a Syrian who moved to America, a journey that as of now would be impossible. Half of all the American startups that are worth more than \$1bn were founded by migrants. Many of the engineers at tech firms were born abroad, too. In Cupertino, a posh suburb in Silicon Valley, half the population is foreign-born.

The industry has long supported immigration, therefore. But taking a vocal stand on political subjects has not been its habit, and by entering the fray it will draw attention to its own hypocrisies. For decades tech bosses have pushed a convenient doublespeak to explain their firms' rise. Their dazzling products are the creations of their leaders. The resulting fortunes are these visionaries' just reward. But the economic and social consequences of the industry's output, not all of them good, are no one's responsibility. Instead, the industry argues, they are the result of unavoidable shifts in technology, in turn responding to society's broad demands. This logic has allowed tech firms to avoid responsibility for the stolen or bilious content that they publish and for the jobs that their algorithms help eliminate—to say nothing of their own oligopolistic market shares. Silicon Valley boasts of its own might and shrugs at its own impotence both at once.

The election campaign underlined that this trick is by now exhausted. It is obvious to all that technology firms are political beasts. Politicians rely on Twitter and Facebook messages, social-media advertising and data mining. Tech platforms are used to disseminate fake news. And tech firms are prominent actors in the economic debate that drives populism. The job losses in manufacturing that infuriate Americans have resulted far more from decades of technological advance than from globalisation. The piles of uninvested cash stashed unpatriotically abroad, which Mr Trump now wants to bring home, belong chiefly to technology firms. The low share of American profits that is reinvested partly reflects the heft of Silicon Valley. For every dollar of cash the tech industry makes, it reinvests 24 cents; that

compares with 50 cents for other non-financial firms. Growing inequality is partly the result of its concentrated ownership, with a small group of individuals taking a big share of a giant stream of profits.

In the weeks since November 8th, the technology industry has started to come clean. Google and Facebook have announced measures to try to tackle fake news. In January Mr Zuckerberg said he would travel to 30 American states this year to meet ordinary Americans and hear how globalisation and technology have affected them. Mr Nadella is talking publicly about the effects of artificial intelligence on employment. Others have chosen to make their mark by helping the new government. Elon Musk, the head of Tesla, an electric-car firm, and Travis Kalanick, of Uber, have both become advisers to the president (early this month they promised to confront him about his stance on immigration).

| *Swipe for the next ethical dilemma*

Coming out of the closet as among the most important actors in American society boosts technology bosses. So does standing up for their beliefs in things like immigration. It is more intellectually honest. It goes down well with employees. And it is probably popular with customers, too. Most consumer-facing technology firms have user bases that are skewed towards the young and non-Americans, both groups that dislike Mr Trump. After taxis went on strike at JFK airport in New York in protest against the travel ban, Uber came under fire for not boycotting the airport, too, and the hashtag “#DeleteUber” went viral.

Yet tech firms still have an awfully long way to go. Often they define virtue as what they judge to be in their business interests. Last year, Mr Cook dismissed a demand by the European Union to pay more tax as “political crap”. In December Apple agreed to a state request to ban the *New York Times's* app in China, where the firm makes just over a fifth of its sales. Mr Zuckerberg fits the same pattern: he says he wants to give away 99% of his

fortune and that he believes in the ideal of free expression, but his firm paid a tax rate of just 6% over the past half-decade, and he has toadied up to China's censors, too. Oligopolistic, hubristic and ruthless to its core, Silicon Valley is no beacon of moral leadership. ■



熊彼特

硅谷勇士

科技公司在移民问题上的立场会让人们注意到它们的虚伪

2016年初，熊彼特专栏记者与一位硅谷牛人共进晚餐。此君智力超群，且毫不谦卑。当被问及即将举行的大选时，他嗤笑道：美国总统是谁都无所谓，政治已经变得无关紧要。不管是谁入主白宫，科技公司及其领袖都会继续创造出炫目的产品，在地球上广泛执行上帝的工作。此处是一阵自鸣得意的笑声，又一轮夏威夷红甘鱼为宾客们适时奉上。

眼下硅谷已经一头扎进了由总统引发的“恶臭”中。特朗普于1月27日颁布行政命令，暂时禁止中东七个以穆斯林人口为主的国家的公民进入美国，科技公司在各大企业中率先抨击了这一禁令。苹果老板蒂姆·库克在员工面前批评了这一决定；Facebook的马克·扎克伯格对此表示“担忧”；谷歌CEO桑达尔·皮查伊（Sundar Pichai）对工作人员说，他在禁令下达当天“很沮丧”；一天后，谷歌联合创始人谢尔盖·布林（Sergey Brin）的身影出现在旧金山机场的数百名抗议者中。

就在一个月前，所有上述科技公司和其他一些企业的人还齐聚特朗普大厦，向当选总统致敬。各家公司的领导人对着镜头欢笑，而特朗普则许诺：“我是来帮你们的。”而现在，由于移民对科技业至关重要，双方的蜜月期戛然而止。但科技行业的自由主义倾向也是双方失和的一个原因——不像大多数其他公司，该行业的董事会中很少有骨子里是共和党的人。

将超级聪明的人从世界各地吸引过来是科技行业商业模式的核心要务。布林出生在莫斯科，皮查伊出生在印度的泰米尔纳德邦（Tamil Nadu），微软老板萨提亚·纳德拉（Satya Nadella）出生在印度的海得拉巴（Hyderabad）。已故的乔布斯的生父是移民到美国的叙利亚人，换在当下，这样的旅程就不可能实现了。美国价值超过10亿美元的创业企业有半数都是由移民所创办，许多科技公司的工程师也都出生在国外。在硅谷的上流郊区库比蒂诺（Cupertino），一半的人口都出生在海外。

因此，科技行业长期支持移民。但是，该行业不常在政治问题上明确表达立场，而此次加入移民政策争论，将会让人们注意到它自身的虚伪。几十年来，科技公司的老板们一直在推行一套方便自身的欺人言论，来解释其公司的崛起——那些耀眼的产品是由公司领导人的创造，随之而来的财富是这些梦想家应得的回报。然而却没有人对科技行业的产出带来的经济和社会后果（并非全然是好处）负责。相反，该行业辩称这些后果是由不可避免的技术转变所导致，相应地，它们也是在响应社会的广泛需求。这一逻辑让科技公司免于对它们所发布的剽窃而来的或恶劣的内容担责，也不用去解决它们的算法令工作岗位减少的问题，更不要说它们寡头垄断的市场份额了。硅谷一边吹嘘自己的伟大，一边又对自己的无能不以为然。

总统选举凸显出这个伎俩大限已到。人人都看得出，科技公司就是政治野兽。政治家依赖推特和Facebook上发布的消息、社交媒体广告以及数据挖掘；技术平台被用于散布假新闻；在推动了民粹主义的经济辩论中，科技公司是主要参与者。让美国人愤怒的制造业岗位流失主要是由几十年的技术进步所致，其影响远甚于全球化。如今特朗普想让缺乏爱国精神的那些公司将留存国外的资金回流到国内，而这些资金主要归属于科技公司。美国企业利润的再投资比例之低也在一定程度上体现了硅谷的分量。科技行业每赚取一美元仅再投资24美分，而其他非金融企业再投资额为50美分。不平等日益严重，原因之一便是所有权集中，一小部分个人掌握了巨额利润的很大部分。

去年11月8日以后的几个星期里，科技行业开始“坦白”。谷歌和Facebook已经宣布了对抗假消息问题的举措；今年1月，扎克伯格说他今年将访问30个州，见见普通的美国人，倾听他们诉说全球化和科技对他们的影响。纳德拉也正在公开谈论人工智能对就业的影响。其他人选择通过帮助新政府来做出自己的贡献。电动汽车公司特斯拉的老板伊隆·马斯克（Elon Musk）和优步的特拉维斯·卡兰尼克（Travis Kalanick）都已成为总统的顾问（本月初他们承诺将就总统移民政策的立场与他面谈）。

| 滑向下一个道德困境

技术公司老板们身居美国社会最重要的参与者之列，出柜会提升他们的形

象，在移民等问题上捍卫自己的信念也有同样的效果。这样做更坦诚磊落，也为员工所接受，可能还会受到客户的拥护。大多数面向消费者的科技公司的用户群体都偏重年轻人和非美国裔，这两类人群都不喜欢特朗普。在出租车司机在纽约肯尼迪国际机场罢工抗议禁穆令后，优步因未参加抵制机场的活动而遭到抨击，“删除优步”迅速成为网上讨论的热门话题。

然而，科技公司还有很长的路要走。通常它们对美德的定义是看它是否符合自己的商业利益。去年，库克称欧盟要求苹果补缴税款的裁定纯属“政治扯淡”。而在销售额占其总额超五分之一的中国，苹果于去年12月应中国政府的要求，下架了《纽约时报》应用。扎克伯格的言行也如出一辙：他说他想捐出自己99%的财富，还说他信奉言论自由这一理念，但在过去五年里他公司的税率只有6%，而且他也对中国的审查机构卑躬屈膝。骨子里追求寡头垄断且自大傲慢、冷酷无情的硅谷绝不是道德领导的楷模。





Snapchat's future

Snap to it

The messaging app has quickly become a cultural sensation. Building it into a lasting business will take longer

WHEN Snapchat first became popular in 2013, many thought the messaging app would disappear almost as quickly as its vanishing messages. Instead, it has become one of the most intriguing internet firms to emerge in years. When Snap, Snapchat's parent company, goes public at an expected valuation of \$20bn-25bn—the IPO is expected in March—its market debut will be the most closely watched since Alibaba, a Chinese e-commerce giant, floated in 2014. Snap's offering documents were filed publicly early this month.

Snapchat has captivated youngsters in the West with its quickly disappearing content and playful features. It appears to have connected with youth more successfully than older rivals such as Facebook (or its messaging service, WhatsApp). Users share digitally enhanced photos and videos of themselves vomiting rainbows and morphing their faces into animal masks. Around 41% of Americans aged 18 to 34 use the ephemeral messaging service every month, and 150m people globally spend time on it every day.

Older grown-ups should pay attention too. Snapchat is experimenting with new technologies, such as augmented reality (AR) and wearable devices. A large share of people who have used AR will have experienced it on Snapchat, where users can overlay computer-generated images on photos and videos.

The firm's IPO prospectus is expected to describe not an internet or communications company but a "camera company". Snapchat has

prospered from access to the camera on every smartphone, and now it wants to sell hardware as well. Its new sunglasses, called Spectacles, sell for \$130 and enable users to record video from their exact line of sight. They have caught the attention of analysts, who are impressed by the glasses' ambition, functionality and clean design.

How well it fares as a public company will also serve as a litmus test of whether it is possible to prosper in the shadow of digital behemoths like Facebook and Google. Snapchat has a different outlook. Facebook creates permanent records of users' lives; Snapchat offers liberating impermanence. On most social-media sites, people post about their achievements to a huge circle of acquaintances; Snapchat's users share images of themselves looking silly with smaller groups of friends.

| *Rainbows, streaks, and unicorn faces*

Snapchat started in 2011 as Picaboo. It was created by three members of a fraternity at Stanford University: Reggie Brown, Bobby Murphy and Evan Spiegel (now Snap's chief executive). The app, which they later renamed, was not an overnight sensation that crashed the internet, as Thefacebook did at Harvard. It lay virtually undiscovered for some time, until high-school girls discovered it and started using the app to send (sometimes risqué) messages.

Mr Spiegel (snapped) has proven himself to be creative in devising new features for Snapchat's app and in imagining how it might evolve. At first it was a one-to-one messaging function for people to send disappearing "snaps" to one another. Three years ago Mr Spiegel launched a one-to-many broadcast function, called "stories", where people can string together images and videos and share them with all their friends at once. In 2015 it launched "Discover", where professional publishers offer a selection of disappearing articles and videos tailored to millennials (*The Economist* publishes on Discover). These features offer elements of scarcity and

urgency that bring people back repeatedly.

Snapchat has innovated in other ways, too. It shows users how many snaps they have sent and received since joining, and they try to keep this score high. It invented “streaks” that keep track of how many consecutive days friends have sent messages back and forth. When Braden Allen, a 16-year-old in Dallas whose tally of sent and received snaps stands at around 170,000, needed a break from Snapchat to study, he gave his login information to a friend to keep sending on his behalf.

Lenses are another distinctive feature. When people take selfies, they can choose to alter their appearance, becoming an animal, switching faces with a friend or doing other fantastical things with the app’s facial-recognition technology. Snapchat has quietly become the most-used augmented reality product in the world, says Ben Thompson of Stratechery, a research firm.

Although Snap encourages users to be silly on its app, it hopes to be taken seriously as a business. It will need to decide what approach it should take when using information about users to target ads. Mr Spiegel has called the practice “creepy” in the past. Yet Snap may need to share more data about its users; Mr Spiegel has indicated that he may be willing to do this.

The company has started to allow advertising in between users’ stories and in the midst of publishers’ articles on Discover. Brands can also buy sponsored lenses. For example, Taco Bell, a fast-food chain, paid for a lens that allowed users to change their faces into tacos. These promotions can be expensive, at around \$550,000-800,000 for a lens that is available across America for a day, and can take some months to prepare. Snap insists on keeping some creative control, and can veto projects it thinks look too much like basic advertising. That has irked some brands in the past.

Snapchat is nowhere near earning the sort of ad revenues that Google and

Facebook bring in. Those two scoop 58% of digital advertising in America and last year claimed nearly all of the market's growth. One of the world's largest advertising agencies spent \$60m on Snapchat in 2016, compared with \$1bn on Facebook. The same agency expects to spend \$170m on Snapchat this year. Snap could have around \$1bn of revenue in 2017, three times its total sales in 2016. Advertisers certainly welcome the prospect of having an alternative to the Facebook-Google duopoly, says Chris Vollmer of PwC, a consultancy.

Yet there are questions over how large Snapchat's user base can become, and whether it can support the high stockmarket valuation that is talked of. The app has yet to establish that it has strong appeal for older users, for example. In emerging markets it costs more to use lots of data on smartphones, and Snapchat's data-intensive app is less widely used. Brian Wieser, an internet analyst, reckons that Snapchat is an "important niche player" but that it will never achieve the scale of Facebook. It doesn't have to target more than a billion daily users to be a valuable company, but Mr Spiegel will need to be careful not oversell the app's potential reach, as Twitter did when it went public in 2013 promising to attract "the largest audience in the world".

He has so far focused on Western markets, whose users are most valuable to advertisers, in contrast to Facebook and Twitter, which emphasise their global reach. He is expected to point to high user engagement with Snapchat, rather than relentless user growth, as the gauge investors should watch. This will require a shift in thinking for stockmarket investors, who have been trained by Facebook, Twitter, LinkedIn and several other internet firms to demand fast-growing audiences.

Snap's profit margins in its various business lines may also disappoint: they are unlikely to be as generous as those of Google and Facebook, which both fulfil a lot of their ad orders using automated programmes. Because its

ads tend more often to be individually designed, it relies on a large, human salesforce. Selling also takes more time, as it does in television.

Mr Spiegel will also need to prove his ability to lead. Many of his boosters compare him to the late Steve Jobs for his creative, perfectionist vision of products. He may resemble Mr Jobs in more negative ways, too. He is secretive and controls information tightly. No one but Mr Spiegel—not even the board and other top executives—knows all the important details of the firm’s strategy and future plans. He is off-limits to most employees and travels between Snap’s buildings in a black Range Rover with a security detail.

Some early backers also privately express concern that the talent pool behind him is not as experienced as they would like. Adult supervision will come from Michael Lynton, a seasoned entertainment executive, who is resigning from running the film studio of Japan’s Sony to serve as Snap’s chairman. But there are few like him at the company.

The competition against Facebook and Google (which owns YouTube, an online-video site, against which Snapchat will directly compete for ad dollars) is unlikely to let up. Facebook tried to buy Snapchat for \$3bn in 2013, and has since then copied many of its popular features. Last summer Instagram, which is owned by Facebook, launched its own “stories” feature; its parent company is now testing the idea of rolling out this feature on its own social network. Usage of Snapchat stories has declined significantly since Instagram stories began. That could shake the faith of some Snapolytes, who believed that Snapchat had sufficient allure to keep its young users away from Facebook’s properties and those of other internet firms.

The public offering stands as evidence that Snap wants to stay independent. But Facebook or Google could still buy it. “That is why I

would not short the stock,” says one hedge-funder, who is sceptical about the high valuation it is likely to receive. Mr Spiegel must know that his firm, as one of the only real threats to the two giants, would be a prize for either of them.

If Snap wants to survive as an independent firm, he may need to make some smart acquisitions of his own, as Facebook did by buying Instagram and WhatsApp. One opportunity may be visual search. Snapchat’s users are using their cameras to capture the world around them. When they point their smartphones at objects, they could be served with advertising. Only Mr Spiegel knows the plan. But in the highly concentrated internet ecosystem, companies increasingly must eat or risk being eaten. The coming years will show whether Snap is predator or prey. ■



Snapchat的未来

时不我待

这款即时通讯应用已经迅速成为一场文化上的轰动。但要建成一家长青的公司还需要更长时间

2013年Snapchat刚开始流行时，许多人认为这款应用会像它传递的消息那样转瞬即逝。结果它却成为了多年来最引人注目的新兴互联网公司之一。Snapchat的母公司Snap预计于3月上市，估值200亿至250亿美元，这将是继中国电商巨头阿里巴巴于2014年上市之后最受关注的一场亮相。Snap的募股文件已于本月初公开发布。

Snapchat以其迅速消失的内容和有趣的功能迷住了西方的年轻人。比起Facebook（或其即时通讯服务WhatsApp）等历史更悠久的竞争对手，它似乎更讨年轻人的欢心。用户分享经过数字增强的自拍照和视频，口吐彩虹，把脸变形成动物面具。18至34岁的美国人中大约有41%每月使用这款“阅后即焚”的即时通讯服务，全球则有1.5亿人每天都使用该软件。

年长的成年人也应该注意它。Snapchat正在尝试增强现实（AR）和可穿戴设备等新技术。有很大一部分用过AR的人都在Snapchat上体验过，用户可以将计算机生成的图像叠加在照片和视频上。

人们预计该公司的招股说明书描述的并不是一个互联网或通信公司，而是一家“相机公司”。Snapchat因每台智能手机都有相机而兴起，现在它还想要卖硬件。它名为“Spectacles”（眼镜）的新款太阳镜售价130美元，用户可将视线所及录制为视频。这也吸引了分析师的目光——这款眼镜的雄心、功能和简洁设计令他们印象深刻。

Snap作为上市公司的表现也将成为一块试金石，检验其能否在Facebook和谷歌等数字巨头的阴影下蓬勃发展。Snapchat的目标与二者不同。Facebook永久性地记录用户的生活，Snapchat的不持久则令人解脱。在大多数社交媒体网站上，人们在庞大的熟人圈子里张贴自己的成就；

Snapchat用户则与一小撮朋友分享自己的傻照。

| 彩虹、连胜和独角兽相

Snapchat在2011年成立时叫做Picaboo。它是由斯坦福大学一个兄弟会的三名成员——雷吉·布朗（Reggie Brown）、博比·墨菲（Bobby Murphy）和埃文·施皮格尔（Evan Spiegel，Snap现任首席执行官）创建的。他们后来改名为Snapchat的这个应用并未像Thefacebook当初在哈佛时那样在互联网上一夜爆红。它有段时间几乎不为人知，直到高中女生们发现了它，并开始用它来发送（有时有伤风化）的消息。

施皮格尔（如图）已经证明了自己正在为Snapchat设计新功能并设想其演变方向方面非常有创造性。起初消息功能是一对一的，人们可以相互发送会消失的“快照”。三年前，施皮格尔推出了称为“故事”的一对多广播功能，人们可以将图像和视频串起来并同时与所有的朋友们分享。2015年又推出“发现”，让专业出版商针对千禧一代提供一组会消失的文章和视频（《经济学人》也在“发现”上发行）。这些功能带来了稀缺和紧迫的感觉，吸引人们反复前来。

Snapchat在其他方面也有创新。它显示用户自加入以来发送和收到了多少快照，而人们则努力保持高分。它发明了“连胜”来跟踪朋友们连续多少天往复发送消息。达拉斯的16岁少年布雷顿·艾伦（Braden Allen）发送和接受的快照已达17万张，当他需要放下Snapchat来学习时，他把自己的登录信息交给朋友以代他不断发送消息。

另一大特色功能是滤镜。人们自拍时可以选择改变自己的外表，变成动物，与朋友换脸，或利用应用的面部识别技术做其他荒诞的事情。

Snapchat已悄然成为世界上最常用的增强现实产品，研究公司Stratechery的本·汤普森（Ben Thompson）说道。

虽然Snap鼓励用户在应用上装疯卖傻，作为企业它却希望得到认真对待。它需要决定采用什么方法来利用用户信息以定向投放广告。施皮格尔过去说这种做法很“恐怖”，但Snap仍然可能需要分享更多有关用户的数据。施

皮格尔曾提及他也许会愿意这样做。

该公司已开始允许在用户的“故事”以及出版商的“发现”文章中间做广告。品牌也可以购买赞助滤镜。例如，快餐连锁塔可钟（Taco Bell）购买了一款滤镜，让用户可以把自己的脸变成玉米卷饼。这些促销活动可能会很贵，覆盖全美一日的滤镜价格在55万到80万美元，而且可能需要好几个月来准备。Snap坚持保留一些创意控制，并且可以否决它认为看起来太像简单广告的项目。这在过去曾惹恼了一些品牌。

Snapchat的广告收入还完全不能与谷歌和Facebook相提并论。两大巨头攫取了美国数字广告58%的市场，去年则几乎包揽了该市场的全部增长。2016年，世界上最大的广告机构之一在Snapchat上花费6000万美元，在Facebook的投入则达10亿美元。同一机构预计今年在Snapchat上的花费将达到1.7亿美元。Snap在2017年的收入可能达到10亿美元，为2016年总销售额的三倍。咨询公司普华永道（PwC）的克里斯·福尔默（Chris Vollmer）称，广告商当然欢迎在Facebook和谷歌的双寡头之外还有其他选择。

然而，人们对Snapchat的用户群能增长到多大，以及它是否能支撑预测的高估值还有疑问。比如这一应用目前尚未能很好地吸引年长用户。在新兴市场中，在智能手机上大量使用数据花费较高，使得Snapchat的数据密集型应用受众不广。互联网分析师布莱恩·维塞尔（Brian Wieser）估计，Snapchat是一个“重要的利基厂商”，但它永远无法实现Facebook的规模。要成为有价值的公司无需瞄准每日十亿以上的用户，但施皮格尔要当心，不要夸大应用的潜在影响力，像推特于2013年上市时那样承诺吸引“世界上最大的受众”。

他迄今都专注西方市场，这里的用户对广告商价值最高。相形之下，Facebook和推特都强调其全球影响力。预计他将把Snapchat的高用户参与度，而不是用户的不断增长作为投资者应该关注的指标。这将需要股市投资者转变思路——他们已经被Facebook、推特、领英以及其他一些互联网公司训练得惯于要求受众快速增长了。

Snap各项业务线的利润率也可能令人失望：它们不太可能像用很多自动化程序来完成广告订单的谷歌和Facebook的利润率那样可观。它的广告往往更多地进行个性化设计，这就要依赖一支庞大的人力销售队伍。销售也需要更多的时间，就像电视广告一样。

施皮格尔还需要证明自己的领导能力。他的许多支持者都将其对于产品的创造性和完美主义构想与已故的史蒂夫·乔布斯相比。然而他可能有更多的负面特征像乔布斯。他遮遮掩掩，严格控制信息。除了他自己之外，没有人了解公司战略和未来计划的所有重要细节，哪怕董事会和其他高管也不例外。他对于大多数员工来说都遥不可及，乘坐一辆加强安保的黑色路虎揽胜在Snap的大楼间穿梭。

一些早期的支持者也私下表示担心，认为他身后的人才储备经验不足。经验丰富的娱乐高管迈克尔·林顿（Michael Lynton）将是负责监护的家长，他辞去了管理日本索尼公司电影工作室的职务，转任Snap的董事长。但公司中像他这样的人没有几个。

与Facebook和谷歌（谷歌拥有在线视频网站YouTube，将与Snapchat直接竞争广告收入）的竞争不太可能松懈。Facebook在2013年尝试以30亿美元买下Snapchat，之后复制了它许多受欢迎的功能。去年夏天，Facebook旗下的Instagram推出了自己的“故事”，而Facebook正在测试在自己的网站上推出这一功能的想法。自从Instagram的故事启动以来，Snapchat故事的使用率明显下降。这可能令Snap的一些信徒信心动摇，他们本来相信Snapchat有足够的诱惑力让其年轻用户远离Facebook和其他互联网公司的产品。

本次公开募股是Snap想保持独立的明证。但Facebook或谷歌仍然可以买下它。“这就是为什么我不会做空它的原因。”一位对冲基金从业人士说道。他对Snap可能获得的高估值心存疑虑。施皮格尔必须知道，他的公司是两大巨头不多的真正威胁之一，对于二者而言都十分值得争取。

如果Snap想要作为一个独立的公司生存，它可能需要自己做出一些明智的

收购，就像Facebook收购Instagram和WhatsApp那样。一个机会可能是视觉搜索。Snapchat的用户用相机捕捉他们周围的世界。当他们把智能手机对准一个物体时，这就是一个提供广告的机会。只有施皮格尔知道计划是怎么样的。但在高度集中的互联网生态系统中，公司越来越有必要吃掉其他公司，不然就有可能被吃掉。再过几年我们就知道Snap到底是捕食者还是猎物了。■



Logistics firms

Boxed in

The return of borders poses a challenge to the soaring parcel-delivery business

DURING the day, Leipzig's airport is quiet. It is at night that the airfield comes to life. Next to the runway a yellow warehouse serves as the global sorting hub for DHL, a delivery firm owned by Deutsche Post of Germany. A huge extension, which opened in October, means it can sort 150,000 parcels each hour, says Ken Allen, DHL's CEO. It was built as business soared. But the express-delivery industry faces a new challenge: the return of trade barriers due to the protectionist bent of Donald Trump and because of Brexit.

The slower-moving shipping and air-cargo business has long been in the doldrums as a result of slow overall growth in trade in recent years. Yet the rise of cross-border e-commerce has still meant booming business for express-delivery firms. On January 31st UPS revealed record revenues for the fourth quarter of 2016; FedEx and DHL are expected to report similarly buoyant results next month. Since 2008 half of the increase in express-delivery volumes has come from shoppers buying items online from another country.

Falling trade barriers have greatly helped them. When DHL and FedEx were getting going, in the 1970s, there was little demand for international express deliveries. Packages often got stuck in customs for weeks and were heavily taxed. The expansion of free-trade areas, lower tariffs and the internet brought years of growth. But after Mr Trump's threats to raise tariffs on goods from China and Mexico, together with the indication last month from Theresa May, Britain's prime minister, that the country will leave the EU's customs union, there are widespread fears that the favourable tailwinds enjoyed by the industry for decades are gone. "It's all a

real nightmare,” groans David Jinks of ParcelHero, a British parcel broker which works with DHL, FedEx and UPS.

Start with Brexit. More physical border checks between Britain and Europe would do little direct damage. Most packages arriving in Britain have already been checked for drugs and dangerous items. Goods from outside the EU go through customs 95% of the time without any inspection or delay.

Instead, post-Brexit costs will probably come from long wrangles over which of 19,000 customs codes should be applied to a consignment. As an example of what could happen, Halloween costumes from China often get stuck at Britain’s border while customs officials work out whether they are toys or children’s clothes, which attract different duties. Such complexity would force delivery firms to put up their prices to customers, Mr Jinks says. Sending an item from Britain to Switzerland (outside the EU) costs 150% more than it does to Italy (inside the EU).

The most severe impact on business would come from higher tariffs, which would hurt demand for cross-border imports and deliveries in favour of local goods. This is where Mr Trump’s threats come into focus. A trade war would hit the massive volume of consignments that DHL’s, FedEx’s and UPS’s planes carry every day in and out of America.

For the moment, a customs exemption exists for packages worth under \$800. This means that higher tariffs on a Chinese watch imported in bulk into the United States, for instance, could be avoided by an American ordering direct from Alibaba, a Chinese retailer, for delivery direct to their home. But if Mr Trump is serious about cutting imports, he could get rid of this exemption. It was only last March that Barack Obama increased it to \$800 from the previous \$200. If it were lowered or eliminated by executive order, logistics-industry people would really panic.

They are putting a brave face on things. DHL's Mr Allen has emphasised that "globalisation is here to stay", whatever Mr Trump does. UPS's boss, David Abney, hopes the president is not really against trade agreements. Even more telling are the actions of Fred Smith, FedEx's founder and CEO. Last week, he quietly gave up running the firm day-to-day to spend more time campaigning for free trade. ■



物流公司

陷入困境

贸易壁垒的回归对迅猛发展的快递业提出了挑战

白天，莱比锡机场很冷清，到了晚间停机坪上便恢复了生气。跑道旁的一个黄色仓库是德国邮政旗下快递公司DHL的全球分拣中心。这个分拣中心经过了一次大规模扩建，于去年10月投入使用。DHL的CEO肯·艾伦（Ken Allen）说，扩建后的中心每小时能够处理15万个包裹。扩建是在快递业务飙升时进行的。但如今快递业面临着一个新的挑战：由于特朗普的保护主义倾向和英国脱欧，贸易壁垒将重新回归。

由于近年贸易总体增长缓慢，运速较慢的航运和空运业很久以来都处于低迷状态。然而，跨境电子商务的兴起让快递公司仍然生意兴隆。1月31日，UPS公布的2016年第四季度收入创下新高，预计联邦快递和DHL下月也会公布类似令人振奋的业绩。自2008年以来，快递增长量的一半都来自于“海淘”买家。

贸易壁垒的降低极大地促进了快递业的发展。20世纪70年代DHL和FedEx刚起步时，人们对国际快递的需求还很少。包裹经常被卡在海关长达数周，还要支付高额的关税。自由贸易区扩张、关税下调以及互联网的发展为该行业带来了持续多年的增长。然而，特朗普威胁要对中国和墨西哥的货物提高关税，英国首相特雷莎·梅上月也透露英国将退出欧盟关税同盟，这让人们普遍担心令快递业顺利发展几十年的利好条件已消失不见。与DHL、联邦快递和UPS都有合作的英国快递代理公司ParcelHero的大卫·金克斯（David Jinks）哀叹道：“这是一个真正的噩梦。”

先从英国脱欧说起。英国与欧洲彼此间边境检查的增多并不会造成多少直接损害。大多数运抵英国的包裹都已经过毒品和危险品检查。来自欧盟以外的货物在95%的情况下不经过任何检查或延误就可通关。

相反，脱欧后物流成本的增加可能缘于对某批货物应适用19,000条海关编

码中的哪一条而争论不休。例如，可能会发生这样的情形：来自中国的万圣节服饰经常会困在英国边境，因为海关官员需要确定它们是属于玩具还是儿童服装——不同的类别对应不同的税率。金克斯说这种复杂性将迫使快递公司向客户提高运费。从英国到瑞士（欧盟以外）的寄件成本要比英国到意大利（欧盟内部）的高出150%。

对快递业最为严重的影响将来自于关税的提升，这会让消费者更倾向于购买本地商品，从而抑制对境外商品和运送的需求。这就是令特朗普的威胁成为焦点的原因。贸易战将严重影响DHL、联邦快递和UPS的飞机每天从美国运进运出的大量货物。

目前，美国海关对价值低于800美元的包裹免税。因此，假如美国消费者个人直接在中国零售平台阿里巴巴下单购买手表并直接寄送至其家中，就可避免从中国进口大批手表所需缴纳的更高关税。但如果特朗普当真要削减进口，他大可取消这种免税待遇。奥巴马去年3月才刚把之前200美元的进口免税额提高到800美元，如果特朗普以行政命令降低或取消它，物流业人士真的会惶恐不已。

目前他们都在强作镇定。DHL的艾伦强调，无论特朗普做什么，“全球化的趋势都不会变”。UPS的老板大卫·艾伯尼（David Abney）希望总统并不是真的反对贸易协议。联邦快递的创始人及CEO弗雷德·史密斯（Fred Smith）的行动更能说明问题。上周，他静悄悄地放下公司的日常事务，花更多的时间为倡议自由贸易奔走。■



Emerging markets

Back from the frontier

One of the original emerging markets returns to the fold

EMERGING markets have not been the same without Argentina, a country that embodies the promise and peril, the romance and the rockiness of the asset class. In 1988 it was one of the ten original members of the most popular emerging-market equity index, introduced by MSCI. In the late 1990s it was also the biggest member of the benchmark-bond indices compiled by JPMorgan Chase. But once it defaulted at the end of 2001, Argentina was exiled from global debt markets. And after it subsequently imposed capital controls on “hot money”, its shares suffered a similar banishment, ejected from MSCI’s index in 2009. It became a remote “frontier market”, like countries such as Bangladesh.

Since Mauricio Macri succeeded Cristina Fernández de Kirchner as president at the end of 2015, Argentina has been finding its way back from the financial periphery. It has floated its currency and lifted capital controls, recently abolishing a remaining requirement that foreign investors keep their money in the country for at least 120 days. In April the government sold \$16.5bn of dollar bonds to international investors in a single day (a record for an emerging market). Later this year, MSCI will decide whether to welcome Argentina’s shares back into its emerging-market index, starting with companies with an overseas listing, such as Adecoagro, which farms sugar and soyabeans, among other things. And on January 5th, JPMorgan Chase said it would admit Argentina’s peso bonds into its widely tracked benchmark indices, probably from February.

The emerging-market asset class has not lacked drama in Argentina’s absence. The introduction of quantitative easing (QE) after the financial crisis inspired a rush into higher-yielding emerging-market bonds. Talk of

“tapering” QE in 2013 prompted a partial reversal. As a borrowing currency, the dollar has waned in significance relative to local currencies such as the rupiah or real. Dollar-denominated bonds have been a better buy for investors in recent years, but less popular among government issuers. The share of hard-currency debt declined from roughly half on average in 2000 to about a quarter in 2014, according to Moody’s, a rating agency.

Much of this evolution has passed Argentina by. Until 2016 its government had to sell most of its bonds to fellow Argentines, including the country’s banks and its public-pension reserve fund. But although it was mostly sold to locals, the debt was chiefly denominated in dollars. Over 70% of the government’s debt is still denominated in foreign currencies, according to the ministry of finance. The high inflation and capricious currency policies of the post-default years meant Argentines did not trust the peso to hold its value. So for all of the nationalist fire of Ms Kirchner and her husband, her predecessor as president, their policies left them heavily reliant on the greenback to attract creditors.

Argentina’s expulsion from global debt markets came within days of China’s entry into the World Trade Organisation. Asia now accounts for about 70% of emerging-market GDP and a similar share of MSCI’s emerging-market equity benchmark (see chart). The bond indices, in contrast, remain far more evenly balanced between the regions. JPMorgan Chase’s most popular local-currency version still excludes China’s vast market altogether.

That may not last. In the past year China, too, has eased the capital controls that fenced off its debt markets. China may thus follow Argentina into the benchmark indices in due course. Emerging markets have not been the same without Argentina. But nor have they stayed the same. ■



新兴市场

从边缘回归

最早的一个新兴市场重回阵营

没有了阿根廷的新兴市场已是另一番景象。这个国家体现了这一资产类别的希望与危险、浪漫与动荡。1988年，摩根士丹利资本国际公司（MSCI）建立了最受欢迎的新兴市场指数，阿根廷是十个初始成分股之一。上世纪90年代末，它还是摩根大通（JPMorgan Chase）编制的基准债券指数的最大成分股。然而，阿根廷却在2001年底违约，随即被逐出全球债券市场。接着，它对“热钱”实施了资本管制，随后其股票也遭遇了一次类似的放逐，于2009年被剔除MSCI指数。阿根廷成了一个像孟加拉等国一样的遥远的“边缘市场”。

自从毛里西奥·马克里（Mauricio Macri）在2015年底接替克里斯蒂娜任总统以来，阿根廷一直在努力从融资圈的边缘回归。它实行汇率浮动并取消了资本管制，最近还撤销了剩余的一项要求外国投资者将资金在该国停留至少120天的限制。去年4月，阿根廷政府在一天之内向国际投资者出售了165亿美元的美元债券，创下新兴市场的记录。今年晚些时候，MSCI将决定是否欢迎阿根廷的股票回归其新兴市场指数，从Adecoagro（种植糖和大豆等作物）这样的海外上市公司开始。1月5日，摩根大通表示将把阿根廷比索债券纳入其广受关注的基准指数——大约从2月开始。

在阿根廷缺席期间，新兴市场资产类别也并非风平浪静。金融危机后出台的量化宽松推动投资者蜂拥购入收益较高的新兴市场债券。2013年，逐步退出量化宽松的传言引发了部分逆转。相对于印尼盾或巴西雷亚尔等本地货币，美元作为借贷货币的重要性已经减弱。近年来，以美元计价的债券对投资者而言是一种较好的购入目标，但在发行债券的政府中却不那么受欢迎。评级机构穆迪称，硬通货债券的比例从2000年时的大约一半下降到了2014年时的大约四分之一。

这种演变在阿根廷却几乎没有出现。直到2016年前，该国政府都不得不向

包括本国银行和公共养老储备基金在内的国人出售大部分债券。但是，尽管大部分都卖给了本国人，债券却主要是以美元计价。该国财政部称，超过70%的政府债券仍以外币计价。违约之后，高通胀率和反复无常的货币政策令阿根廷人不相信比索能够保值。尽管克里斯蒂娜和她丈夫、前任总统基什内尔饱含民族主义热情，他们的政策却使他们严重依赖美元来吸引债权人。

在阿根廷被驱逐出全球债券市场前不久，中国加入了世界贸易组织。目前，亚洲约贡献了新兴市场GDP的70%，在MSCI的新兴市场股票基准中也占相近份额（见图表）。相比之下，债券指数在各地区的权重上保持得远为均衡。摩根大通最受欢迎的本币债券指数仍然不包括中国的广阔市场。

这种情况可能并不会持续下去。在过去一年中，中国也放松了保护其债券市场的资本管制。因而在适当的时候，中国可能会继阿根廷之后进入基准指数。没有了阿根廷的新兴市场已不同往昔，但也并没有一成不变。■



Emerging markets

Turkeys and blockbusters

Why and how the paths of developing economies are set to diverge

WISE investors know that winning bets shine more brightly if they are not overshadowed by big loss-making trades. The way in which capital flowed to and from emerging markets in recent years meant that such discrimination went out of the window. Now, however, change is coming.

Two influences in particular are behind this. The first is the retreat by America's Federal Reserve from ultra-loose monetary policy. Cheap credit gave good and bad economies alike a boost; as its effect fades, capital allocation will become more disciplined. The peculiar traits of each emerging market, from macroeconomic management to productivity growth, will have a greater say in how its economy performs as well as how investors view it. The second shift is in America's trade policy, which is taking a worrying turn towards economic nationalism—a course whose effects on emerging economies will differ depending on their location and trade patterns. As a result, the reasons for success or failure among emerging markets may be quite different from the recent past.

Begin with macroeconomic management, in which there is already a growing divergence. Turkey is at one end of the spectrum. Despite its fiscal prudence, it has other ills that have long made the cautious wary of emerging markets, including a big trade deficit financed by hot money and lots of foreign-currency debt. It also suffers high inflation. The central bank has been slow to tackle this and seems cowed by Recep Tayyip Erdogan, the president, who insists that high interest rates cause inflation.

Contrast this with progress elsewhere. Little more than a year ago, South Africa was bracketed with Turkey as an emerging market to avoid. Its

president, Jacob Zuma, attempted to subvert the Treasury, a bastion of orthodoxy. He failed. South Africa's central bank has also stuck to its inflation mandate in the face of a slowing economy and weaker rand. Despite a brutal recession, Brazil's central bank has also concentrated on pulling inflation back towards its goal of 4.5%; the country is getting to grips with the fiscal laxity which is the source of much of its economic misery. With interest rates at 13%, there is ample room to ease monetary policy. Central banks in Russia and India have also run fairly tight monetary policies. As inflation falls further, they will have scope to cut interest rates.

Ultimately, sustained success depends on productivity growth. The sharp slowdown in rich countries has been mirrored in emerging markets. It is marked in commodity-led economies, where resource booms have deterred productive investments in other industries. Export-led growth has proved a reliable spur to efficiency. It is harder to achieve consistent gains in output per person in any economy that looks inwards. Letting domestic spending rip often leads to wasteful building booms. Still, there are biggish emerging markets that have managed fairly steady productivity growth through the swings of the global credit cycle. India is one; Indonesia another. Of smaller countries, the recent records of Peru, the Philippines and Uruguay stand out.

With American economic nationalism, strengths will be tested against a new criterion: exposure to established trade routes. Supplying the American consumer was once a ticket to riches for emerging markets. It may now be a source of frailty: Mexico is now a target of American protectionism (see Free exchange). Other places may also suffer. Singapore, South Korea and Taiwan have enjoyed strong manufacturing output and exports on the back of a reviving world economy. But it is hard to feel upbeat about the prospects of such export-leaning economies if trade wars break out.

India, in contrast, missed out when a new breed of global supply chains in manufacturing was forged between rich and developing countries. But with anti-trade sentiment a growing threat, there is a lot to like about an economy of 1.25bn people that is powered by domestic demand. Brazil, too, has a bigish domestic economy with fairly weak trade ties to America and the potential to strengthen its regional links.

| *To the discerning, the spoils*

Even in this new era, the influence of rich-world monetary policy will not disappear. The value of the dollar will continue to matter, especially to those emerging markets that took on lots of foreign-currency debts in the go-go years. Equally, the impact of economic policy and trade vulnerability will rarely be neatly aligned. Turkey, for instance, counters its macroeconomic weakness with underlying strengths in its patterns of commerce. It trades far more with Europe than America, an advantage it shares with economies in eastern Europe. This means the identities of those emerging-market economies that will thrive and those that will falter are not preordained. But the factors sorting blockbusters from turkeys will be new. ■



新兴市场

胜者为王，败者为寇

发展中经济体势将分流的原因和方式

精明的投资者知道，如果不被大笔亏损的交易蒙上阴云，那些赢得的赌注会更加熠熠生辉。近年来新兴市场资本流入和流出的方式表明没人再把这种鉴别力当回事了。然而，如今变化即将来临。

这背后有两大因素的影响尤为突出。第一是美联储退出超宽松货币政策。廉价信贷对好的和坏的经济体有相似的促进作用，随着这一效应逐渐消失，资本配置将变得更加严格。每个新兴市场的独特特征，从宏观经济管理到生产力增长，都将对其经济表现以及投资者对它的态度产生更大的影响。第二个因素是美国的贸易政策，它正转向经济民族主义，令人担忧。这种转变对新兴经济体的影响将因其地理位置和贸易模式的差异而有所不同。因此，新兴市场成功或失败的原因可能会与不久以前大不相同。

先来看宏观经济管理。在这方面，新兴市场间的差异已经越来越大。土耳其即代表着一个极端。尽管土耳其财政政策稳健，但还是存在着其他长期以来让谨慎的投资者对新兴市场保持警惕的弊病，包括依靠热钱和大量外汇债务来填补的巨额贸易赤字。土耳其还饱受高通胀之苦，其央行在对付这一问题上一直动作缓慢，似乎畏惧坚持认为高利率会导致通胀的总统埃尔多安。

再将土耳其的情况与其他国家的进展做一下对比。仅仅一年多前，南非和土耳其一样，被划为投资者应当绕道的新兴市场。南非总统祖马（Jacob Zuma）企图颠覆财政部这一正统派的堡垒，但失败了。南非的央行在经济放缓和兰特疲弱的情况下，仍然坚持抑制通胀。巴西尽管经历了严重的经济衰退，其央行同样集中力量希望将通胀水平拉回到4.5%的目标；巴西正在认真解决财政政策过于宽松的问题，这是其大部分经济问题的根源。巴西目前的利率为13%，有足够的空间放宽货币政策。俄罗斯和印度的央行也一直执行着相当紧缩的货币政策。随着通胀进一步下降，它们将迎来

降息的空间。

持久的成功最终要取决于生产力的增长。富国经济增长的大幅放缓也已在新兴市场中出现。这在以大宗商品为主导的经济体中尤为明显，资源繁荣阻碍了其他行业的生产性投资。事实证明，出口导向型增长可以有力地提高效率。在任何内向型经济体中，要实现人均产出持续增长都更加困难。恣意扩大国内支出往往导致浪费性的建筑热潮。尽管如此，在全球信贷周期的波动中，仍有一些较大型的新兴市场维持着相当稳定的生产率增长。印度是其一，另一个是印度尼西亚。在较小的国家中，秘鲁、菲律宾和乌拉圭近期也表现突出。

随着美国经济民族主义的兴起，新兴市场的实力将接受一个新标准的检验：对既有贸易路线的依赖程度。供应美国消费者曾经是新兴市场致富的门票，如今却可能成为一个脆弱的源头：墨西哥现在成了美国保护主义的攻击目标，其他地方可能也会遭殃。在世界经济复苏的背景下，新加坡、韩国和台湾实现了强劲的制造业生产和出口。然而，如果爆发贸易战，这些出口型经济体的前景将难以令人乐观。

相比之下，当富裕国家和发展中国家之间形成新的制造业全球供应链时，印度错失了机会。但随着反贸易情绪的威胁不断增长，作为一个拥有12.5亿人口的经济体，印度由国内需求驱动的经济有很多值得青睐之处。巴西的国内经济规模同样可观，与美国的贸易关系也相当薄弱，且有加强其区域联系的潜力。

| 胜利属于明智的投资者

即使在这个新时代，富裕世界货币政策的影响仍不会消失。美元的价值仍将具有重要意义，尤其是对那些在好年头里大举借贷外币的新兴市场来说。同样，经济政策的影响和贸易脆弱性之间很少会有明确的因果关联。例如，土耳其以商业模式的潜在优势来抵消宏观经济的疲软，它与欧洲的贸易规模远超过与美国的贸易，这是土耳其与东欧经济体的共同优势。这意味着，哪些新兴市场经济体将蓬勃发展，哪些又将会步履蹒跚，这一点并非注定。但是，谁将成王、谁为败寇，区分它们的原因将会是全新的。





Dublin as a financial centre

Emerald aisles

Why Brexit could threaten Ireland's soaring aircraft-finance industry

THE glass office blocks of Dublin's docklands still stand proud; the banks that built them no longer do. The financial crisis of 2008 took down Ireland's six biggest lenders. Within five years Dublin slid from being rated by Z/Yen, a London-based business think-tank, as the world's tenth-best financial centre to its 70th. Britain's readiness to leave Europe's single market has since sparked hopes Dublin's fortunes could be revived. An English-speaking base from which to keep doing business inside the EU may appeal to London's bankers. But worries are growing that the impact will not be all good for Dublin.

To see why, look at aircraft finance, perhaps the city's most successful industry. The topic of Brexit dominated the chatter at the world's two biggest air-finance conferences, both held in Dublin in January. Drawing more than 4,500 airline bigwigs, lessors and bankers, such gatherings are usually preoccupied by issues such as aeroplane prices and the aviation cycle. This year geopolitics predominated. "In Ireland we're surrounded by Trump to the west and Brexit to the east," one industry veteran sighed in despair.

The financing and leasing of aircraft is a peculiarly Irish business. Its origins in the 1970s were as a way for Aer Lingus, the country's flag-carrier, to exploit its planes during the lean winter seasons. Previously, airlines owned all their aircraft. Leasing allows them to finance rapid expansion or contraction of their fleets without taking on debt. Only 2% of aircraft were leased in 1980. Now over 40% are.

For a country of under 5m people, Ireland has made a global success story

of leasing. Irish firms manage in excess of 5,000 commercial aircraft, worth over \$130bn, accounting for half of all leased planes and a quarter of the fleet globally. Although Irish lessors were once chiefly thought to be used by struggling African airlines unable to get bank loans, says Peter Barrett, the boss of SMBC Aviation Capital, now virtually everyone leases planes.

Aircraft lessors took up the slack created by the implosion of the banks, renting their old offices in central Dublin. The industry in Ireland is now growing so fast, it is skewing the country's economic data. Official GDP growth of 26% in 2015 was largely the result of lessors buying so many new planes; the rest of the economy probably grew only by about 5%.

Although Ireland's first lessor, Guinness Peat Aviation (GPA), collapsed in 1993, Ireland has remained the industry's global hub. All but one of the world's 15 largest aircraft lessors have operations there. Patrick Blaney, a former boss of GPA, cites a number of big attractions. Dublin has a ready supply of workers already trained to manage and finance aircraft. It is home to the international registrar of aircraft that enables owners to gain swift repossession of their aircraft if an airline defaults on lease payments. And Ireland's low-tax regime leavens the industry's otherwise wafer-thin margins. Ireland's low corporate-tax rate of 12.5%, generous capital allowances and vast network of double-taxation treaties all offer further help.

At first glance, Brexit should have no direct impact on any of these advantages. But it worries the industry. A survey of aircraft-finance executives in January by Deloitte, a consultancy, showed that 38% think Brexit will damage Ireland's attractiveness as a base for leasing. The proportion was much higher among executives outside Ireland, says Pieter Burger of Deloitte. They know that other financial centres such as Hong Kong and Singapore are aggressively trying to attract lessors away from Dublin with lower tax rates and other incentives. Almost a third of aircraft-

finance executives say that they could move operations out of Ireland if it changes its tax policies for the worse.

This is where Brexit poses a potential threat to Ireland. France and Germany have long wanted Ireland to align its corporate-tax system with their, much higher rates. After Brexit, Britain, Ireland's only big ally against European tax harmonisation, will no longer have a seat at the table. Many in Ireland believe the EU is already closing in. They point to the big fine imposed by the European Commission on Apple last year, when the tech giant was accused of paying too little in Irish taxes, and to plans to standardise the rules on how corporate taxes are calculated.

Dublin does have advantages for companies fleeing a hard Brexit: the English-speaking population, a very similar legal system and light-touch regulation. Yet many air lessors say they would be quietly relieved if hordes of exiled bankers do not turn up. The city is already short of office space, housing, roads and international-school places.

Irish central bankers are worried about whether they have the right expertise to regulate some of the complex trading that could move out of Britain. Even if Ireland retains its edge on tax, a post-Brexit exodus of financiers from London might not be an unalloyed boon. ■



作为金融中心的都柏林

绿宝石通道

为什么说英国脱欧或许会威胁到爱尔兰飞速发展的飞机融资租赁业

在都柏林的港口区，一幢幢玻璃幕墙的办公大楼仍傲然挺立着，但建造起它们的各大银行却再也没了那份骄傲。2008年的金融危机令爱尔兰最大的六家银行遭受重创。在商业智库Z/Yen（总部位于伦敦）发布的世界最佳金融中心排名中，都柏林在五年内从第十位下滑至第七十位。之后，英国表现出了脱离欧洲单一市场的意愿，都柏林时来运转的希望也随之燃起。伦敦的银行家们也许会有兴趣在一个说英语的地方继续在欧盟内部经营业务。然而，人们也越来越担心都柏林所受的影响并不会只有积极的一面。

要了解个中缘由，不妨对飞机融资租赁这一或许是都柏林最成功的产业做一番探究。全球最重大的两次航空金融会议均于1月在都柏林举行，英国脱欧成为与会者谈论最多的话题。这类大会动辄吸引4500多位航空业大佬、租赁公司及银行业人士参加，通常关注的都是飞机价格以及航空业周期等问题。今年，地缘政治成为主要议题。“在爱尔兰，我们受到两面夹击：西边有特朗普，东边是英国脱欧。”一位业内资深人士绝望地叹息道。

飞机融资和租赁是爱尔兰的特色产业，起源于上世纪70年代。当时，该国国家航空公司爱尔兰航空（Aer Lingus）在冬季淡季以这种方式充分利用自己的飞机。在此之前，航空公司的飞机都归自己所有。有了租赁业务，航空公司无需举债就可以有足够资金快速扩充或收缩机队。在1980年，租赁的飞机只占到2%，如今则超过40%。

作为一个人口不足五百万的国家，爱尔兰的飞机租赁业务却在全球范围内取得了成功。爱尔兰的租赁公司管理着5000多架商用飞机，价值超过1300亿美元，占全球所有租赁飞机的一半、全球飞机机队的四分之一。日本住友航空资本（SMBC Aviation Capital）的老板彼得·巴雷特（Peter Barrett）说，虽然人们曾一度以为，无法获得银行贷款、苦苦挣扎的非洲

航空公司才是爱尔兰租赁公司的主要客户，但如今几乎所有的航空公司都在租借飞机。

各大银行崩盘后，由飞机租赁商来收拾残局，租下了它们位于都柏林市中心的旧办公室。该行业目前在爱尔兰发展十分迅猛，整个国家的经济数据都因此而扭曲。2015年，官方的GDP增长率高达26%，大体上就是因为租赁公司购买了大量的新飞机。而该国经济其余部分的增长也许只有5%左右。

虽然爱尔兰第一家飞机租赁公司吉尼斯·匹特航空公司（Guinness Peat Aviation，简称GPA）已于1993年倒闭，爱尔兰一直都还是全球飞机租赁产业的中心。世界上最大的15家飞机租赁公司中，只有一家没在爱尔兰开展业务。GPA的前老板帕特里克·布莱尼（Patrick Blaney）列举了爱尔兰的几大吸引力所在。都柏林已经培养了足够多的飞机管理及融资租赁人员。这里还是全球飞机的国际注册处，如果航空公司拖欠租赁费用，飞机所有人能够迅速收回飞机。此外，爱尔兰的低税率也令该产业原本微薄的利润得以提升。爱尔兰低至12.5%的企业所得税、慷慨的资本免税额，以及广泛的避免双重征税的协定网络都起到了积极的作用。

乍一看，英国脱欧应该不会对上述任何优势产生直接的影响，但它还是引起了业内人士的担忧。咨询公司德勤1月对飞机融资高管的一项调查显示，他们当中有38%的人认为英国脱欧会损害爱尔兰作为飞机租赁基地的吸引力。德勤的皮特·伯格（Pieter Burger）称，在爱尔兰以外地区的高管中，这个比例还要高出许多。他们知道，香港和新加坡等其他金融中心正虎视眈眈，试图以更低的税率及其他激励措施将租赁公司从都柏林吸引至本地。几乎有三分之一的飞机融资高管表示，如果爱尔兰向对自己不利的方向改变税收政策，他们也许会将业务从爱尔兰迁出。

这才是爱尔兰或许会因英国脱欧而遭受威胁的原因。法国和德国早就想让爱尔兰调整其公司税体系，使之与它们高得多的税率一致。英国是爱尔兰抵抗欧洲税收统一的唯一重要盟友，但脱欧后，英国在磋商中将不再占有一席之地。在爱尔兰，很多人都相信欧盟已步步逼近。他们提到去年欧盟

委员会向苹果施以重罚——当时这家科技巨头被指控在爱尔兰缴税过少；他们还提到欧盟统一公司税计算规则的计划。

对意欲逃离“硬脱欧”的公司来说，都柏林确有其优势：说英语的人口、与英国非常相似的法律体系，以及“点到为止”的监管。然而，很多航空租赁公司表示，如果大批逃亡的银行家最终并未现身，它们将暗自松一口气。都柏林的办公空间、住房、道路以及国际学校名额都已吃紧。

爱尔兰央行的官员们也担忧，自己是否具备适当的专业技能来监管或许会从英国迁出的一些复杂交易。即使爱尔兰在税收方面的优势得以保持，英国脱欧后大批金融家从伦敦出走对它来说或许并不会是百分之百的好事。





Brexit and financial regulation

Lost passports

How the City hopes to secure its future after a hard Brexit

THERESA MAY'S speech on January 17th set Britain definitively on a path to a "hard" Brexit, in which it will leave not just the EU but the European single market. This was not what the City of London wanted to hear. The prime minister did at least pick out finance, along with carmaking, as an industry for which "elements of current single-market arrangements" might remain in place as part of a future trade deal. The City is holding out hope that a bespoke deal built on the existing legal concept of "equivalence" could still accord it a fair degree of access to Europe.

"Passporting", which allows financial firms in one EU member state automatically to serve customers in the other 27 without setting up local operations, was always going to be difficult after Brexit. Outside the single market, says Damian Carolan of Allen & Overy, a law firm, the "passport as we know it is dead." Already, two big banks, HSBC and UBS, each confirmed in late January plans to move 1,000 jobs from London.

Financial companies all have to firm up their contingency plans. For the City, these focus on so-called "equivalence" provisions, allowing third-country financial firms access to the EU if their home country's regulatory regime is deemed equivalent. Currently only some regulations, such as those governing clearing houses and securities trading, contain the provisions. Much of finance, notably bank lending and insurance, is not covered. And even where the provisions exist, applying them will, in effect, be a political decision.

Optimists hope equivalence could not just form the basis of a feasible deal, but might even allow Britain to remove some onerous regulations.

Jonathan Herbst of Norton Rose Fulbright, another law firm, notes that precedents exist for “variable geometry” in regulation. For instance, to gain access to American clients, some British clearing houses already submit to partial American regulatory oversight. If they deal in euro-denominated trades, nothing seems to stop them from submitting to, say, direct oversight by the European Central Bank without leaving London.

Such proposals may be stymied by cold political considerations. Equivalence determinations are at the full discretion of EU regulators, and the status can be withdrawn at short notice. Britain, as a current EU member, starts with identical rules. In a charged political environment, even a small future divergence could be construed as moving away from equivalence. For all the creative solutions proposed by lawyers in London, Europeans are not minded to let Britain off the hook by allowing it easily to “cherry-pick” sectoral carve-outs. Even before the Brexit referendum in June the ECB had sought to move euro clearing into the euro area.

Yet that is not a reason to dismiss equivalence altogether. It would seem strange, as Mr Herbst points out, to admit Canadian banks into the EU on the back of the recent EU-Canada free-trade deal under better terms than British banks. (Indeed, many Canadian banks have their main European presence in London.)

Even on clearing, it is more likely that euro-denominated derivatives would move to New York rather than continental Europe. According to Mr Carolan, it would be tricky for the ECB to stop this unless it were to forbid European banks from using non-European clearing houses, which would deprive them of access to liquidity. It might be in the ECB’s interest, then, to agree on a bespoke arrangement on clearing. Other financial-market activities may prove harder nuts to crack—especially if, as seems possible, broader Brexit negotiations descend into acrimony. ■



英国脱欧与金融监管

丢失护照

硬脱欧后，伦敦想怎样保障未来？

1月17日英国首相特雷莎·梅发表演讲，明确英国将走“硬”脱欧之路，即不仅脱离欧盟，还要退出欧洲单一市场。这可不是伦敦金融城愿意听到的消息。但她起码还特别提到了金融业和汽车制造业，称针对这两个行业，“目前单一市场协议中的某些元素”或许会被保留下来，作为未来贸易协定的一部分。伦敦金融城如今只希望，基于“同等性”这一现有法律概念制定的具针对性的贸易协定仍能在相当程度上助其参与欧洲市场。

在“单一牌照机制”（Passporting）下，任一欧盟成员国的金融公司都会自动获得资格为其余27国的客户提供服务，而无需在当地设立分支机构。但这一机制在英国脱欧后必然将难以操作。英国安理国际律师事务所（Allen & Overy）的达米安·卡罗兰（Damian Carolan）表示，在单一市场外，“我们所知道的那种单一牌照机制已不复存在。”1月下旬，汇丰和瑞银这两家大银行集团均已确认，各自计划从伦敦撤走1000个职位。

所有金融公司都必须明确应急计划。伦敦金融城计划聚焦于所谓的“同等性”规定，即第三国只要被视为具备同等监管体系，其国内的金融企业便可进入欧盟市场。目前只有部分监管法规包含这类规定，例如针对清算所及证券交易的法规。金融业的大部分都不在这一范围内，特别是银行借贷及保险。实际上，即使在这类规定涵盖的领域，实施它们也还要依赖政治决定。

乐观主义者希望，“同等性”不仅能成为可行协定的基础，甚至还可令英国取消一些繁琐的监管法规。英国诺顿罗氏律师事务所（Norton Rose Fulbright）的乔纳森·赫布斯特（Jonathan Herbst）指出，在监管问题上，存在着“可变几何”（译注：一种灵活政策，即欧盟成员国可以对是否履行部分条约条款进行灵活谈判）的先例。例如，为获得美国客户，一些英国清算所已部分接受美国法规的监管。假如它们要处理欧元计价的交

易，似乎没什么可阻止它们接受欧洲央行的直接监管而同时仍留在伦敦。

这些方案也许会因冷酷的政治考量而受阻。是否具有同等性，这完全由欧盟监管机构裁定，而且“同等”地位转眼间就可能被撤销。英国作为现任欧盟成员，开始时规则是一样的。但在紧张的政治环境下，未来即便是出现很小的分歧，也可能被认作偏离“同等性”。即便伦敦的律师提出了种种有创意的解决方案，欧洲各方也还是无意就此放过英国，轻易就让它“东挑西拣”地决定就哪些行业作选择性剥离。早在去年6月英国脱欧公投前，欧洲央行就已试图将欧元结算转移到欧元区内。

然而，这并不说明“同等性”一无是处。正如赫布斯特指出的，如果在欧盟与加拿大最近签署的自由贸易协议之后，让加拿大银行以更优于英国银行的条件进入欧盟市场，这会显得很奇怪。（事实上，许多加拿大银行在欧洲的主要运营机构均设在伦敦。）

即使在清算这一领域，欧元计价的衍生品也很可能转移到纽约而非欧洲大陆。据卡罗兰称，欧洲央行难以阻止这一变化，除非它禁止欧洲银行使用非欧洲的清算所，然而这会使欧洲银行资金流动性受限。那么，出于自身利益考虑，欧洲央行也许应就清算问题定制一套方案。金融市场的其他活动可能更为棘手，尤其是如果更广泛的脱欧谈判陷入恶语相向的话——这似乎颇有可能。■



Advanced manufacturing

The new manufacturing footprint

Adidas prepares a high-tech plant to bring production of trainers back to Germany

BEHIND closed doors in the Bavarian town of Ansbach a new factory is taking shape. That it will use robots and novel production techniques such as additive manufacturing (known as 3D printing) is not surprising for Germany, which has maintained its manufacturing base through innovative engineering. What is unique about this factory is that it will not be making cars, aircraft or electronics but trainers and other sports shoes—an \$80bn-a-year industry that has been offshored largely to China, Indonesia and Vietnam. By bringing production home, this factory is out to reinvent an industry.

The Speedfactory, as the Ansbach plant is called, belongs to Adidas, a giant German sports-goods firm, and is being built with Oechsler Motion, a local firm that makes manufacturing equipment. Production is due to begin in mid-2017, slowly at first and then ramping up to 500,000 pairs of trainers a year. Adidas is constructing a second Speedfactory near Atlanta for the American market. If all goes well, they will spring up elsewhere, too.

The numbers are tiny for a company that makes some 300m pairs of sports shoes each year. Yet Adidas is convinced the Speedfactory will help it to transform the way trainers are created. The techniques it picks up from the project can then be rolled out to other new factories as well as to existing ones, including in Asia—where demand for sports and casual wear is rising along with consumer wealth.

Currently, trainers are made mostly by hand in giant factories, often in Asian countries, with people assembling components or shaping, bonding and sewing materials. Rising prosperity in the region means the cost of

manual work outsourced to the region is rising. Labour shortages loom. Certain jobs require craft skills which are becoming rarer; many people now have the wherewithal to avoid tasks that can be dirty or monotonous.

Adidas's motivation for its Speedfactories, however, goes well beyond labour cost. People want fashionable shoes immediately, but the supply chain struggles to keep up. "The way our business operates is probably the opposite of what consumers desire," says Gerd Manz, the company's head of technology innovation.

From the first sketch of a completely new pair of trainers to making and testing prototypes, ordering materials, sending samples back and forth, retooling a factory, working up production and eventually shipping the finished goods to the shops can take the industry as long as 18 months. Yet some three-quarters of new trainers are now on sale for less than a year. An order to replenish an existing, in-demand design—the latest edition of the NMD R1, say, a popular trainer in 2015-16—can take two or three months to reach the shelves, unless the shoes travel not in a shipping container but at huge cost in the hold of an aircraft.

| *On your marks...*

The Speedfactory's main strength is to shorten the supply chain, and so the time to shops, to less than a week, perhaps even to a day, once the trainer design is complete. The design process itself is increasingly done digitally. The trainers are not just styled on a computer screen but can also be tested by the computer for things like fit and performance. To enhance the process, the Speedfactory will also have a digital twin: a virtual computer model in which production of the new trainers can be simulated. Once all is well, the digital product will then move to the physical production system.

Adidas claims its new production system is extremely fast and highly

flexible. The details are being kept secret for now. What is known, however, is that instead of ordering components that will be assembled into a new pair of trainers, the Speedfactory will instead make most of the parts itself from raw materials, such as plastics, fibres and other basic substances.

The machines carrying out this work will be highly automated and use processes such as computerised knitting, robotic cutting and additive manufacturing, which involves building up shapes layer by layer. Industrial 3D printing machines are appearing in many different forms and are capable of handling an increasing variety of materials. Driven by software, the robots, knitting machines and 3D printers take their instructions directly from the computer-design program, so they can switch from making one thing to another quickly, without having to stop production for what can amount to several days in order to retool conventional machines and instruct manual workers.

Not every job in the Speedfactory will be automated. Robots can be slower and less precise at some tasks, such as the final shaping of a shoe. So each Speedfactory will create 160 production jobs, compared with a thousand or more in a typical factory in Asia. The new functions will also be more highly skilled. Adidas wants the new plants to complement the Asian operations, not to compete with them. But as advanced manufacturing expands, the need for armies of manual workers in Asian factories will surely diminish.

Sneakerheads are likely to approve. "This will lead to products that will look and perform differently," says Mr Manz. Leaving behind manual production methods will allow Adidas to come up with novel shapes and finishes. One new material the firm has already experimented with is Biosteel, a synthetic silk made by AMSilk, a German biotech company. Production will also become more customised, perhaps even with bespoke trainers fashioned from a computer scan of how a person walks or runs.

In such a competitive and trend-driven market, one thing is certain: Adidas's arch-rival Nike will not just sit on the touchline. The American company faces similar cost increases in Asia and is equally keen to shorten the time it takes to get new products to market.

One of its initiatives is a form of computerised knitting to make the upper parts of a range of trainers it calls Flyknit, much like the way a sock is knitted. Nike has also set up what it calls an Advanced Product Creation Centre at its headquarters in Beaverton, Oregon, to explore other automated production methods, including 3D printing. The company has already employed these techniques to produce customised shoes for some top athletes. The race between the world's biggest sports-shoe makers is about to become much more fleet of foot. ■



先进制造

制造业新足迹

阿迪达斯正在建设高科技工厂，将运动鞋的生产迁回德国

在德国巴伐利亚州的安斯巴赫镇（Ansbach），一家新工厂正悄然成形。它将运用机器人及增材制造（又名3D打印）等新型生产技术。这在德国并不稀奇，该国一直通过创新工程技术保持着制造业基地的地位。这家工厂的独特之处在于它接下来要生产的并非汽车、飞机或电子产品，而是各种运动鞋（这一产业年产值800亿美元，主要在中国、印尼和越南等海外地区生产）。通过将生产转回德国，该工厂力图重塑整个行业。

这家设在安斯巴赫镇的“快速工厂”（Speedfactory）属于德国体育用品巨头阿迪达斯，目前正由该集团与德国生产设备制造公司Oechsler Motion合力打造，预计将于今年年中投产。一开始生产会较为缓慢，而后将逐步提升至年产50万双运动鞋。阿迪达斯正在亚特兰大附近建造针对美国市场的第二家“快速工厂”。一切顺利的话，其他地方也会陆续出现这类工厂。

对于这家年产约3亿双运动鞋的公司来说，上述数字微不足道。但阿迪达斯深信，“快速工厂”将有助公司革新运动鞋的制造方式。从该项目中获得的技术可以推广至其他新工厂及现有工厂，包括在亚洲的工厂——那里对运动休闲服饰的需求正随着消费者财富的增长而上升。

目前，运动鞋大多是在大型工厂里手工制造，且通常是在亚洲国家。工人们组装部件，或使物料成型并进行粘合和缝制。随着亚洲地区日渐繁荣，将人力外包至该地区的成本也逐渐上升。劳动力面临短缺。某些工作需求的手工艺正变得愈加稀缺；如今，许多人已有足够的资本拒绝从事肮脏或单调的工作。

然而，阿迪达斯创建“快速工厂”远不止是出于劳动力成本的考虑。人们希望时尚的鞋子可以立即到手，但供应链却难以跟上需求。“我们的业务运营方式可能和消费者的愿望背道而驰。”阿迪达斯的技术创新主管格德·

曼兹（Gerd Manz）表示。

从为一双全新的运动鞋设计初稿开始，接下来，制作及测试原型、订购材料、来来回回寄送样品、工厂设备调整更新、启动生产，最后再将成品运送至店铺，整个过程可长达18个月。但现在约有四分之三的新款运动鞋上架销售的时间都不会超过一年。现有热销款若要补货（比如2015至2016年流行的运动鞋NMD R1的最新款），可能需两到三个月才能到货，除非鞋子不是经由海运而是采用高成本的空运。

| 各就各位.....

“快速工厂”的主要优势是缩短供应链。如此一来，运动鞋在设计完成后，成品到店所需时间可缩短至不到一周，甚至还可能在一天内上架。设计过程也越来越数字化。运动鞋不仅可在计算机屏幕上设计，而且还可以通过计算机测试舒适度及性能等指标。为提升设计过程，“快速工厂”还将打造数字化同步模拟系统，用虚拟的计算机模型模拟新款运动鞋的制造过程。一切调试妥当，数字化成品将转移到实体生产体系中。

阿迪达斯称，这套新的生产系统速度极快且高度灵活。相关详情目前尚属保密。但已知的是，“快速工厂”不会外购部件来组装新的运动鞋，而是使用原材料（如塑料、纤维及其他基础材料）自行制造鞋子的大部分部件。

执行这项工作的机器将高度自动化，运用诸如计算机针织、机器人切割及增材制造（逐层叠加材料使之成型）等工艺流程。工业用3D打印机类型众多，可处理的材料也日益增多。以软件驱动的机器人、针织机及3D打印机直接从计算机设计程序中接收指令，从而可从制造某一产品快速转换成另一产品，无需为重新整备常规机器及指导工人执行新任务而停工多达数日。

在“快速工厂”中，并非所有工作都将实现自动化。机器人在完成某些任务时可能会速度较慢且不够精准，比如鞋子的最后成型。所以，每家“快速工厂”将创造160个生产岗位。相比之下，在亚洲的一家常规工厂需要一千名或更多的工人。这些新岗位也将需要更高的技能。阿迪达斯希望新工厂

能成为亚洲工厂的补充，而非竞争对手。但随着先进制造的扩展，亚洲的工厂对大批工人的需求肯定会减少。

鞋迷们很可能赞成这种变革。“这会令产品拥有不一样的外观和性能。”曼兹说。放弃手工生产方式，阿迪达斯可打造出新颖的造型和修饰细节。该公司已试验过的一种新材料是名为Biosteel的合成纤维，由德国生物科技公司AMSilk制造。生产也将变得更为定制化，也许甚至可以通过计算机扫描一个人走路或跑步的姿态来定制运动鞋。

在这样一个竞争激烈、潮流驱动的市场，有一点可以肯定：阿迪达斯的宿敌耐克是不会呆坐场边的。这家美国公司在亚洲也遭遇类似的劳动成本上升问题，同样渴望缩短新产品的上市时间。

耐克的新项目之一采用电脑编织技术来制造其Flyknit系列运动鞋的鞋面，过程与编织袜子相似。耐克也在俄勒冈州比弗顿（Beaverton）的总部设立了“先进产品创造中心”（Advanced Product Creation Centre），探索其他自动化生产方法，包括3D打印。该公司已采用这些技术为一些顶级运动员定制运动鞋。世界两大运动鞋制造商的赛跑即将大大提速。■



Schumpeter

Status contentment

It's getting easier for the merely rich to live like tycoons

LAMENTING the rise of inequality is one of the few growth industries in an age of stagnation. One authority on the American wealthy, Robert Frank of CNBC, a TV channel, worries that the rich are “floating off” into their own country. Chrystia Freeland, a journalist-turned-politician, frets about the rise of the “new global super-rich” and the fall of everyone else. Charles Murray, America’s gloomiest social scientist, warns that society is “coming apart” as the rich retreat into their gated communities.

At the top of the income scale, however, a small counter-trend is observable. Never before have so many people been able to get access to the accoutrements of tycoonery—private planes, luxury yachts, fancy cars and interior-designed, exclusive homes. There is only so much comfort to be had from the fact that it is easier for the merely rich to lay claim to the lifestyle of the super-rich. But as a result of a combination of new technologies and businesses, that is nonetheless what is happening.

Tycoon living begins with a private jet. Whereas yachts are dispensable (not everyone wants to float around for weeks with the same dinner companions) private jets are necessities for the aspiring billionaire. They save valuable time. Even first-class passengers have to wait an hour or so for their flights. Private-jet owners can turn up when they want and climb on board. The planes can double as flying offices, and you don’t have to worry about other passengers eavesdropping on your deals or objecting to your spreading papers. The flight is smoother (private jets typically fly at 45,000 feet), the seats are more throne-like, and you can bring your pets.

No longer do you need a net worth in the hundreds of millions of dollars to

have one. With 700 jets, NetJets is now the fifth-largest airline by number of planes, after Southwest Airlines, and it has access to thousands of private airports. Its main innovation was to apply the principle of fractional ownership, or time-sharing, to the ultimate executive tool. Customers buy a share in a jet which entitles them to, say, 200 hours of travel a year.

NetJets is skilled at providing its rich clients with an entrée into the cultural world of the super-rich, with hard-to-get tickets to events such as Art Basel, a series of art fairs, and to private dinners with celebrities. The company is also finding ways to bring down the cost: one of its latest ideas is the private-jet equivalent of London Underground's electronic ticket, the Oyster card. Rather than buying a share in a jet you can buy a pre-paid card that entitles you to a certain number of flying hours a year, with 25 hours' worth of flights adding up to about €155,000 (\$163,435).

The sharing economy was hardly inspired by the needs of the rich. But in some ways it suits them perfectly. The whole idea depends on people having spare assets that they are willing to rent out to total strangers. Who has more idle assets than the super-rich? And who loves extra income more than people who have spent their lives accumulating money? On the other side of the market, bustling plutocrats are an ever-present source of demand for temporary accommodation and bursts of luxury. The system can even have a strange public-relations benefit. A wealthy boss who makes use of NetJets won't need to explain to his shareholders why he bought a jet, even as he treats the one he flies on as though it were his own.

Uber, a ride-hailing firm, and Airbnb, an accommodation-sharing service, are prominent in the luxury market as well as the mass market. Uber offers yacht trips in Dubai (UberYacht) and helicopter commutes in São Paulo (UberCopter). Airbnb does a booming trade in luxury apartments in London, Hong Kong and the Caribbean. There are providers in almost every cranny of the luxury landscape. GetMyBoat, a San Francisco-based

company, gives customers access to motorboats, luxury houseboats, yachts and jet skis in 7,100 places around the world. Stratajet sells tickets on empty legs on private jets for the price of a business-class ticket or even less. Staller, which describes itself as the “Airbnb for horses”, helps horse-owners rent stalls near equestrian competitions. A home-sharing club called ThirdHome.com allows people with just a couple of homes to live as if they have a dozen.

The same constraints that affect the wider sharing economy—NIMBY pressure groups who put their interests above the common good and regulators who fail to adapt to new technology—find echoes in the luxury market. With its helicopter service from Manhattan to the Hamptons, Blade has immeasurably improved the life of those New Yorkers who weekend on Long Island. That hasn’t prevented curmudgeons in Battery Park and Brooklyn Heights from complaining about the occasional whump-whump-whump over their heads.

| *From merely rich to Uber rich*

Methods of managing wealth as well as consuming it are trickling down. Until recently only people called Rockefeller and Morgan could afford so-called “family offices” that manage their investments, taxes and charitable giving (and get entry into the best hedge funds). Now people with as little as \$5m to invest can afford to do so thanks to a boom in so-called “multi-family” offices. Banks such as Citigroup have set up multi-family divisions. Even blue-blooded wealth advisers such as Rockefeller & Co, in Manhattan, are offering family-office services to the “merely” crowd.

That things are getting better for more rich people does not contradict Mr Frank’s broader worry, but among the Art Basel class it is a notable shift. Once upon a time you had to be born rich to join the global elite. Then you had to make a hundred million dollars, and then the threshold rose to a billion. Now goods and services that used to be confined to a handful of

tycoons are available to the millionaire or pretend-millionaire next door, thanks to the magic of the sharing economy. The super-rich may be floating off into their own country. But more people can join them, even if temporarily, than ever before. ■



熊彼特

地位满足

小富充大亨愈加容易

在经济停滞时期还能有增长的领域并不多，人们对社会日趋不平等的怨念便是其中之一。供职于美国全国广播公司财经频道CNBC的罗伯特·弗兰克（Robert Frank）是研究美国富豪的专家，他担心富豪们正日渐自成一国。从记者转身成为政客的克里斯提亚·弗里兰（Chrystia Freeland）为“全球新型超级富豪”的崛起以及其他所有人的没落而忧虑。美国最悲观的社会学家查尔斯·默里（Charles Murray）警告说，随着富人们退避至重门深户内，社会正在“分崩离析”。

然而，在顶层收入群体中，却可观察到一个小小的逆趋势。从来没有那么多人可以享用到大亨式的行头装备——私人飞机、豪华游艇、炫目豪车，以及装潢考究的高档住宅。小富之人愈加容易拥有巨富的生活方式了，这一点带给人们的安慰颇为有限。不过，由于一系列新科技和新业务的结合，这确实是正在发生的事。

要享受大亨式的生活首先得有一架私人飞机。游艇是可有可无的（并非每个人都喜欢花上好几周时间漂游海上，天天和同一群人用餐），但对于未来的亿万富翁而言，私人飞机则是必需品。拥有飞机可以节省宝贵的时间。即使头等舱乘客也得为航班等候一小时左右，而私人飞机机主则可随心所欲地即时登机。飞机可以充当空中办公室，不必担心其他乘客听到你谈的交易，摊开报纸也不会有人提意见。飞行也更顺畅平稳（私人飞机一般在45,000英尺的高度飞行），座椅更加豪华舒适，乘客还可以带上宠物。

如今，你并不需要身家数亿美元才能坐拥私人飞机。备有700架喷气式飞机的NetJets现已成为排在西南航空公司之后的第五大航空公司（按飞机数量计算），可抵达数以千计的私人机场。该公司的主要创新是把所有权共享或分时共享的原则应用在私人飞机这一“高管终极交通工具”上。客户购

买私人飞机的部分所有权进而获得一定使用权，比如，每年200小时的飞行时数。

NetJets善于把一般富人领入超级富豪的文化世界，让其跻身巴塞尔艺术展（Art Basel）的系列展会这类一票难求的盛事以及名流的私人晚宴。该公司也正在想办法降低成本：最新的一个创意是推出类似伦敦地铁电子票“牡蛎卡”的私人飞机搭乘卡。你不必拥有私人飞机的部分所有权，只需购买一张预付卡，每年便可享用一定飞行时数，25小时的飞行约花费155,000欧元（163,435美元）。

分享经济并非由富人的需求所催生，但在某些方面，这一经济模式却完全贴合其需求。这一模式的整体理念是基于人们拥有空闲资产且愿意出租给陌生人。谁能比超级富豪拥有更多闲置资产？谁又会比这些终生金钱挂帅的人更爱额外收入？在市场的另一边，在商界忙碌的小富豪们对临时租用住所和时不时的奢侈生活总有需求。分享经济甚至能带来一种奇特的公关效益。豪阔的老板们可以通过NetJets享用如同自有私人飞机的服务，而无须向股东解释为何斥资购买私人飞机。

网约车公司优步及住宿分享服务公司Airbnb除了在大众市场大行其道，在奢侈品市场的服务也很突出。优步在迪拜提供游艇旅行服务（优步游艇），在圣保罗推出直升机接送服务（优步直升机）。Airbnb在伦敦、香港、加勒比海的豪华公寓业务兴旺。富豪生活的方方面面几乎都有公司在提供服务。总部位于旧金山的GetMyBoat在全球7,100个地方向顾客出租摩托艇、豪华船屋、游艇及水上摩托。Stratajet以等同甚至低于商务舱的票价出售私人飞机的空驶航段机票。Staller自称是“服务马匹的Airbnb”，帮助马主在马术竞赛场地附近租借马厩。名为“ThirdHome.com”的房屋共享俱乐部让仅拥有三两套房子的人们像是十多套房子的主人那样到处旅行居住。

但奢侈市场同样面临更大范围共享经济所面对的制约——将自己利益置于大众利益之上的邻避压力群体及无法适应新技术的监管者。Blade提供从曼哈顿到汉普顿的直升机服务，大大方便了到长岛度周末的纽约人，但无

法阻止炮台公园和布鲁克林高地的倔老头们抱怨头顶偶尔出现的直升机轰鸣声。

| 从小富到超级富

除了消费财富，管理财富的方法也正一点点向下渗透。以往只有那些名叫洛克菲勒和摩根的名门望族才有能力设立所谓“家族理财室”来管理自己的投资、税务及慈善捐赠（并涉足最优质的对冲基金）。现在，由于“多家族理财办公室”的兴起，即使只有500万美元投资资金的人们也能享用这一服务。花旗集团等银行已设立了多家族理财部门。连曼哈顿的洛克菲勒公司（Rockefeller & Co）这类高贵的投资咨询公司也开始为小富人群提供家族理财服务。

更多富人的生活质量得到提升与弗兰克更宽泛的忧虑并不矛盾，但在巴塞爾艺术展的观众人群中，这是个显著的转变。在过去，你必须出身富贵才能打入全球精英圈子。之后是你得赚上一亿美元，后来门槛又上升到十亿。然而由于分享经济的魔力，以前仅限于少数大亨专享的商品和服务现在连隔壁的百万小富或装阔之人也能享用。超级富豪们也许是越来越自成一国，但史无前例地，更多的人可以加入其中，即便只是暂借的奢华。■



Renewable energy

Clean energy's dirty secret

The renewables revolution is wrecking the world's electricity markets. Here's what to do

ALMOST 150 years after photovoltaic cells and wind turbines were invented, they still generate only 7% of the world's electricity. Yet something remarkable is happening. From being peripheral to the energy system just over a decade ago, they are now growing faster than any other energy source and their falling costs are making them competitive with fossil fuels. BP, an oil firm, expects renewables to account for half of the growth in global energy supply over the next 20 years. It is no longer far-fetched to think that the world is entering an era of clean, unlimited and cheap power. About time, too.

There is a \$20trn hitch, though. To get from here to there requires huge amounts of investment over the next few decades, to replace old smog-belching power plants and to upgrade the pylons and wires that bring electricity to consumers. Normally investors like putting their money into electricity because it offers reliable returns. Yet green energy has a dirty secret. The more it is deployed, the more it lowers the price of power from any source. That makes it hard to manage the transition to a carbon-free future, during which many generating technologies, clean and dirty, need to remain profitable if the lights are to stay on. Unless the market is fixed, subsidies to the industry will only grow.

Policymakers are already seeing this inconvenient truth as a reason to put the brakes on renewable energy. In parts of Europe and China, investment in renewables is slowing as subsidies are cut back. However, the solution is not less wind and solar. It is to rethink how the world prices clean energy in order to make better use of it.

| *Shock to the system*

At its heart, the problem is that government-supported renewable energy has been imposed on a market designed in a different era. For much of the 20th century, electricity was made and moved by vertically integrated, state-controlled monopolies. From the 1980s onwards, many of these were broken up, privatised and liberalised, so that market forces could determine where best to invest. Today only about 6% of electricity users get their power from monopolies. Yet everywhere the pressure to decarbonise power supply has brought the state creeping back into markets. This is disruptive for three reasons. The first is the subsidy system itself. The other two are inherent to the nature of wind and solar: their intermittency and their very low running costs. All three help explain why power prices are low and public subsidies are addictive.

First, the splurge of public subsidy, of about \$800bn since 2008, has distorted the market. It came about for noble reasons—to counter climate change and prime the pump for new, costly technologies, including wind turbines and solar panels. But subsidies hit just as electricity consumption in the rich world was stagnating because of growing energy efficiency and the financial crisis. The result was a glut of power-generating capacity that has slashed the revenues utilities earn from wholesale power markets and hence deterred investment.

Second, green power is intermittent. The vagaries of wind and sun—especially in countries without favourable weather—mean that turbines and solar panels generate electricity only part of the time. To keep power flowing, the system relies on conventional power plants, such as coal, gas or nuclear, to kick in when renewables falter. But because they are idle for long periods, they find it harder to attract private investors. So, to keep the lights on, they require public funds.

Everyone is affected by a third factor: renewable energy has negligible or

zero marginal running costs—because the wind and the sun are free. In a market that prefers energy produced at the lowest short-term cost, wind and solar take business from providers that are more expensive to run, such as coal plants, depressing power prices, and hence revenues for all.

| *Get smart*

The higher the penetration of renewables, the worse these problems get—especially in saturated markets. In Europe, which was first to feel the effects, utilities have suffered a “lost decade” of falling returns, stranded assets and corporate disruption. Last year, Germany’s two biggest electricity providers, E.ON and RWE, both split in two. In renewable-rich parts of America power providers struggle to find investors for new plants. Places with an abundance of wind, such as China, are curtailing wind farms to keep coal plants in business.

The corollary is that the electricity system is being re-regulated as investment goes chiefly to areas that benefit from public support. Paradoxically, that means the more states support renewables, the more they pay for conventional power plants, too, using “capacity payments” to alleviate intermittency. In effect, politicians rather than markets are once again deciding how to avoid blackouts. They often make mistakes: Germany’s support for cheap, dirty lignite caused emissions to rise, notwithstanding huge subsidies for renewables. Without a new approach the renewables revolution will stall.

The good news is that new technology can help fix the problem. Digitalisation, smart meters and batteries are enabling companies and households to smooth out their demand—by doing some energy-intensive work at night, for example. This helps to cope with intermittent supply. Small, modular power plants, which are easy to flex up or down, are becoming more popular, as are high-voltage grids that can move excess power around the network more efficiently.

The bigger task is to redesign power markets to reflect the new need for flexible supply and demand. They should adjust prices more frequently, to reflect the fluctuations of the weather. At times of extreme scarcity, a high fixed price could kick in to prevent blackouts. Markets should reward those willing to use less electricity to balance the grid, just as they reward those who generate more of it. Bills could be structured to be higher or lower depending how strongly a customer wanted guaranteed power all the time—a bit like an insurance policy. In short, policymakers should be clear they have a problem and that the cause is not renewable energy, but the out-of-date system of electricity pricing. Then they should fix it. ■



可再生能源

清洁能源的肮脏秘密

可再生能源革命正在破坏全球电力市场。以下是应该去做的事

光伏电池和风力发电机发明近150年后，它们的发电量仍只占全球总量的7%。然而，某些显著变化正在发生。十多年前可再生能源还是次要的能源系统，但现在它们的增长速度超过其他任何能源，成本的下降也使之能够与化石燃料相抗衡。石油公司BP预计，未来20年内可再生能源将占全球能源供应增长的一半。认为世界正在进入一个清洁、廉价和电力无限供应的时代的想法已不再是天方夜谭。而且也是时候了。

不过在此之前还需借20万亿美元的东风。要跨进未来的电力时代，在未来几十年内还需大量投资，以取代喷烟吐雾的老旧发电厂，并升级向消费者输电的电缆塔和电线。由于回报可靠，投资者通常喜欢投资电力行业。然而，绿色能源有一个肮脏的秘密。绿色能源部署越多，就会把其他来源电力的价格打压得越低。这让向无碳未来的过渡变得很难管理，因为在这期间，许多发电技术不论清洁与否都需要保持盈利，才能保证电力供应。除非能解决市场问题，否则对电力行业的补贴只会增长。

政策制定者已经把这一“难以忽视的真相”视为限制可再生能源的理由。在欧洲部分地区和中国，由于补贴减少，对可再生能源的投资正在放缓。不过解决问题的方法不是减少风能和太阳能，而是要重新思考清洁能源的定价问题，以便更好地利用这些能源。

| 系统震撼

问题的核心是，政府支持的可再生能源被强加在一个设计于不同时代的电力市场上。在20世纪的大部分时间里，电力都是由垂直整合的国有垄断企业生产和传送。20世纪80年代开始，很多垄断电力企业被拆分、私有化和自由化，让市场力量可以决定最佳投资方向。如今，只有约6%的用户由垄断企业提供电力。然而，各地要求低碳电力供应的压力让国家的影响又重新蔓延到各个市场之中。这是具有破坏性的，原因有三：第一是补贴制

度本身；另外两个原因与风能和太阳能自身的特点有关：这两种能源是间歇性供应的，且运行成本非常低。这三点都有助于解释为什么电力价格低，而公共补贴却难以戒停。

首先，2008年以来的公共补贴高达8000亿美元左右，扭曲了市场。补贴的理由很崇高：应对气候变化，推动昂贵新技术的应用，包括风力发电机和太阳能电池板。然而，由于能源效率的提高和金融危机的影响，富裕国家的电力消费停滞不前，而补贴恰逢此时。结果便是发电能力过剩，这大大减少了电力公司在电力批发市场上的收入，从而阻碍了投资。

第二，绿色能源的供应有间歇性。风和太阳变化无常（特别是在天气条件不利的国家），令风电机组和太阳能电池板只能在部分时间发电。为了保持电力持续供应，电力供应系统仍需依赖传统发电厂（例如火电厂、天然气电厂或核电站）在可再生能源供应不足时顶上。但由于传统发电厂长期闲置，吸引私人投资者变得更加困难。因此，为了保证电力供应，它们就需要公共资金补贴。

第三个因素影响整个电力行业：可再生能源的边际运行成本可谓微不足道，甚至为零，因为风和太阳光是免费的。电力市场更喜欢以最低短期成本生产出来的能源，风能和太阳能便从运行成本更高的电力供应商（如火电厂）手中抢走了生意，压低了电价，结果大家的收入都减少了。

| 动动脑筋

可再生能源的渗透率越高，这些问题就越严重，尤其是在饱和市场。欧洲首当其冲，那里的电力行业经历了“失落的十年”——收益下降、资产搁浅、企业拆分。去年，德国两大电力供应商意昂集团（E.ON）和莱茵集团（RWE）都一分为二。在美国可再生能源丰富的地区，电力供应商很难为新电厂找到投资。像中国这样风能充沛的地方正在缩减风电场以保证火力发电厂得以为继。

结果是，投资主要流向了受益于政府支持的领域，而电力系统正在重新受到监管。吊诡的是，国家对可再生能源的支持越多，对传统发电厂的补贴

也就越多，因为政府需要支付“保持产能费用”来缓解清洁能源间歇性供电的问题。实际上，现在又换成政客而不是市场来决定如何避免停电了。然而政客却经常犯错：德国尽管对可再生能源提供巨额补贴，但仍支持低价、肮脏的褐煤发电，导致排放量上升。没有新的方法，可再生能源革命就会后劲不足。

好消息是新技术可以帮助解决这个问题。数字化、智能电表和电池使公司和家庭能够调节需求，例如在夜间做耗电多的工作，这有助于应对间歇性电力供应的问题。小型模块化的发电厂容易调节发电量，高压电网也可以更有效地在电网上调配多余的电力，这些也都变得越来越受欢迎。

更严峻的任务是重新设计电力市场，以反映对灵活供需的新需求。市场应更频繁地调整价格，以体现天气的波动。在电力极端稀缺的时候，可以启动高固定电价来防止停电。市场应该像奖励多发电的电厂那样，奖励愿意少用电的人或机构来平衡电网。电费账单上的电价可以根据客户对24小时供电保证需求的意愿上调或下降，有点像保险单那样。总之，政策制定者应该明白他们遇到了问题，但原因并不出在可再生能源上，而是过时的电价制度。然后他们就该解决问题了。■



Schumpeter

They've lost that loving feeling

Foreign firms were lukewarm on America long before Donald Trump

WHICH is it? The home of free speech, the rule of law and the rich world's most dynamic economy? Or a land of social decay, septic politics and the rich world's worst roads and schools? America divides foreign observers. It divides foreign firms, too. Some bosses fall head over heels for its insatiable consumers and dazzling technology. Other executives are put off by its insufferable lawyers and hypocritical protectionism. Donald Trump promises to give foreign firms a rude awakening when he reaches the White House: last month he beat up Toyota for making cars in Mexico and selling them north of the border. But in truth many foreign firms fell out of love with America years ago.

The conventional view is that foreign companies are irresistibly attracted to the place. If one affair ends in tears, there is always a new paramour in the wings. In the 1970s British buccaneers, led by Sir James Goldsmith, picked up neglected firms. In the 1980s Japanese firms lost their financial virginity by paying too much for Hollywood studios and Californian skyscrapers. A decade later continental European firms rushed across the pond, culminating in Daimler's doomed tryst with Chrysler, a rival carmaker. By this account, Chinese firms are the latest to get the love bug, with China's richest man, Wang Jianlin, in the role of the besotted tycoon, having paid a blockbuster \$4bn to assemble a chain of mature American cinemas since 2012.

But this narrative is hopelessly out of date. The most accurate metaphor for foreign firms in America today is of disappointed hopes. Their share of private output has been flat at about 6% since 2000. The share of sales that European firms make in America has declined from 20% in 2003 to 17%

now, according to Morgan Stanley, a bank. Foreign firms' profits in America fell from \$134bn in 2006 to \$123bn in 2014, the latest year for which figures are available. Their return on equity fell to 6%, compared with 11% in 2006. American multinationals make 12% on their home turf.

This souring romance reflects three deep shifts in America's economy. First, technology has a greater importance than it used to. At the same time the gap between Silicon Valley's giants and their peers abroad has grown wider. A generation ago Europe and Japan had real contenders in the technology industry, such as Nokia and Sony. Now they have no answer to the likes of Apple, Google and Uber.

Second, waves of mergers and acquisitions have made the economy more concentrated. That has raised the barriers to entry for outsiders. If you split the world's companies into 68 industries, American firms are the largest in two-thirds of them. Foreign companies in America are often subscale and too small to buy the leading firms in their sector. So they try to grow organically or buy weaklings instead. In 2013 SoftBank, a Japanese technology group, paid \$22bn to buy a struggling mobile-phone operator, Sprint, which is now losing a billion dollars a year. The most profitable investment in living memory by a foreign firm in America was not a gutsy triumph but a passive stake in a domestic oligopoly: Vodafone's 45% share of Verizon Wireless, which it sold for \$130bn in 2014.

The third reason for foreign firms' discontent is the growth in lobbying, litigation and regulatory action in America. Foreign companies feel they are at a competitive disadvantage. In the most regulated sector of all—banks—their market share has fallen to 14% from 18% in the past 24 months, partly, they argue, owing to onerous new rules. Most fines involve lots of official discretion. In carmaking and energy, Volkswagen and BP have admitted their respective responsibilities for fake emissions tests and the Deepwater Horizon oil spill. But many European bosses believe that the

cumulative \$70bn of legal costs and penalties they have paid or currently face far exceed those that General Motors and ExxonMobil paid for similarly grave mistakes. In December Barclays vowed to fight a \$5bn-odd fine for mortgage mis-selling, which it argues is harsher than those faced by American banks.

The Trump administration could well awaken a protectionist impulse at big domestic firms that lies not far beneath the surface, reckon the most pessimistic of all. Jamie Dimon's latest letter to the shareholders of JPMorgan Chase warns that American banks' dominance could be threatened by Chinese rivals. A report on semiconductors for the White House last month, written by a body that includes the bosses of Google, Qualcomm and Northrop Grumman, recommends protecting the chip industry from Chinese competition. America's airlines constantly complain about unfair competition from Emirates and other rivals.

| *Takeovers or makeovers*

A more populist America may require fresh tactics from foreigners. Some are working on their connections. Masayoshi Son, boss of SoftBank, pledged to invest \$50bn in America after meeting Mr Trump in December. The head of Anbang Insurance, a Chinese firm that is no stranger to relationship-based capitalism at home, dined with Mr Trump's son-in-law, Jared Kushner, in November. Anbang owns the Waldorf Astoria, among other American assets. Another approach is to buy a well-placed oligopoly. InBev's purchase in 2008 of Anheuser-Busch, maker of Budweiser Beer, has become a model for winning in America. Other deals in 2016 echoed it. Bayer agreed to buy Monsanto, which dominates the agricultural-seed business, and BAT is bidding for Reynolds American, which has a big share of the tobacco market.

A last option is for foreign firms to assume a more American identity. In sensitive sectors, they already try to take on a local character. BAE Systems,

a defence concern, has a separate American board stacked with former brass hats. After the trade spats of the 1980s, Asian car firms localised their production and management. Rupert Murdoch shifted his media empire's domicile from Australia to America in 2004. As any dating-website veteran will tell you, if you can't find love, change your appearance. ■



熊彼特

爱意已褪

特朗普上台前，外国公司对美国早已丧失热情

以下两者哪个才是美国？言论自由、法治之地、富裕世界中最具活力的经济体？还是社会堕落、政治腐败、富裕世界里道路和学校最糟糕的国家？外国观察家对美国看法不一，外国公司同样如此。有些公司老板为美国庞大的消费群体和炫目的科技倾倒，也有高管因美国那些令人讨厌的律师和虚伪的保护主义而却步。特朗普承诺入主白宫后给外国公司猛敲一记警钟。上月，他便因丰田公司在墨西哥制造汽车并销往美国而向其开炮。但实际上，许多外国公司在多年前便已不再钟情美国。

一般看法认为，外国公司难以抗拒美国的魅力。假如一段情缘悲剧收场，总会有新的情人伺机而动。上世纪70年代，以詹姆斯·戈德史密斯爵士（Sir James Goldsmith）为首的英国“海盗”把受冷落的美公司收入囊中。80年代，日本公司首度大举投资，高价收购好莱坞的电影公司和加州的摩天大楼。十年后，欧洲大陆的公司竞相跨越大西洋涌入美国，随着戴姆勒与对手克莱斯勒发生一场注定难有善终的幽会，这一风潮达到顶峰。这样看来，中国公司是美国市场的最新情人。中国首富王健林就扮演了一位为美国疯狂的大亨，自2012年来，他已投入惊人的40亿美元来整合一系列成熟的美国院线。

不过这样的故事已经完全过时了。对于如今在美的外国公司，最准确的形容是“美梦破灭”。自2000年以来，它们在私营部门产出中所占份额一直停留在6%左右。据摩根士丹利的数据，欧洲公司在美国的销售份额已从2003年的20%下降至如今的17%。外国公司在美利润从2006年的1340亿美元降至2014年的1230亿美元（可获得数据的最近一年）。其股本回报率下降到6%，而2006年为11%。美国跨国公司在自家主场的股本回报率则为12%。

花残月缺，浪漫不再——这反映出美国经济的三个深刻转变。首先，科技

的重要性更胜从前。同时，硅谷巨头与其海外同行之间的差距也已拉大。二三十年前，欧洲和日本在科技行业还拥有可与美国企业实力匹敌的公司，如诺基亚和索尼。而现在，它们并没有能挑战苹果、谷歌、优步等美国巨头的企业。

第二，并购浪潮令美国经济更为集中，继而提高了外来者进入美国市场的门槛。如果将全世界的公司分为68个行业，其中有三分之二都由美国公司称霸。在美国的外国公司通常规模较小，无法收购所在行业的领先企业。所以它们试图内生扩展或转而收购较弱小的公司。2013年，日本科技企业软银斥资220亿美元收购苦苦挣扎的美国手机运营商Sprint，而现在Sprint年亏损十亿美元。记忆中，外国公司在美国投资获利最丰厚的并非是大胆行动获取的胜利，而是来自对美国国内寡头的被动投资：2014年，沃达丰以1300亿美元出售其拥有的威讯无线（Verizon Wireless）45%的股份。

令外国公司不满的第三个原因是美国游说、诉讼、监管行动的日益增多。外国公司感觉自己处于竞争劣势。在银行业这一监管最严的领域，它们所占的市场份额在过去24个月里已从18%下降至14%。它们认为繁重的新规定是导致这一结果的部分原因。大多数罚款都涉及很多的行政裁量。在汽车制造业和能源产业，大众和BP已分别对排放测试造假及“深海地平线”（Deepwater Horizon）钻井平台石油泄漏事故承认负有责任。但许多欧洲公司老板相信，两家公司已支付或目前面临的累计700亿美元的诉讼费用及罚款远超过通用汽车和埃克森美孚为类似的严重错误所付出的代价。去年12月，巴克莱银行因不当销售抵押贷款证券的指控被判罚50多亿美元。巴克莱誓将上诉，认为这比其他美国银行受到的判罚更严厉。

最为悲观的看法认为，特朗普政府很可能唤起国内大企业那隐藏不深的保护主义冲动。杰米·戴蒙（Jamie Dimon）最近在给摩根大通股东的信件中警告道，美国银行的主导地位可能会受到中国对手的威胁。上月，谷歌、高通（Qualcomm）、诺斯洛普·格鲁门（Northrop Grumman）等公司的高管联合为白宫撰写了有关半导体的报告，建议保护美国芯片行业免受来自中国的竞争。美国的航空公司也经常抱怨阿联酋航空等对手的不公平竞争。

| 收购，或者变身

面对民粹主义抬头的美国，外国人可能需要采取新策略。有些人正在努力搭建人脉。软银老板孙正义在去年12月与特朗普会面后承诺向美国投资500亿美元。中国的安邦保险在本国深谙资本主义的关系之道，其董事长与特朗普的女婿贾瑞德·库什纳（Jared Kushner）在去年11月曾聚餐接洽。安邦拥有华尔道夫酒店等美国资产。另一方式是收购业绩优秀的寡头垄断企业。英博（InBev）在2008年收购了百威啤酒的制造商安海斯-布希（Anheuser-Busch），成为外国公司在美国的制胜典范。2016年的其他并购案重复了这一模式。拜耳同意收购雄霸农业种子生意的孟山都（Monsanto），英美烟草公司（BAT）正在竞购在烟草市场上占有相当份额的雷诺兹美国公司（Reynolds American）。

外国公司的最后一个选择是进一步美国化。在敏感行业，它们已努力尝试本地化。军火企业英国BAE系统公司（BAE Systems）单独另设美国董事会，由退役高级军官坐镇。20世纪80年代的贸易争端后，亚洲的汽车公司已将其生产及管理本地化。2004年，默多克将其媒体帝国的注册地从澳大利亚转移至美国。正如所有约会网站的老手会告诉你的那样，如果找不到爱人，那就改头换面再来。■



Rare diseases

Fixing fate

New medical cures may mean changes in drugmakers' business models

WHEN families leave the genetic institute at the San Raffaele Hospital in Milan, they are still anxious. Later, many will come to see the day their children received gene therapy as a blessed new start. Youngsters who had been sentenced to short lives, full of suffering caused by faulty DNA, get better and thrive. Cures for rare genetic diseases, both for children and adults, were once no more than a dream, but now they are set to become commercial reality.

Gene therapies take sections of correct DNA and insert them into cells, often using viruses. Once inside the cell, the new DNA produces the protein that was formerly missing and the fault is fixed. Last July America's Food and Drug Administration (FDA) handed out "breakthrough" designations—intended to hasten the approval of important new treatments—to two gene therapies. One, made by Pfizer, a giant drugmaker, and Spark Therapeutics, a biotech company, is for haemophilia B, a rare bleeding disorder. The other, made by a specialist gene-therapies firm, AveXis, is for a severe neuromuscular disease. Money is pouring into the area: last July, a gene-therapy biotech firm, Audentes, raised \$75m in an initial public offering.

Although only a handful of gene therapies have been approved around the world, the number in development has doubled since 2012, according to analysts at Datamonitor Healthcare. Spark Therapeutic's SPK-RPE65, which restores vision by treating an inherited retinal condition, is most likely to be the first to receive full approval in America.

But most genetic diseases are extremely rare. Take Strimvelis, a therapy that

GSK, a British drug company, has approval to market in Europe. The treatment, developed at the San Raffaele, cures ADA-SCID, an immune disease that is often fatal in the first year of life. Annually, just 15 patients are diagnosed with it across Europe. Developing financially viable therapies for such tiny markets will be extremely difficult.

So far GSK has not said how it will price Strimvelis, but the industry is watching the decision keenly. Martin Andrews, the firm's head of rare diseases, says there is little point in bringing a medicine to market that nobody can afford, so the price has to be set as low as possible. But his firm also has to make a return on its investment, he points out. The lessons from Glybera, the first gene therapy to be sold in Europe, still loom large. It cures a genetic condition that causes a dangerously high amount of fat to build up in the blood system. Priced at \$1m, the product has only been bought once since 2012 and stands out as a commercial disaster.

Some suggest the costs of expensive therapies like this might be spread over many years. Another idea is to pool the risk of having to pay for them among health insurers. Andrew Chadwick-Jones, a partner at Oliver Wyman, a consulting firm, says the pharmaceutical industry would like to move to an "outcome-based system" for many drugs, in which firms can show that high prices still reduce overall health-care costs. Health providers may find that cures are cheaper in the long run than existing treatments for chronic and life-shortening conditions, so they may be willing to pay prices that allow the drug firms to make a profit.

Mr Andrews predicts that eventually, larger numbers of patients will generate far more creative thinking by pharmaceutical companies. GSK is looking at automation as a way of reducing the cost of gene-therapy treatments. Keith Thompson, boss of the Cell and Gene Therapy Catapult, an accelerator funded by the British government, says there is a "global race" to see who can do this better and faster. His group is building a

manufacturing centre that aims to help supply gene therapies to the drugs industry. Industrialising the process will take years. But a new chapter in medicine, and perhaps in the pharmaceutical business model, has begun. ■



罕见疾病

修补宿命

新的医疗方法可能意味着制药公司商业模式的变化

离开米兰的桑拉斐尔医院（San Raffaele Hospital）遗传研究所时，家属们仍然忧心忡忡。再过些时候，他们中的许多人都会将孩子接受基因治疗的那一天视为幸运的新起点。那些青少年曾经由于DNA缺陷而被认定为短寿而多病，如今他们却病情好转、身体复健。治疗儿童和成人的罕见遗传病曾经只是梦想，但现在则势将成为商业现实。

基因疗法提取正常DNA的片段——通常运用病毒——植入细胞内。一旦进入细胞，新的DNA就会产生之前缺失的蛋白质，从而修复缺陷。美国食品药品监督管理局（FDA）去年7月授予两种基因疗法“突破性”疗法认证（此认证旨在加快对重大新疗法的审批）。第一种疗法由制药巨头辉瑞和生物科技公司Spark Therapeutics推出，针对罕见出血性疾病B型血友病。第二种疗法由专注基因疗法的AveXis公司研发，用以治疗一种严重的神经肌肉疾病。资金正在涌入这一领域：去年7月，专注基因疗法的生物技术公司Audentes上市融资7500万美元。

根据Datamonitor Healthcare公司分析师的数据，尽管全世界只有为数不多的基因疗法获得批准，但自2012年以来，在研基因疗法的数量已经翻了一番。Spark Therapeutic的SPK-RPE65疗法通过治疗遗传性视网膜疾病来恢复视力，最有可能第一个在美国得到全面批准。

然而，大多数遗传病都非常罕见。以英国制药公司葛兰素史克（GSK）的Strimvelis疗法为例——该疗法于桑拉斐尔医院开发，已在欧洲获批上市，用于治疗免疫性疾病ADA-SCID。这种病症在患者出生一年之内发作往往会致其死亡。整个欧洲每年只有15名患者被确诊。要为这种微不足道的市场开发出财务上可行的疗法将极其困难。

葛兰素史克至今尚未透露将如何为Strimvelis疗法定价，但业界正密切关

注此决定。该公司的罕见疾病业务负责人马丁·安德鲁斯（Martin Andrews）表示，将一种没有人买得起的药物推向市场并没太大意义，因此定价得尽可能低。但他同时指出，他的公司也必须在投资上获得回报。在欧洲销售的第一个基因疗法Glybera的经验教训仍然历历在目。该疗法用于治疗一种在血液系统中积聚大量脂肪而导致危险的遗传病，售价100万美元。2012年以来仅售出一次，堪称商业灾难。

有人认为像这样昂贵的疗法，成本可以在多年内分摊。另一个想法是由健康保险公司来分担支付这种成本的风险。咨询公司奥纬咨询（Oliver Wyman）的合伙人安德鲁·查德威克-琼斯（Andrew Chadwick-Jones）表示，制药行业希望能将很多药物纳入一种“结果导向的体系”，在此体系下制药公司可以证明高药价仍然能够降低医疗保健的总成本。医疗机构可能会发现，从长远来看，能治愈顽疾的疗法还是会比针对慢性及减寿病症的现有疗法要便宜，因此它们也许会愿意接受高药价，令制药公司得以获利。

安德鲁斯预测，患者增多最终会让制药公司产生更多创造性思考。葛兰素史克认为自动化是降低基因疗法成本的一种方法。英国政府资助的行业促进机构“细胞与基因疗法促进会”（Cell and Gene Therapy Catapult）的负责人基思·汤普森（Keith Thompson）认为，一场“全球竞赛”正在进行，看谁能做得更好更快。他的机构正在建立一个制造中心，旨在帮助向制药行业供应基因疗法。把这一做法产业化将需要数年，但是医药学——或许还有制药厂的商业模式，已经翻开了新的篇章。■



A history of skyscrapers

The up and up

Using economics to explain why buildings get big

THE world is in the middle of an unprecedented skyscraper boom. Last year more than 100 buildings over 200 metres tall were built. What forces drive such ambition? A new book by Jason Barr, an economist at Rutgers University-Newark, focuses on Manhattan, and shows why these behemoths develop, in a conversational style that almost makes you forget that you are reading a book about economic history.

Why is Manhattan synonymous with skyscrapers? In the late 19th century the island was booming: demand to be in particular areas was so high that the only option was to build up. But geography also played a role. The famous grid pattern of the city's streets, imposed early in that century, meant that the average plot of land in the city was fairly small. Manhattan is itself a thin piece of land, making it hard for economic activity to spread out, Mr Barr notes.

New York's first skyscraper, the 11-storey Tower Building, went up in the 1880s. Situated on Broadway, it was a technological breakthrough. The architect, Bradford Lee Gilbert, realised that supporting a super-tall building using conventional techniques would require walls so thick that there would be little floorspace left. So he created an iron frame for the building (after which the only function of the walls was to keep the rain out). On a gusty morning in 1888, New Yorkers anxiously watched Gilbert as he climbed right to the top.

Along the way, Mr Barr punctures some skyscraper myths. For instance, there are relatively few towers between Downtown and Midtown. Urban folklore has it that New York's geology is the reason: the bedrock in that

part of town, the assumption goes, cannot support tall buildings.

A better explanation is New York's economic history. Mr Barr argues that the area between Downtown and Midtown historically had low land values. In the 18th century the rich lived in Downtown areas close to the port and the seat of government. The poor lived just outside. The wealthy reacted to the gradual introduction of public transport in the 1820s and 1830s by moving far out, eventually as far as Midtown, a less-developed area which could be built to their tastes. The in-between zones thus left behind were undesirable, and few people thought it profitable to build skyscrapers there. The spatial economics of the 19th century continues to shape Manhattan's skyline today.

Mr Barr tackles another popular myth, often referred to as the "skyscraper curse". Some economists reckon that a boom in skyscraper construction artificially forces up the price of land; developers want to build an even taller building than their rivals, so they furiously compete for plots. This can push an economy into bubble territory, the thinking goes. Indeed, the 1920s was a period of frantic floor-adding, often with little economic rationale. It culminated in the opening of the Empire State Building in 1931—just as the Great Depression bit. However, Mr Barr's careful statistical analysis indicates that over the long sweep of history, skyscraper construction is rational: bursts of activity tend to follow an increase in land values, but not the other way round.

Economists will appreciate Mr Barr's careful use of wonky concepts; architects and historians will enjoy his keen eye for detail. But whatever your persuasion, after reading this book you will never look up at a skyscraper the same way again. ■



摩天大楼史 拔地而起

用经济学解释为什么建筑越建越大

一场前所未有的摩天大楼热潮正席卷世界。去年，有100多座200米以上的高楼落成。是什么力量推动着这样的壮志雄心？一本由罗格斯大学纽瓦克分校的经济学家杰森·巴尔（Jason Barr）撰写的新书把目光聚焦在曼哈顿，将这些庞然大物出现的原因娓娓道来，几乎让人忘记手中是一本讲经济史的书。

为什么曼哈顿成了摩天大楼的代名词？在19世纪末，曼哈顿蓬勃发展：对于某些区域的需求是如此之高，以至于唯一的选择便是越建越高。不过地理也是一个原因。纽约市的街道在19世纪初就定下了著名的网格格式规划，这意味着城市中普通的地块相当小。巴尔说，曼哈顿本身只是不大的一块地，经济活动难以铺开。

纽约市第一座高楼是在19世纪80年代落成的11层高的塔楼（Tower Building）。它坐落于百老汇，在当时是一项技术突破。建筑师布拉德福德·李·吉尔伯特（Bradford Lee Gilbert）意识到，如果使用传统技术来支撑超高建筑，墙壁就需要非常厚，导致楼面空间所剩无几。于是他为建筑搭建了一个钢制框架，这样墙壁唯一的的功能就是挡雨了。在1888年一个凛冽的早晨，纽约人焦急地看着吉尔伯特爬上了楼顶。

在书中，巴尔还打破了一些关于摩天大楼的迷思。例如，在下城和中城之间的高楼相对比较少，有传闻称这是由纽约的地质原因造成的：城市中这片区域的基岩无法支撑高楼大厦。

更好的解释源自于纽约的经济史。巴尔认为，下城和中城之间区域在历史上地价较低。在18世纪，富人住在靠近港口和政府所在地的下城区，而穷人则住在外围。随着公共交通在19世纪20至30年代逐渐出现，富人越搬越远，最终搬到了中城这个开发不多、可按照自己的口味进行建设的区域。

这样一来，留在中间的区域就不受欢迎了，很少有人认为在那里建设摩天大楼能够赚到钱。直至今日，19世纪的空间经济学仍在塑造着曼哈顿的天际线。

巴尔先生还谈到了另一个往往被称为“摩天大楼诅咒”的流行迷思。一些经济学家认为，摩天大楼的建设热潮人为推高了土地价格，开发商想要建比对手更高的楼，就会拼命争夺地块。这种思路认为这会给经济带来泡沫。确实，20世纪20年代进行了一波疯狂的建设，从经济上看往往没什么道理。疯狂的顶点就是1931年帝国大厦的开张——大萧条接踵而至。不过，巴尔细致的统计分析表明，如果放在历史的长河中，摩天大楼的建设是理性的：土地价值增长后往往出现经济活动的高峰，而不是相反。

经济学家们会赞赏巴尔谨慎地使用了那些靠不住的概念，建筑师和历史学家则会喜欢他对于细节的敏锐眼光。但是不管你持什么想法，读了本书后，你看待摩天大楼的方式必将不同。■



Resistance to antibiotics

The other global drugs problem

A neglected health problem is debated by the UN

All around the world, drug-resistant infections are on the rise. They now kill more than 700,000 people a year. In 2014 nearly 60% of samples of *Escherichia coli*, a common gut bacterium, collected from patients in hospital were strains that could not be treated with penicillins. About 25% were resistant to one or both of two other commonly used sorts of antibiotics.

The main reason for this resistance is overuse of antibiotics by people, both on themselves and on their animals. Between 2000 and 2014, the number of standard doses of antibiotics used increased by 50%. By 2050 drug-resistant infections could cost between 1.1% and 3.8% of global GDP, according to a report published on September 19th by the World Bank.

Two days later, the United Nations held a meeting of heads of state to mull the matter over—only the fourth occasion that the General Assembly has debated a health problem. The assembly did not adopt any targets to curb the use of antibiotics, as some scientists have urged it to do. But its members did promise to draw up and pay for national plans to tackle the issue. There is no time to waste: on current trends, drug-resistant bugs could kill as many as 10m a year by 2050. ■



抗生素耐药性

另一个全球性的药物问题

联合国就一个被忽视的健康问题展开热烈讨论

在世界各地，抗药性感染都在上升。这一问题现在每年会夺走超过70万人的生命。2014年，从医院住院患者身上收集的大肠杆菌（一种常见肠道细菌）样本中，有将近60%无法以青霉素类药物治疗。大约25%的样本对其他的一种或两种常用抗生素有耐药性。

产生这种耐药性的主要原因是人们无论在自身还是在动物身上都过度使用抗生素。2000年至2014年期间，标准剂量抗生素的使用数量增加了50%。世界银行9月19日发布的一份报告表明，到2050年，抗药性感染可能会导致全球GDP损失1.1%至3.8%。

两天之后，联合国举行了一次各国首脑会议以仔细商讨这一问题——联大讨论健康问题，这才是第四次。联大并没有像一些科学家敦促的那样采纳任何目标以遏制抗生素的使用。但其成员国承诺制定全国性计划并拨款来解决这个问题。没有时间可以浪费了：按目前的趋势，到2050年，耐药性细菌每年可能会夺走多达1000万人的生命。■



Architecture

Pile 'em in style

The most exciting architecture in Miami Beach is car parks

CAR parks are rarely well-designed. Even more rarely do they amount to “design”: something to enjoy on a purely aesthetic level. However, in Miami Beach, Florida, the car park has become not just a building type that is visually pleasing, but something else entirely: a set piece that offers architects the chance to show off.

Perhaps because the city has expanded rapidly as a travel destination, its new hotels are invariably disappointing dumb citadels of glass and steel that dominate the city’s charming old art-deco look apparently on purpose. Most galleries and museums are soulless, too, the glamorous veranda of the Pérez Art Museum notwithstanding. Miami is largely built on sand or swamp and has a high water-table, making subterranean parking expensive; building above ground is a better option.

The first building to turn this inconvenience into a design opportunity was the evocatively titled Ballet Valet. Arquitectonica, a local firm, had established itself in the 1980s with a series of brash, colourful apartment blocks that were immediately snapped up as sets for “Miami Vice”, a television series, and “Scarface”, a Cuban gangster epic. Asked in the following decade to create a car park that would add something to a block of boutique shops, Arquitectonica adapted its garish palate to the more sensitive 1990s by wrapping the building in a fibreglass mesh with an irrigation system, and filling it with indigenous clusias and sea lettuce, which ran riot.

Ballet Valet might have remained a one-off were it not for the arrival of Art Basel in Miami Beach. When one of the largest art fairs in Europe was

seeking to expand into America it made an inspired choice. Art was popular there, both among the American celebrity set, who had taken to Miami Beach as a place to party, and among the wealthy Latin Americans who saw the city as both their home and their financial base in America. There were only a handful of galleries, however. Entering into the art-led regeneration of Miami Beach, the car parks are in many ways monuments to the success of that relationship, creating spaces that enable commerce and art to exist side by side.

Car parks put developers at the centre of upcoming areas. Herzog and de Meuron, a Basel firm that also specialises in museums, completed 1111 Lincoln Road in 2010. A ziggurat of bare concrete linked by precipitous ramps, it provides accommodation for a series of art-crowd-friendly shops on the ground floor and a home for the developer, Robert Wennett, on the roof. This giddy stack of concrete cards set a benchmark for audacity, its upper deck providing stunning views and one of the most sought-after party spaces during Art Basel Miami Beach. From this example, the high-end car park became firmly established.

In November, as part of a new six-block development in the mid-Beach area, Alan Faena, an Argentine developer, revealed his parking garage (pictured). It boasts a glazed side elevation that exposes the robotic car elevator, which installs and retrieves cars from closely stacked shelves: a preparation for the dance performances in the Faena Forum arts centre to which it is appended. The car park actually only provides room for around 100 cars (though there are 300 subterranean parking places beneath the development). Yet still Mr Faena felt that the development needed an above-ground car park, to be “a statement”. He had his designed, like the adjacent arts centre, by OMA, the fashionable firm founded by Rem Koolhaas.

Soon the designer car park will breach the borders of the Beach into the

wider metropolitan area. Later this year in downtown Miami, Terence Riley, a former curator at New York's Museum of Modern Art, will open an 800-car garage that will be clad in a crazy collage of different façades designed by five of the world's trendiest practices. Although Miami has no more cars per person than the rest of America, it is still hugely car-dependent. The competition among developers to build the most extravagant or most striking take on an otherwise dull building is typical of Miami's peculiarly intimate glamour. ■



建筑

叠得有格调

迈阿密海滩最令人兴奋的建筑是停车场

停车场很少会经过精心设计，而能称得上有“设计感”，即在纯粹的审美层面上令人享受的就更少了。然而在佛罗里达州的迈阿密海滩（Miami Beach），停车场不但变得在视觉上使人愉悦，还已经完全有别于一般的建筑类型：它们是让建筑师有机会炫技的艺术作品。

也许是因为这座城市作为旅游目的地迅速扩张，这里新建的酒店总是令人失望——清一色是由玻璃和钢铁打造的笨重堡垒，似乎有意要压倒这座城市迷人的老式装饰艺术风格。尽管佩雷斯艺术博物馆（Pérez Art Museum）前的立体植物游廊引人入胜，但大多数画廊和博物馆还都是缺乏灵魂的建筑。迈阿密主要建在沙地或沼泽上，地下水位高，建造地下停车场成本高昂。因此，地上停车场是更好的选择。

第一座将这种不便转为设计机会的建筑是雅名为“芭蕾代客泊车”（Ballet Valet）的停车场。当地建筑设计公司Arquitectonica在20世纪80年代建造了一系列大胆花哨的公寓楼，并因此成名。这些公寓楼立刻被电视连续剧《迈阿密天龙》（Miami Vice）和描述古巴黑帮的史诗电影《疤面煞星》（Scarface）抢先用作拍摄地。在接下来的十年中，Arquitectonica公司受邀在一个精品店街区建一个停车场，为这个街区增添新元素。Arquitectonica调整了自己浮夸的风格以适应九十年代更为感性的审美观，用带有灌溉系统的玻璃纤维网格包裹建筑物外墙，并在网格内种满本土植物金丝桃和海葛苣，长得极为茂盛。

如果不是巴塞尔艺术展来到迈阿密海滩，Ballet Valet停车场很可能只是昙花一现。这个在欧洲规模数一数二的艺术博览会在寻求向美国扩展时，做出了一个富有创意的选择。当时众多美国名人都喜欢到迈阿密海滩举办派对；富裕的拉丁裔美国人则把这座城市看作自己的家和在美国的金融根据地。在这两类人当中艺术都深受欢迎。然而，那时迈阿密只有为数不多的

几家画廊。停车场成为迈阿密海滩以艺术为主导的城市改造的一部分，它创造出让商业和艺术得以并存的空间，在许多方面成为成功搭建起这一关联的丰碑。

停车场使得开发商成为了新建地带的焦点。赫尔佐格和德梅隆设计事务所（Herzog and de Meuron）是一家巴塞尔公司，同时专攻博物馆设计。其设计的林肯路1111号停车场于2010年完工。这座神殿般的裸露混凝土建筑各层由大坡度坡道连接，底层为一系列面向艺术群体的商店提供了空间，开发商罗伯特·温内特（Robert Wennett）在顶楼有套房子。这个由大块混凝土板错落堆叠而成的建筑令人眼花缭乱，为“大胆”的设计订立了基准。其高层的视野绝佳，是迈阿密海滩巴塞尔艺术展期间最抢手的派对空间之一。这一建筑落成以后，高端停车场便扎稳了根基。

去年11月，作为迈阿密中海滩地区一个新的六街区开发项目的一部分，阿根廷开发商阿兰·法纳（Alan Faena）展示了他的停车场（如图）。建筑的侧立面透明，可以看到从紧密堆叠的停车架上停车取车的自动汽车升降梯。这是为与停车场相连的Faena Forum艺术中心的舞蹈演出所做的准备。它实际上仅有约100个停车位的空间（虽然还有300个地下停车位），但法纳认为该项目需要建一个地上停车场来表明一种“态度”。法纳的这座停车场和相邻的艺术中心都是请雷姆·库哈斯（Rem Koolhaas）创办的前卫建筑事务所OMA设计的。

用不了多久，设计师停车场就将冲出迈阿密海滩，进入更广泛的大都会区。今年早些时候，纽约现代艺术博物馆的前馆长泰伦斯·瑞莱

（Terence Riley）将在迈阿密市中心主持开张一个800个车位的停车场。该建筑由世界上最前卫的五大建筑设计事务所设计，外立面由不同的炫目元素拼接而成。尽管迈阿密的人均汽车保有量并不高于美国其他地区，但迈阿密人仍可算非常依赖汽车。开发商竞相要把原本平淡沉闷的停车场建成最豪华或最引人注目的建筑，这正是迈阿密奇特的融洽氛围的典型体现。■



Retailing

Following the fashion

The new retail trend is to watch shoppers inside stores

“LOOK up there,” says Edward Armishaw of Walkbase, a Finnish retail-analytics firm, as he points to a small white box above a column clad in mirrors. The sensor—and over a hundred others like it hidden around this department store in London’s Oxford Street—tracks the footsteps of customers through the pings their smartphones emit in search of a Wi-Fi network. Quite unaware, a shopper in a silver puffa jacket ambles past and over to the fitting room. Whether she moves to the till will be logged by Walkbase and its client.

Think of it as footfall 2.0. For many years shops used rudimentary “break-beam” systems—lasers stretched across their entrances—to count people in and out. Only recently have they begun to follow customers inside their buildings, says Nick Pompa of ShopperTrak, an American firm whose work with 2,100 clients worldwide, including malls in Las Vegas and in Liverpool, makes it a giant in the area.

Tracking technologies are ingenious. Some flash out a code to smartphone cameras by means of LED lighting; others, such as IndoorAtlas, a startup with headquarters in California and Finland, monitor how devices disrupt a store’s geomagnetic field. With smartphone ownership rising, the market for tracking phones indoors could grow fivefold between now and 2021, to a total of \$23bn, says Research and Markets, a market-research firm.

What do retailers hope to gain? The answer depends on how far they push the technology. On the most basic level, a store might notice that people often walk from “frozen goods” to “alcohol”, and then bring the two closer together. A retailer could also gain more insight into which departments

are best at promoting goods—all without knowing anything about shoppers beyond where their legs take them.

If stores can persuade clients to reveal personal information, too, they stand to profit more. Some 200,000 shops around the world now have systems to track phones, including free Wi-Fi, according to ABI Research. The often-overlooked terms and conditions for Wi-Fi typically allow stores to see a shopper's online search history as well as track their location. This can open up a "gold mine" of data, points out Dan Thornton of Hughes Europe, a network provider. Daring retailers already use it to target extremely personal, location-based advertisements to customers' phones. If someone googles a rival while in a suit shop in one of Australia's Westfield shopping malls, for example, Skyfii, the startup that provides their internet service, is ready to send a wavering client a discount on the spot.

But the speed of travel towards a world in which Gap, a retailer, can greet each customer individually, as in the 2002 film "Minority Report", has been much slower than expected, says Tim Denison of Ipsos Retail Performance, a British firm. That is partly because most shops are wary of tracking people quite so closely. European ones are particularly worried that they could spark a backlash over privacy.

Soon, though, such concerns may be swept away. Apple and Google have built up their own expertise in indoor location, and to Patrick Connolly of ABI Research, it is clear that they plan to drop a "bombshell" on the retail industry. Currently an iPhone or Android handset can direct its owner to the shops, but not inside them, let alone to the nearest pair of blue underpants. That is because GPS satellite signals bounce off walls, depriving a smartphone of what it needs to locate itself.

Now both firms are beginning to offer indoor-location services to retailers

that use the motion sensors already in handsets. These can see where their owners are, and where they are moving to, using a map of existing Wi-Fi or radio-frequency signals. Shops would not need to set up systems to follow their customers' phones. Around a third of the 100 biggest American stores are experimenting with some mapping technology from either Google or Apple, says Nathan Pettyjohn of Aisle411, another indoor-positioning firm. So the world of physical shopping may come to resemble that online. At the centre of it will be your phone, knowing exactly what you want, and able to lead you to within 30cm of it. Try that on for size. ■



零售业

追逐潮流

新的零售趋势是要留心观察店内的购物者

“看那上面。”芬兰零售分析公司Walkbase的爱德华·阿米肖（Edward Armishaw）指着被镜子覆盖的柱子顶上一个白色的小盒子说。这个传感器通过顾客的智能手机在搜索Wi-Fi网络时发出的脉冲信号来追踪他们的脚步。在这家位于伦敦牛津街的百货商店里，还有一百多个类似的传感器隐藏在各处。一位身着银色棉夹克的购物者浑然不觉地缓步走过，进入试衣间。她最终是否会去收银台买下衣物将被Walkbase及其客户记录下来。

你可以把它看作footfall（客流分析系统）的2.0版本。多年来，商店一直使用简陋的“光束感应”系统（横跨商店入口的激光）来计算进出的人数。美国索博客（ShopperTrak）的尼克·庞帕（Nick Pompa）表示，它们直到最近才开始在各自的建筑物内部追踪顾客。索博客公司是这一领域的翘楚，服务全球2100家客户，包括在拉斯维加斯和利物浦的购物中心。

跟踪技术很巧妙。一些公司通过LED灯向智能手机的相机传送信号码；总部位于加州和芬兰的创业公司IndoorAtlas以及其他公司监控电子设备对商店内地磁场的干扰。市场研究公司Research and Markets表示，随着智能手机拥有率不断攀升，到2021年，室内追踪手机的市场可能会增长5倍，总值达230亿美元。

零售商希望获得什么？答案取决于它们推动技术的程度。在最基本的层面上，一个商店也许注意到人们经常从“冷冻商品”走向“酒类产品”，之后便将这两类商品摆放得更近。零售商还能更深入地了解哪些部门最擅长促销商品，而它们需要知道的仅仅是客户在店内的行踪。

如果商店还能说服客户透露个人信息，它们会获利更多。根据ABI研究公司（ABI Research）的数据，目前全世界大约有20万家商店拥有追踪手机的系统，包括免费Wi-Fi。由于Wi-Fi的使用条款经常被忽视，商店通常便

可趁机查看购物者的在线搜索历史并跟踪其位置。网络提供商休斯欧洲（Hughes Europe）的丹·松顿（Dan Thornton）指出，这会开启一个数据“金矿”。大胆的零售商已经用它来向客户的手机推送非常个性化且基于位置的广告。例如，如果有人澳大利亚西部集团（Westfield）旗下某个购物中心的西装店里用谷歌搜索竞争对手的门店，为购物中心提供互联网服务的创业公司Skyfi当即就会向犹豫不决的客户发送折扣券。

在2002年的电影《少数派报告》（Minority Report）所展示的未来世界中，零售商Gap能单独迎接每位顾客。但英国公司益普索零售业绩（Ipsos Retail Performance）的蒂姆·丹尼逊（Tim Denison）表示，向这一世界进发的速度已大大慢于预期。这在一定程度上是因为大多数商店都对如此紧密地跟踪顾客持谨慎态度。欧洲的商店尤其担心它们会因隐私方面的问题而遭到抵制。

不过，这种担忧可能很快就会被一扫而空。苹果和谷歌已经打造了自己的室内定位技术。而在ABI研究公司的帕特里克·康诺利（Patrick Connolly）看来，它们显然在计划向零售业投放一枚“重磅炸弹”。目前，iPhone或安卓手机可以带领机主前往商店，但在店内却无能为力，更别说把他们引向最近的蓝色内裤。这是因为GPS卫星信号会被墙壁阻隔，使智能手机无法定位。

目前，这两家公司都开始使用手机自带的内置运动传感器向零售商提供室内定位服务。使用现有Wi-Fi或射频信号的分布图，这些手机便可感知主人的位置以及移动的方向。商店不需要建立系统来追踪顾客的手机。另一家室内定位公司Aisle411的纳森·佩蒂约翰（Nathan Pettyjohn）表示，美国100家最大的商场中大约有一三分之一正在试用谷歌或苹果的一些定位技术。因此，在实体店购物可能会变得像网上购物一样。你的手机将成为这一切的中心，它确切地知道你想要什么，并能带你到离它30厘米以内的地方。试试看合不合身吧。■



Free exchange

A cooler head

Thomas Schelling, economist and nuclear strategist, died on December 13th, aged 95

WITHIN half an hour of waking up on October 10th 2005, Thomas Schelling received four phone calls. The first was from the secretary of the Nobel Committee, with news that he and Robert Aumann had jointly won that year's prize for economics. During the fourth call, when asked how winning felt, he answered: "Well, it feels busy." He was nothing if not truthful. He also confessed to feeling confused about which bit of his work had won the prize.

It might have been his work on addiction—flicked off like ash from his own struggles with smoking. Economists must understand, he wrote, the man who swears "never again to risk orphaning his children with lung cancer", yet is scouring the streets three hours later for an open shop selling cigarettes. Mr Schelling's work laid (largely unacknowledged) foundations for future behavioural economists. In his thinking, addicts have two selves, one keen for healthy lungs and another craving a smoke. Self-control strategies involve drawing battle lines between them.

The prize could also have been for his work on segregation, showing how mild individual preferences could lead to extreme group outcomes. Even if people do not mind living in a mixed community but have just a slight inclination to live near others like themselves, that could lead to deep racial segregation.

By the time Mr Schelling arrived in Sweden in December 2005, he had worked out what the prize was for. His acceptance speech observed that "the most spectacular event of the past half century is one that did not occur. We have enjoyed 60 years without nuclear weapons exploded in

anger...what a stunning achievement—or, if not achievement, what stunning good fortune!” If achievement was the word, the credit was partly his.

Like so many of his generation, Mr Schelling was drawn to economics by the horrors of the Depression in the 1930s. By the time he had finished his PhD in 1948, the agenda had changed. With the wounds of the second world war still fresh, the priority was to prevent a third. He dipped into government, gaining first-hand experience of negotiations, such as those that established NATO. Then in the 1950s he began publishing academic work on bargaining, using his crystal-clear prose to formalise concepts that gifted negotiators knew instinctively, and shunning what Richard Zeckhauser, a colleague, called the “Journal of Advanced Economic Gobbledygook”.

The conflicts Mr Schelling considered transcended the case of two parties scrapping for a bigger slice of a fixed pie. The richness of his subject lay in the truth that “in international affairs, there is mutual dependence as well as opposition.” As neither America nor the Soviet Union wanted to be engulfed in a nuclear mushroom cloud, there was scope for military strategy involving wit, not weaponry. In 1960 he set out his ideas in a book, “The Strategy of Conflict”, which showed how the advantages of co-operation could overcome antagonism, even without a formal bargain.

“Any time somebody talks about deterrence, they’re influenced by Schelling,” says Lawrence Freedman, author of “Strategy: A History”. This deterrence could take several forms. Counter-intuitively, limiting your options can strengthen your hand, by convincing the enemy of your seriousness. Applied to nuclear strategy, Mr Schelling saw that it was important to persuade the opposition that in the event of a nuclear attack, there would be a counter-strike. Weapons that would retaliate automatically if the country was attacked could deter nuclear aggression in

the first place, so defending such weapons was the best way of defending civilian lives. The important thing was to avoid a situation in which one side attacked so as to offset the other's perceived first-mover advantage.

Mr Schelling also promoted the importance of reputation as a useful deterrent. Richard Nixon understood this with what he called his "madman theory": the idea of making the North Vietnamese enemy believe he was capable of anything, including pressing the nuclear button. But consistent behaviour can have as deterrent an effect as erratic unpredictability: if your adversaries believe that you will keep your word, then your word can shape their actions. The danger of this approach, however, is that it could lead to perseverance with a stupid strategy, just to save face.

| *United we stand*

Mr Schelling was often referred to as a game theorist, despite not calling himself one. His methods marked him apart. Mathematical minds had proven elegantly that Mr Schelling's games would always have solutions. There would always be at least one set of strategies where each side was playing its best possible response to the other. When whittling down the number of options, however, the mathematical approach was to chuck more assumptions and equations at the problem. Mr Schelling, in contrast, thought that just as one could not deduce logically whether any given joke will make people laugh, so it was ludicrous to deduce what people might think in a nuclear war from logic alone.

Mr Schelling looked to the real world for help, and argued that shared norms were the answer. When he asked his students to pick a meeting place in New York, unco-ordinated, most would settle on the clock at Grand Central station. In his prize lecture, Mr Schelling used this idea to help explain why nuclear weapons had not been used on the battlefield for so long: their use was a taboo, so the world could settle on a focal point.

On that busy morning of October 10th, when pressed by the third journalist of the morning, Mr Schelling refrained from advising young people. “I wouldn’t necessarily try to talk somebody into...becoming an economist.” Instead of being confined by any academic discipline, he led by example, tackling some of the world’s most worrying—and most intractable—problems. ■



自由交流

更冷静的头脑

经济学家、核战略家托马斯·谢林于2016年12月13日辞世，享年95岁

2005年10月10日，托马斯·谢林（Thomas Schelling）在醒来后的半小时内接了四个电话。第一个是诺贝尔奖委员会的秘书打来的，告知他和罗伯特·奥曼（Robert Aumann）共同获得了该年的诺贝尔经济学奖。到了第四个电话，当被问到获奖有何感受时，谢林答道：“哦，觉得挺忙的”。他再坦率不过了。他还坦言觉得纳闷，不知道自己因为哪部分成果拿了这个奖。

有可能是因为他对上瘾的研究——从他自己与烟瘾的苦战中引发的思索。他写道：经济学家得理解，一个发誓“再也不冒得肺癌而让孩子成为孤儿之险”的人，三个小时后就会满大街找卖烟的小店。谢林的研究为未来行为经济学家的工作奠定了基础（这一点很大程度上未得到承认）。他认为，瘾君子都有两个自我，一个想要健康的肺，另一个惦记着那根烟。有效的自我控制策略需要在两者间做出非此即彼的明确选择。

这个奖项也有可能是为了表彰他在隔离方面的研究。他论证了温和的个人偏好会导致极端的群体结果。即便人们并不介意住在一个混合社区，但哪怕他们有一点轻微的偏向，想住在和自己类似的人附近，也会导致严重的种族隔离。

到了2005年12月谢林抵达瑞典的时候，他已经弄清了获奖的原因。他在获奖感言里说道：“过去50年里最了不起的事是一件没有发生的事。我们已经享受了60年没有核武器愤怒爆炸的时光……这是多么惊人的成就——或者，如果这并不算成就，那是多么惊人的好运啊！”如果这算成就，那么有一部分要归功于他。

和他那一代的很多人一样，谢林被经济学吸引是缘于对上世纪30年代大萧条的恐慌。到1948年他获得经济学博士学位时，形势已经发生了变化。二

战新伤未愈，防止第三次世界大战爆发成了第一要务。他曾在政府里短暂就职，获得了关于谈判的第一手经验，例如建立北约时的磋商。50年代他开始发表关于谈判的学术著作，用他非常清晰明了的行文将一些有天赋的谈判者凭直觉就知道的概念表述出来，避免成为同事理查德·泽克豪斯（Richard Zeckhauser）所说的“《高级经济学天书期刊》”。

谢林所考虑的冲突超越了“从固定大小的馅饼中抢夺更大块”的情形。他立论的丰富是基于这样一个事实：“在国际事务中，既有相互依赖，也有对立。”无论是美国还是前苏联都不想被核爆炸蘑菇云吞没，那么就有了空间来施展依赖智慧而非武器的军事策略。1960年他在《冲突的战略》（The Strategy of Conflict）一书中阐述了自己的观点，证明合作的好处如何能够消滅对立，甚至不需要一场正式的谈判。

“任何时候若有人谈到威慑，就一定受到了谢林的影响。”《战略的历史》（Strategy: A History）的作者劳伦斯·弗里德曼（Lawrence Freedman）说道。这种威慑可能有多种表现形式。与我们的直觉恰恰相反的是，限制你的选择能够增强你的威慑力，因为这让敌人确信你是认真的。运用到核战略上，谢林认为重要的是要让对方相信，自己在遭到核攻击时会发起反击。当国家受到袭击时会自动实施报复的武器能在一开始就阻遏核侵略，因此支持使用这类武器是保卫国民生命的最佳方式。重要的是避免一种情况，即一方为了抵消它认为对方所具有的先发优势而袭击对方。

谢林还推崇名声的重要性，认为这是一种有用的威慑力。尼克松很明白这一点，他有一套“疯汉理论”：让北越敌人相信他什么事都干得出来，包括按下核按钮。然而始终一致的行为和古怪的不可预测性具有同样的威慑力：如果你的对手相信你会说到做到，那么你的话语会塑造他们的行为。不过，这种方法的危险之处是它可能导致咬定一个愚蠢的战略不放，仅仅是为了保全面子。

| 团结一致

谢林常被人称作博弈理论家，尽管他自己从不这么自称。他的方法独树一帜

帜。数学大师们已经很好地证明了谢林的博弈总是有其解决办法，总会至少有一套战略让一方在应对另一方时发挥到最好。不过当要减少选项数量时，数学上的方法是给这个问题更多的假设、列更多方程式。与之相反的是，谢林认为正如无法从逻辑上推断任何一个给定的笑话能否让人发笑一样，只从逻辑出发推断人们在核战争中可能有怎样的想法实在是荒唐可笑。

谢林向现实世界寻求帮助，他认为答案在于共同的规范。当他让他的学生们在纽约挑一个集会地点时，大部分人不约而同地选择了中央车站的大钟。在他的获奖演说中，谢林用这个想法来解释为什么这么久以来战场上并没有用到核武器：它们的使用是一种禁忌，因而这个世界会在一个焦点上妥协。

10月10日那个忙碌的早晨，尽管第三个打来电话的记者一再追问，他仍然不愿给年轻人什么忠告。“我不一定会劝谁.....当经济学家。”他没有局限于任何学科，而是以身作则，对付世界上最让人担忧也最为棘手的一些问题。 ■



Retailing and the environment

Wrap stars

Why food packaging can actually cut emissions

ROUGHLY a third of food produced—1.3bn tonnes of the stuff—never makes it from farm to fork, according to the UN's Food and Agriculture Organisation. In the poor world much of this waste occurs before consumers even set eyes on items. Pests feast on badly stored produce; potholed roads mean victuals rot on slow journeys to market. In the rich world, waste takes different forms: items that never get picked off supermarket shelves; food that is bought but then goes out of date.

Such prodigious waste exacts multiple costs, from hunger to misspent cash. Few producers and processors record accurately what they throw away, and supermarkets resist sharing such information. But some estimates exist: retailers are reckoned to mark down or throw out about 2-4% of meat, for example. Even a tiny reduction in that amount can mean millions of dollars in savings for large chains.

Waste also damages the environment. The amounts of water, fertiliser, fuel and other resources used to produce never-consumed food are vast. The emissions generated during the process of making wasted food exceeds those of Brazil in total. Squandering meat is particularly damaging: livestock account for more emissions than the world's vehicle fleet. Consumption of the red stuff is also set to increase by three-quarters by the middle of the century as newly-rich diners in China, India and elsewhere develop a taste for it. The UN wants to halve food waste per person in shops and in households by 2030 under its Sustainable Development Goals.

Help is at hand in the sometimes squishy, see-through shape of packaging. Far from being the blight that green critics claim it is, food wrappings can

in fact be an environmental boon. By more than doubling the time that some meat items can stay on shelves, for example, better packaging ensures that precious resources are used more efficiently. Planet and profits both benefit.

Vacuum packaging helps enormously here (even though shoppers tend to prefer their cuts draped behind glass counters, or nestled on slabs of black polystyrene). The plastic packs, which prevent oxidation, mean meat can stay on shelves for between five and eight days, rather than two to four. It also makes it more tender. The equipment to vacuum-pack meat costs a few hundred thousand dollars, and its flimsier nature requires different methods of stacking. British retailers are pioneers when it comes to reducing waste through clever wrappings, says Ron Cotterman of Sealed Air, an American packaging giant that works in more than 160 countries and whose clients include huge chains such as America's Walmart and Kroger.

J. Sainsbury, a British grocer which also works with Sealed Air, is already benefiting from a new approach. Jane Skelton, its head of packaging, says that in the last financial year the store reduced waste by more than half after moving more beefsteak lines into vacuum packing. Kroger now ensures that cheeses arrive at its deli counters in vacuum-packaged bags ready for slicing; Walmart is searching for better ways to wrap meats.

Packaging works wonders for customers, too. The resealable kind keeps certain dairy products fresher for far longer in customers' fridges. The practice of packaging a lump of produce in portions allows the growing number of singletons to prepare exactly what they need and freeze the rest. Tesco, a British grocer, now offers chicken in pre-portioned packaging, for example. In 2016 the chain said it aimed to reach a point where no edible food would be binned from its stores by the end of 2017—down from 59,400 tonnes a year now—with a little help from apps that allow charities

to collect unwanted items.

Longer-lasting products ought to mean fewer trips to the shops. But according to Liz Goodwin, a food-waste expert at the World Resources Institute, a think-tank, half of the money shoppers save through better-lasting products winds up in retailers' tills anyway. Aspiring cooks are more likely to buy premium items if they know they will use them before they spoil.

| *The wages of bin*

Vacuum packs and other kinds of wrapping do themselves consume energy and resources in their manufacture. But they make more sense than letting food go to waste. Mark Little, who is in charge of reducing food waste at Tesco, points out that every tonne of waste means the equivalent of 3.5 tonnes of carbon dioxide are released without purpose. In contrast, a tonne of packaging causes emissions of 1-2 tonnes.

This fact is insufficiently recognised by many rich-world retailers. Some supermarkets are trying to cut down on packaging because the common perception is that it is wasteful. But cutting the amount of plastic covering food makes no sense if products then spoil faster, says Simon Oxley of Marks and Spencer (another British retailer, which was among the first to start adopting vacuum-packaging a decade ago). The next frontier for the world of packaging, he says, is ensuring that as much of it can be reused as possible. That will be a challenge, however, given the hard-to-recycle layers of plastics that go into most vacuum packs.

The hope is that rich-world adoption of more efficient packaging could encourage supermarkets in places such as China and Brazil, where retail chains are growing apace, to follow suit (even if issues of hygiene and refrigeration are more pressing concerns at the moment). By the middle of the century, when the UN projects the world's population to be almost

9.7bn people, nutrition needs mean that farms, food processors, shops and homes will need to use resources far more efficiently. Unpack the numbers, and it is clear that wrapping up well will help. ■



零售与环境

包装之星

为什么说食品包装其实能够减排

联合国粮农组织的数据显示，全球每年生产的食品中约有三分之一——13亿吨——未能从产地走上人们的餐桌。在贫穷国家，被浪费的食品中有相当一部分消费者还没来得及看到：存储不当的食品成了害虫的美餐，坑洼不平的道路导致食品在长时间运输过程中腐烂。在富裕国家，浪费的情况有所不同：有些食品摆在超市货架上没人买，有些是被买回去后又放过期。

从饥荒到花冤枉钱，这种巨大的浪费会造成多种后果。很少有生产者和加工者会精确记录自己丢弃了多少食物，超市则拒绝分享此类信息。不过还是有人做了一些估算：例如，零售商会将大约2%到4%的肉类减价销售或丢弃。这部分浪费哪怕能减少一点点，大型连锁超市就能节省数百万美元。

浪费还有害环境。人们消耗了大量的水、肥料、燃料和其他资源来生产这些从未被食用的食品，在这个过程中所产生的排放超过巴西全国的排放总量。浪费肉类对环境尤为有害：畜牧业产生的排放比全世界所有车辆的排放总量还要多。由于中国、印度和其他地方的新富人群逐渐喜欢上红肉，预计到本世纪中叶红肉的消耗量将增加四分之三。联合国根据其可持续发展目标，希望到2030年将商店和家庭中的人均食物浪费量减半。

那些有时软软的、透明的包装就能帮助实现目标。食品包装其实于环境有利，根本不像环保人士说的那样会破坏环境。更好的包装可以确保珍贵资源得以更有效地利用，例如将一些肉制品的货架期延长一倍以上，既可保护地球也有利企业利润。

真空包装能起到非常大的作用（尽管购物者一般更喜欢切好挂在玻璃柜台后、或摆放在黑色塑料托盘上的肉类）。塑料包装可以防止氧化，从而让

肉类可以在货架上摆放五至八天，而不是两到四天。它还会让肉质更嫩。真空包装肉类的设备成本为几十万美元，由于其轻薄的外包装，就需要用不同的方法摆放肉类食品。美国包装巨头希悦尔公司（Sealed Air，该公司在160多个国家开展业务，客户包括美国的沃尔玛和克罗格等大型连锁超市）的罗恩·考特曼（Ron Cotterman）说，英国零售商在巧妙利用包装来减少浪费方面是先行者。

英国食品杂货商英佰瑞（J. Sainsbury）也与希悦尔合作，已从一种新的包装方法中受益。其包装部门负责人简·斯克尔顿（Jane Skelton）说，在上个财政年度，英佰瑞将更多的牛排产品改为真空包装后，店内浪费减少了一半以上。克罗格现在确保用真空包装袋包装奶酪，送到熟食柜台后可以直接切片。沃尔玛也正在探索更好的肉类包装方法。

包装也会为消费者带来各种妙处。可重复密封的包装让某些乳制品在消费者的冰箱中保鲜时间更长。将大块食品分块独立包装的做法让越来越多的单身人士可以按需备餐，并将其余部分冻起来。例如，英国超市乐购（Tesco）如今已在售卖预先切分好的独立包装鸡肉。乐购目前每年浪费59,400吨食物，2016年该连锁超市表示将力争在2017年年底之前实现其店内不再丢弃任何可食用的食物。为达到此目的乐购将会借助一些应用，让慈善机构可以收集无人购买的食物。

产品保质期更长应该会令消费者减少去商店采购的次数，但智库世界资源研究所（World Resources Institute）食品浪费方面的专家莉兹·古德温（Liz Goodwin）认为，消费者购买保质期更久的产品节省下来的钱，有一半最终还是进了零售商的收银机。有追求的烹饪者如果知道自己能在食品过期之前吃掉它们的话，就更有可能购买更优质的食品。

| 垃圾的代价

真空及其他类型的包装在制造过程中本身也会消耗能量和资源，但这仍比把食物丢进垃圾桶更合理。乐购负责减少食物浪费的马克·利特尔（Mark Little）指出，每浪费一吨食物就相当于白白排放了3.5吨二氧化碳。而一吨包装仅会产生1到2吨的排放。

许多富裕国家的零售商都没有充分认识到这一事实。一些超市正试图减少包装，因为普遍的看法是包装会造成浪费。但马莎百货（Marks and Spencer，另一家英国零售集团，十年前率先开始采用真空包装的公司之一）的西蒙·奥克斯利（Simon Oxley）说，如果食品因此而腐败得更快，那么减少使用塑料薄膜包装就不合理了。他说，包装行业的下一个前沿领域就是确保食品包装可以尽量重复使用。然而，由于用于大多数真空包装的塑料薄膜难以回收，这方面的发展面临挑战。

希望在于富裕国家采用更高效的包装会鼓励中国和巴西等国的超市效仿，因为这些国家的零售连锁店正在迅速壮大（尽管卫生和冷藏问题在目前更为紧迫）。联合国预计到本世纪中叶世界人口将达到近97亿，那时的营养需求就意味着农场、食品加工商、商店和家庭对资源的利用必须比现在高效得多。仔细剖析数字之后，很显然恰当的包装会很有帮助。 ■



Oncology

Cancer's master criminals

Doctors should look to proteins as well as genes to tackle tumours

ONE of the most important medical insights of recent decades is that cancers are triggered by genetic mutations. Cashing that insight in clinically, to improve treatments, has, however, been hard. A recent study of 2,600 patients at the M.D. Anderson Cancer Centre in Houston, Texas, showed that genetic analysis permitted only 6.4% of those suffering to be paired with a drug aimed specifically at the mutation deemed responsible. The reason is that there are only a few common cancer-triggering mutations, and drugs to deal with them. Other triggering mutations are numerous, but rare—so rare that no treatment is known nor, given the economics of drug discovery, is one likely to be sought.

Facts such as these have led many cancer biologists to question how useful the gene-led approach to understanding and treating cancer actually is. And some have gone further than mere questioning. One such is Andrea Califano of Columbia University, in New York. He observes that, regardless of the triggering mutation, the pattern of gene expression—and associated protein activity—that sustains a tumour is, for a given type of cancer, almost identical from patient to patient. That insight provides the starting-point for a different approach to looking for targets for drug development. In principle, it should be simpler to interfere with the small number of proteins that direct a cancer cell's behaviour than with the myriad ways in which that cancer can be triggered in the first place.

In December, therefore, in a paper in *Nature Reviews Cancer*, he and Mariano Alvarez, a colleague at Columbia, pull together over a decade of work in an effort to understand how the proteins that regulate cancer are organised. Dr Califano and Dr Alvarez call this organisation “oncotecture”.

Creating the oncotectural blueprint for a cancer starts by analysing the gene-expression profiles of cells from samples of that cancer. A gene-expression profile describes which genes are active in a cell's DNA, and how active they are. Because genes encode proteins it gives a sense of which proteins, and how much of them, a cell is making. Many of these proteins are involved in regulating cellular activity, including growth and cell division (the things that go wrong in cancer), via signalling pathways in which one protein changes the behaviour of others (sometimes hundreds or thousands of others), each of which then changes the behaviour of others still—and so on. Applying a branch of mathematics called information theory to these data, to make them manageable, Dr Califano then maps the connections inside a cell.

One of his most important discoveries is that the resulting networks have a few “master regulator” proteins, which control the largest numbers of other proteins. Dr Califano, whose father-in-law was a Mafia prosecutor in Italy, likens these to the bosses of a network of organised criminals. He sees his job as working out the links between them, in the same way that a detective might study a gang in order to find out who is in charge.

So far, he has analysed data from 20,000 tumour samples and generated maps for 36 types of tumour. All told, he has identified about 300 proteins that are probably master regulators in at least one sort of cancer. These are organised into groups of ten to 30 in each tumour type, and are probably, collectively, responsible for controlling most human cancers.

The master regulators, it turns out, are mostly proteins that affect transcription—the process that copies information in DNA into messenger molecules that carry it to a cell's protein factories. In Dr Califano's view, it is these master regulators that drugmakers should concentrate on, since drugs that modify such proteins' activities are likely to be widely

applicable, in contrast to those focused on genetic mutations.

Indeed, the choice of best targets may be even narrower than this, he says—for among his master regulators lurk a few *capi di tutti capi*. In the view of Gordon Mills, of M.D. Anderson, one example of such a *capo* is an oestrogen-receptor that is involved in breast cancer. This is a transcription factor that controls the expression of many genes. Disabling it with a drug such as tamoxifen, so that it can no longer run its part of the network, is thus particularly effective. Dr Mills says it gives an “incredible outcome”, regardless of the mutations that triggered the cancer in the first place. A second example he cites is Bruton’s tyrosine kinase, which regulates various malignancies of white blood cells.

On top of these specific actions master regulators, like pieces of badly written software, can also set up loops that feed back on themselves and so, once activated, do not shut down. In aggressive prostate cancer, Dr Califano observes, two proteins called FOXM1 and CENPF act together in this way to promote a tumour’s growth. In glioblastoma, a cancer of the brain, three proteins collaborate to start and maintain the cancer. And, according to John Minna of the University of Texas Southwestern Medical Centre, in Dallas, two master-regulator proteins in particular govern the malignancy of small-cell lung cancer.

Dr Minna does, though, argue caution in the master-regulator approach. First he observes, lots of known and suspected master regulators are in classes of protein that have proved difficult to affect with drugs. Second, not all of the master regulators suggested by Dr Califano’s modelling work have been shown to act as such in a laboratory. More experiments are needed to see which of his candidates really are proteinaceous *mafiosi* and which mere stool pigeons that have had the finger pointed at them incorrectly.

To that end, several studies are under way. One, at Columbia itself, is recruiting volunteers with cancer to see if attacking putative master regulators in their tumours works in cell cultures or when parts of the tumours in question are grafted into mice. If this approach yields dividends, that will suggest that attacking master regulators could be an effective way to treat cancer.

Along with existing drugs tied to particular mutations, and a newly emerging class of pharmaceuticals that mobilise the immune system against tumours, master-regulator blasters could provide a third form of precise molecular attack upon this most feared of diseases. ■



肿瘤学

癌症的元凶

要对付肿瘤，除关注基因外，医生们还应将目光投向蛋白质

癌症是由基因突变引发的——这是最近几十年来最重要的医学发现之一。但在临床上要利用这一发现来改善治疗却一直很难。位于得克萨斯州休斯敦的M.D.安德森癌症中心（M.D. Anderson Cancer Centre）最近对2600名病人的研究显示，基因分析仅让其中6.4%的病人和某种专门针对其致病突变的药物成功配对。这是因为引发癌症的基因突变中仅有少数是常见的，因而对付它们的药物也很少。而其他致病的基因突变种类繁多，却都很罕见——罕见到没有什么已知的治疗方法，而且考虑到研发新药的经济成本，人们也不大可能去做。

这样的现实，让很多癌症生物学家质疑用基于基因的方法来理解和治疗癌症有多少实际的用处。一些人甚至不单单是质疑，而是已另起炉灶。纽约哥伦比亚大学的安德烈·卡利法诺（Andrea Califano）就是其一。他观察发现，对于同一种癌症，不论引发癌症的突变为何，维持肿瘤存活的基因表达模式以及相关的蛋白质活动在不同的病人身上几乎完全相同。以这一见解为出发点，人们可以用另一种方法寻找药物研发的标靶。原则上，对引导癌细胞活动的少数蛋白质实施干扰，要比对最初引发癌症的无数基因变异方式实施干扰更为容易。

为此，卡利法诺及其哥大同事马里亚诺·阿尔瓦雷斯（Mariano Alvarez）在去年12月发表于《自然评论：癌症》（*Nature Reviews Cancer*）的一篇论文中总结了十多年来的研究，试图理解调控肿瘤的蛋白质如何组织运作。两位博士将这种组织形式称作“肿瘤建筑”（oncotecture）。

| 300因子俱乐部

要为一种癌症勾画“肿瘤建筑”蓝图，先要分析来自这种癌症样本细胞的基因表达图谱。基因表达图谱描绘了一个细胞的DNA中哪些基因是活跃的以及有多活跃。因为基因对蛋白质编码，我们由此了解到细胞正在制造哪些

蛋白质，以及制造了多少。这些蛋白质中有许多都参与调节细胞活动，包括细胞的生长和分裂（发生癌症时这两个过程都出了问题）。这是通过信号通路实现的，一个蛋白质改变了其他蛋白质的行为（有时是数百个或成千上万个蛋白质），被改变的蛋白质继而又改变了其他蛋白质，就这样一直传递下去。卡利法诺使用了一种名为信息论的数学分支来使这些复杂的数据变得可管理，从而描绘出一个细胞内的各种关联。

他最重要的发现之一，是由此得到的网络中存在着几种“主调控因子”蛋白质，它们控制的其他蛋白质数量最多。卡利法诺（其岳父是意大利专门打击黑手党的检察官）把这些蛋白质比做有组织犯罪团伙的老大。他认为自己的工作就是找出这些蛋白质之间的联系，就像侦探调查帮派来找出谁是老大那样。

到目前为止，他已经分析了来自20,000个肿瘤样本的数据，并为36种肿瘤描绘了网络蓝图。他已经鉴定出了总共约300种蛋白质，在至少一种癌症中可能充当主调控因子。它们在每种癌症中被分成10到30种一组，可能共同控制了大部分的人类癌症。

这项分析发现，主调控因子大多是影响基因转录的蛋白质。基因转录是把DNA中的信息复制到信使分子中（这些分子再把信息运送到细胞的蛋白质生成工厂）。卡利法诺认为，制药公司应该把注意力集中到这些主调控因子上，因为修改这些蛋白质活动的药物很可能适用广泛，这与专注基因变异的药物截然不同。

他说，实际上，最佳靶点的选择可能还会更少，因为在这些主调控因子中潜伏着少数“教父级”蛋白质。在安德森中心的戈登·米尔斯（Gordon Mills）看来，乳癌中的一种雌激素受体就是这样一个“教父”。这种转录因子控制着许多基因的表达，因而如果用他莫昔芬（tamoxifen）等药物令其失效，使其不能再操纵自己那部分网络，效果会尤为显著。米尔斯说，这带来了“难以置信的结果”，而不论起先是什么基因变异引发了癌症。他举的第二个例子是布鲁顿酪氨酸激酶（Bruton's tyrosine kinase, BTK），它调控各种B细胞肿瘤。

除了这些特定的活动之外，主调控因子就像糟糕的软件程序一样，还会制造出环路来作用于自身，因而一旦被激活就无法关闭。卡利法诺发现，在恶性前列腺癌中，名为FOX M1和CENPF的两种蛋白质共同以这种方式促进了肿瘤的生长。在胶质母细胞瘤这种脑癌中，三种蛋白质协作启动和维持了这种恶性肿瘤。而根据德州大学达拉斯西南医疗中心的约翰·明纳（John Minna）的研究，在小细胞肺癌恶性肿瘤中，有两种蛋白质扮演了特别重要的主调控角色。

不过，明纳对这种瞄准主调控因子的方法态度审慎。他指出，首先，许多已知的或被怀疑为主调控因子的蛋白质属于那类已被证明难以用药物影响的蛋白质。其次，由卡利法诺的模型导出的主调控因子并非都已在实验室中被证实了这种身份。需要更多实验来验证这些候选者中哪些确实是黑手党，哪些是被冤枉的内线。

为此，几项研究正在进行中。一项就在哥大展开，研究人员正在招募癌患志愿者，看看对其肿瘤中假设为主调控因子的蛋白质发起攻击是否有效。实验在细胞培养环境中进行，或将部分肿瘤移植到小鼠身上。如果这种方法确有效果，那么将表明攻击主调控因子可以是治疗癌症的一种有效方法。

目前已经有了一些针对特定基因变异的药物，调动免疫系统以对抗肿瘤的新药也在涌现。现在，轰炸主调控因子的药物可以对人类最害怕的疾病发起第三种精确的分子攻击。 ■



Schumpeter

The tycoon as intellectual

Charles Koch is a rare thing, a businessman besotted by ideas

CHARLES KOCH may well be the most demonised businessman in America, with his younger brother, David, a close second. Journalists argue that he is the mastermind of the country's vast right-wing conspiracy. Lunatics have made death threats. The ultra-rich, particularly those who made their original fortunes in oil and gas, are supposed to make amends by giving their money to liberal causes. The Kochs have instead spent hundreds of millions backing conservative political causes (though Charles Koch has no love for Donald Trump), lobbying for lower taxes and attacking the idea of man-made global warming.

Mr Koch doesn't come across as Dr Evil. True, the headquarters of Koch Industries is a collection of black boxes outside Wichita, Kansas; the security screening is rigorous. But its CEO has more of the air of a university professor. Despite his \$40bn fortune, he lives in a nondescript neighbourhood in one of America's most boring cities, puts in nine or more hours a day in the office and lunches in the company canteen. He doesn't seem that interested in his surroundings: complimented on the firm's art collection, he says his wife takes care of that sort of thing. What he is really interested in is books and ideas.

It was as an engineering student at the Massachusetts Institute of Technology in the 1950s that he first fell in love with ideas. There he hit on the subject that has preoccupied him since: why some human organisations flourish while others stagnate. He gorged on the Austrian school of economics—F.A. Hayek, Joseph Schumpeter and, his personal favourite, Ludwig von Mises, Hayek's mentor. He devoured American polemicists such as F.A. "Baldy" Harper, whose treatise of 1957, "Why Wages

Rise” (because of productivity improvements by workers, not union action), he describes as “life-changing”.

Since then his reading has taken him far and wide. The bookshelves in his office are stuffed with works of history, biographies and the latest titles with big ideas. He is surprisingly keen on Howard Gardner, a quintessential Harvard-Yard liberal, and his theory of multiple intelligences (linguistic, musical and interpersonal among them). But Mr Koch found the answer to his question about how organisations prosper by reading the classical liberals: he regards the “spontaneous order” of the free market—the notion that systems are best left to correct naturally, free of human intervention, with the price mechanism allocating resources to the most efficient use—with the same awe with which he regards the natural order of the universe.

Mr Koch has used his reading to forge a theory of management which the Charles Koch Institute, his think-tank-cum-philanthropic outfit, has trademarked as market-based management or MBM. The main idea is that market signals should operate just as vigorously within organisations as between them. Workers should be paid according to the value they add rather than their position in the hierarchy. Koch Industries keeps base pay low (it is regarded as just a down-payment on the year’s value-added reward) and workers are often paid more than their bosses. Companies should grant “decision rights” to those employees who have records of making choices that boost profits.

As Mr Koch’s philosophy took shape, so his company boomed. When he took over as chief executive from his father in the late 1960s Koch Industries was a small company centred on oil and gas with \$200m in yearly sales and 650 employees. Today it is the second-largest private firm in America, with \$100bn in annual revenues and more than 100,000 employees. It is one of the world’s largest commodities traders, operates

three ranches covering more than 460,000 acres, processes some 600,000 barrels of crude oil a day and produces a wide range of materials such as paper towels, nylon and spandex. Koch Industries estimates that its value has increased over 4,500 times since 1960, outperforming the S&P 500 index by a factor of nearly 30.

Yet MBM has attracted remarkably few imitators. Mr Koch says that Morning Star, a California-based tomato producer, has also experimented, independently, with an internal-market system, but that hardly suggests a fashion. One reason may be that Koch Industries is based in the Midwest, away from the great business-theory factories such as Harvard or Stanford. Another is that it is easy to imagine MBM degenerating into a time-consuming bureaucracy. In any case, the firm's success probably owes as much to Mr Koch's managerial drive as to MBM (insiders joke that Koch stands for "keep old Charlie happy"), and to two big insights: that its core competence in processing, transporting and trading can be applied to a wide range of commodities; and that the Midwest is full of first-class engineers and technicians educated in places like Murray State University and the University of Tulsa.

| *The wizard of Kansas*

Even if MBM is not quite the magic formula that Mr Koch claims, however, it serves two clear purposes. It provides a diverse and rapidly growing company with a glue. Koch employees speak of MBM with the same enthusiasm that General Electric's employees once talked about Six Sigma. Unsurprisingly, many have read Mr Koch's books on MBM, "The Science of Success" (2007) and "Good Profit" (2015). For the less scholarly, MBM is funnelled into ten "guiding principles" (such as "principled entrepreneurship") printed on coffee cups and posters throughout the group.

His philosophy also keeps the firm focused on Schumpeter's idea of

creative destruction. Mr Koch is good at spotting opportunities (buying Georgia Pacific, a pulp and paper firm, in 2005 for \$21bn, produced a spell of fast growth). Less obviously, he is always pruning businesses that start to fade. Koch Industries could easily have been a low-growth energy company stuck in the middle of the Great Plains. That it has instead succeeded in doubling its earnings every six years or so since the 1960s is thanks in large part to Mr Koch's unconventional and scholarly mind. ■



熊彼特

知识分子大亨

查尔斯·科赫身为商人，却醉心于思想，实为另类

在美国，查尔斯·科赫（Charles Koch）很可能是被妖魔化最厉害的商人，他的弟弟大卫紧随其后。新闻记者们认为他是美国右翼庞大阴谋集团的幕后主脑。极端分子已向他发出死亡威胁。在人们看来，超级富豪们，尤其是那些靠油气发家的富商，本应资助自由事业以作补偿。科赫兄弟却把数十亿美元用于支持保守派的政治活动（但查尔斯·科赫对特朗普并无好感），为减税游说，并攻击“人类活动导致全球变暖”的说法。

科赫看上去并不像“邪恶博士”。诚然，科氏工业集团（Koch Industries）位于堪萨斯州威奇托（Wichita）郊外的总部仿佛一排排黑盒子，且出入安检严格。但这位集团CEO的气质却更像一名大学教授。尽管坐拥400亿美元身家，他却选择在美国一座沉闷至极的城市中一个平淡无奇的街区里安家，每天在办公室工作至少九小时，午饭都在公司食堂解决。他对周围环境似乎不太在意：别人夸奖公司的艺术藏品时，他表示那都是妻子张罗的。他真正感兴趣的是书籍和思想。

上世纪50年代，科赫在麻省理工学院研读工程学，自此爱上思想研究。在那里，他找到了令他终生求索不懈的主题：人类组织中，为何有些蓬勃发展，有些停滞不前？他饱读奥地利经济学派人物的著作——哈耶克（F. A. Hayek）、熊彼特及他最喜爱的路德维希·冯·米塞斯（Ludwig von Mises，哈耶克的导师）。他谙熟美国思想家的理论，比如哈珀（F. A. “Baldy” Harper），其1957年所著的《工资为何上涨》（因为工人生产力提升，而非工会行动）被科赫誉为“醍醐灌顶”之作。

从那时起，他博览群书，眼界大开。他办公室的书架上摆满了历史著作和人物传记，还有介绍各种重大创见的新书。出人意料的是，他对哈佛自由派代表人物霍华德·加德纳（Howard Gardner）及其多元智能理论（包括语言、音乐及人际智能等）甚为热衷。然而，关于组织机构如何蓬勃发展

这一问题，科赫是通过阅读自由派的经典著作找到答案的：他视自由市场的“自发秩序”如同宇宙的自然秩序，敬畏不已，认为最好让市场体系自行纠正，不加人为干预，通过价格机制最有效地分配资源。

科赫运用阅读心得打造出一套管理理论，并由其智库兼慈善机构查尔·斯科赫研究所（Charles Koch Institute）申请注册商标，称为“基于市场的管理模式”（Market-Based Management, MBM）。其主要理念是，市场信号在组织内部也应像在组织之间那样积极发挥效用。员工薪酬应基于其增值贡献，而非职位等级。在科氏工业集团内，员工的基本工资并不高（仅被视为他们一年增值奖励的部分预付款），而且员工收入往往比上司还高。公司应给予有提升利润往绩的员工“决策权”。

随着科赫的理念成形，他的公司也高速发展起来。上世纪60年代末他从父亲手上接棒时，科氏工业集团只是一家年销售额为两亿美元、专注油气业务的小公司，且仅有650名员工。今天，集团已成为美国第二大私人企业，年收入达1000亿美元，员工人数超过十万。科氏工业也是全球最大的大宗商品交易商之一，经营三个总面积超过46万英亩的牧场，每天处理约60万桶原油，生产纸巾、尼龙、氨纶等各类材料。科氏工业估计，自1960年以来，集团已增值4500多倍，是标普500指数同期增幅的近30倍。

然而，MBM模式却追随者寥寥。科赫表示，加州的西红柿生产商“晨星”（Morning Star）也独立试验过这种内部市场体系，但这几乎并不能表示该模式已成气候。一个原因可能是科氏工业总部在美国中西部，远离哈佛或斯坦福这些“伟大商业理论的工厂”。另一原因是，不难想象，MBM可能沦为空耗时间的官僚做法。不管怎么说，科氏工业的成功，除了归功于MBM模式之外，科赫的管理能力也许同样重要，内部人士开玩笑说，“Koch”是“keep old Charlie happy”（让老查理满意）的缩写。此外，还有两大认知功不可没：公司在加工、运输及贸易方面的核心能力可以应用在众多大宗商品之上；美国中西部不乏从莫瑞州立大学（Murray State University）和塔尔萨大学（University of Tulsa）毕业的一流工程师和技术人员。

| 堪萨斯的魔法师

即使MBM并不完全是科赫所称的神奇配方，但仍有两个明显的作用。该模式为快速成长的多元化企业提供了一种凝聚力。科赫的员工谈及MBM时眉飞色舞的劲头，跟当年通用电气的员工谈论六西格玛的热情有得一拼。其中许多人读过科赫有关MBM的著作——《成功的科学》（The Science of Success, 2007年）及《优秀盈利》（Good Profit, 2015年），这不足为奇。而对于不那么爱钻研书本的员工来说，MBM已浓缩为十大“指导原则”（例如“有原则的企业家精神”），印在咖啡杯和海报上，在集团内随处可见。

科赫的理念也使公司专注于熊彼特所谓的“创造性破坏”上。科赫善于发掘机遇，比如在2005年以210亿美元收购纸浆及纸制品企业乔治亚太平洋公司（Georgia Pacific），缔造了一段快速增长期。相对低调地，他也不断割舍日渐衰微的业务分支。科氏工业原本很可能成为困居北美大平原腹地的低增长能源公司。但相反，自上世纪60年代以来，集团收入每六年左右就翻一番，这很大程度上要归功于科赫突破常规且博学的头脑。 ■



Amancio Ortega

Behind the mask of Zara

The management style of Europe's most successful businessman

IT IS a short walk from a tiny shop with peeling yellow paint in downtown La Coruña, in northern Spain, to a dazzling five-storey store, opened in September by Zara, by far the world's most successful purveyor of "fast fashion". In this stroll across three city blocks, the career of Amancio Ortega unfolds: from teenaged apprentice in the corner shop, Gala, a men's clothing business, to Europe's richest entrepreneur, the majority owner of one of its best-performing firms.

According to one employee of Zara who works with him, "the true story of Amancio Ortega has not been told." Mr Ortega, the son of an itinerant railway worker, who started at the corner shop aged 13, had a basic upbringing: an ex-colleague says he talks of meals of "only potatoes". He has lived mainly in Galicia, a relatively poor region with no history in textiles. Yet there, in 1975, he founded Zara—a manufacturer-cum-retailer that, along with its sister brands, has over 7,000 shops globally.

Mr Ortega (pictured) is now 80 but he remains energetic and involved in the business (if uninterested in wearing trendy clothes). He owns nearly 60% of Inditex, the holding company of Zara and the other chains, which is worth some €100bn (\$106bn). According to *Forbes* magazine, in September his total assets, of nearly \$80bn including his properties and other holdings, briefly surpassed those of Bill Gates.

The manner in which he rose does not fit the usual template. His lack of formal education has profoundly affected his management style. Those close to him confirm that he does read—novels and newspapers—but he is reportedly ill-at-ease with writing at length. He has never had his own

office, desk or desktop computer, preferring to direct his firm while standing with colleagues in a design room of Zara Woman, the flagship line. One former long-term CEO of Inditex, and Mr Ortega's business partner for 31 years, José María Castellano, says that his ex-boss's working method is to discuss things intensely with small groups, delegate paperwork, listen hard to others and prefer oral over written communication.

This preference for close personal interaction may even have helped him concoct the formula behind Zara's success. At a time when the fashion industry mostly outsourced production to China and other low-wage countries (as it still does), Mr Ortega decided to keep most manufacturing close to home. Some 55% happens in Spain, Portugal and Morocco—near the firm's main markets. That in turn allows twice-weekly deliveries of small but up-to-the-minute fashion collections to every store. Inditex's share price has soared tenfold since its flotation in 2001, outstripping rivals such as Gap and H&M (see chart).

His leadership style appears to favour extreme introversion. A video from a surprise 80th birthday party in March shows him tearful and backing off from assembled staff. He almost never speaks in public nor accepts national honours—aside from a “workers' medal” in 2002. Colleagues say he resented a rare biography of him, from 2008, by a fashion journalist, Covadonga O'Shea. So few photos existed of him pre-flotation that investors who visited awkwardly confused him with other staff. But that low profile means there is room for other top executives to shine. Inditex's chairman and CEO, Pablo Isla, has run things since 2011, yet Mr Ortega shows up to work every day. In many firms a professional manager might chafe against the presence of a revered founder, but there are no such reports at Inditex.

In one respect at least, Mr Ortega is more typical of European billionaires.

Like other rich recluses—such as Ingvar Kamprad, the Swedish founder of the IKEA furniture chain—he goes in for only limited philanthropy. He pays for 500 annual scholarships for Spanish students in America and Canada and gives to Catholic charities and for emergency relief. Larger-scale philanthropy would bring unwanted publicity. Like others in southern Europe, he may also be wary of inviting political attacks, such as when Pablo Iglesias, of the left-leaning Podemos party, insinuated during a lament about inequality that Mr Ortega was a “terrorist”.

The managers of his wealth, which grows by some €1bn a year, say they are now scrambling to have slightly less dependence on Inditex, in line with normal investing principles—a difficult task because Mr Ortega only wants property, an investment “he can touch” but which is time-consuming to buy and manage. In December he spent \$517m on Florida’s largest office tower, the Southeast Financial Centre in Miami.

Most of his income is still from Inditex dividends. On December 14th the firm reported results that, once again, met high expectations in financial markets. The numbers will have doubtless gratified the limelight-loathing Mr Ortega, who is said in private to chide others to admire his company, not himself. ■



阿曼西奥·奥尔特加

Zara的面具背后

欧洲最成功商人的管理风格

在西班牙北部拉科鲁尼亚（La Coruña）市中心有一家小店，黄色的墙漆已片片剥落。从这里出发，不用走多远便到达一幢令人目眩的五层建筑。这是目前世界上最成功的“快时尚”供应商Zara于去年9月开张的商铺。这段跨越三个街区的路途，浓缩了阿曼西奥·奥尔特加的职业生涯：十几岁时在街角的男装店Gala里做学徒，之后成为欧洲最富有的企业家、在该洲业绩名列前茅的公司的大股东。

与其共事的一名Zara员工说，“阿曼西奥·奥尔特加的真实故事并不为人所知。”奥尔特加是一个巡线铁路工人的儿子，13岁就开始在街角小店里工作。他只得到了最基本的养育：一位前同事说，奥尔特加曾提到经常一顿饭里“只有土豆”。那时他多数时间都生活在加利西亚（Galicia），这个地区相对贫穷，且历史上并不存在纺织业。然而，就是在那里，他于1975年创立了Zara。这家制造商兼零售商连同其姐妹品牌在全世界已有7000多家门店。

奥尔特加（见图）现年80岁，但仍精力充沛，并积极参与生意上的事务（不过他对时髦的穿着就不感兴趣了）。他拥有Zara及其他连锁品牌的控股公司印地纺（Inditex）将近60%的股份，价值约1000亿欧元（1060亿美元）。《福布斯》杂志报道说，到去年9月，他的总资产（包括房产及其他持有财产）约为800亿美元，略微超过比尔·盖茨。

奥尔特加的崛起之路并不符合惯常的范本。他缺乏正规的教育，这一点深刻地影响了他的管理风格。他身边的人证实，他的确会阅读（小说和报纸），但据说他写起较长篇幅的东西时就不那么自如了。他一直都没有自己的办公室、办公桌或台式电脑，他更喜欢和同事们一道，在旗舰系列“Zara女士”的一间设计室里站着管理自己的公司。曾长期担任印地纺CEO的何塞·玛利亚·卡斯特利亚诺（José María Castellano）与奥尔特加是

长达31年的商业伙伴。他说，他前老板的工作方式是同小组激烈讨论事务，委托他人进行文书工作，认真聆听他人的意见，并且喜欢口头交流更甚于书面沟通。

这种对紧密人际互动的偏好甚至可能还帮他调配出了促使Zara成功的配方。当时时尚产业的大多数从业者都将生产外包至中国及其他低收入国家之时（现在仍旧是这样），奥尔特加却决定将大部分制造工作都留在离本国较近的地方。这其中约有55%是在西班牙、葡萄牙和摩洛哥，毗邻公司的主要市场。如此一来，每家店铺都可以收到每周两次的供货。虽然量不大，但却是最新的服装系列。自2001年上市以来，印地纺的股价已大涨十倍，超越一众竞争对手，如Gap和H&M（见图表）。

看上去，他的领导风格偏向于极度的内敛。一则视频显示，在去年3月庆祝他80岁生日的惊喜派对中，他眼含热泪地从聚集在一起的员工身边退去。他几乎从未在公开场合发言过，也没接受过国家荣誉，除了在2002年获得的“劳动者勋章”。2008年，时尚记者科瓦东高·奥莎（Covadonga O'Shea）十分罕有地为他撰写了一部传记，但他的同事们称，他对这本书很是反感。公司上市前他的照片流传甚少，竟令来访的投资者尴尬地将他与其他员工混淆。不过，这样的低调作风也意味着其他高管就有了大显身手的机会。印地纺的主席兼CEO帕布罗·伊斯拉（Pablo Isla）自2011年开始管理事务，但奥尔特加仍每天都去上班。在许多公司，职业经理人也许会因一位倍受尊敬的创始人的存在而烦躁不已，但在印地纺并没有这样的传闻。

不过至少有一个方面令奥尔特加更符合欧洲亿万富翁的典型特质。和其他深居简出的富翁一样（例如家具连锁店宜家的瑞典创始人英瓦尔·坎普拉德[Ingvar Kamrad]），他只参与有限的慈善活动。他每年提供500个奖学金名额，资助西班牙学生赴美国和加拿大学习，并向天主教慈善机构以及紧急救援行动提供资金支持。更大手笔的慈善捐助只会引来不必要的关注。和其他南欧富豪一样，他似乎也很谨慎，以避免招致政治上的攻击。左倾的社会民主力量党（Podemos）领导人帕布洛·伊格莱西亚斯（Pablo Iglesias）某次哀叹社会不公时，曾影射奥尔特加是个“恐怖分

子”。

奥尔特加的财富每年约增加10亿欧元。他的理财经理称，他们如今正力求略微减少对印地纺的依赖，以遵循一般的投资原则。不过这个任务并不简单，因为奥尔特加只想要不动产这种他“看得见摸得着”、但购买和管理都很耗时的投资项目。去年12月，他豪掷5.17亿美元，购买了佛罗里达最庞大的办公大楼——位于迈阿密的东南金融中心（Southeast Financial Centre）。

奥尔特加的大部分收入依旧来自印地纺的股息。去年12月14日，该公司发布的报告显示，公司业绩再一次达到了金融市场的高预期。据说，不喜欢被关注的奥尔特加曾在私下不无责备地敦促他人去赞赏他的公司而不是他本人。毫无疑问，如今公司取得的数字定会令他感到欣慰。■



Building materials

Top of the tree

The case for wooden skyscrapers is not barking

THE five-storey pagoda of the Temple of the Flourishing Law in the Nara prefecture of Japan is one of the world's oldest wooden buildings. It has withstood wind, rain, fire and earthquakes for 1,400 years. Analysis of the rings in the central pillar supporting the 32-metre structure suggests the wood that it is made from was felled in 594, and construction is thought to have taken place soon after.

In an age of steel and concrete, the pagoda is a reminder of wood's long history as a construction material. New techniques mean that wood can now be used for much taller buildings. A handful are already going up in cities around the world. The 14-storey Treet block of flats in Bergen, Norway, is currently the tallest. But Brock Commons, an 18-storey wooden dormitory at the University of British Columbia in Canada, is due to be completed in 2017. That is when construction is expected to begin on the 21-storey Haut building in Amsterdam. Arup, a firm of engineering consultants working on the project, says it will be built using sustainable European pine. Some architects have even started designing wooden skyscrapers, like the proposed Trätoppen ("the treetop" illustrated), a 40-floor residential tower on the drawing-board in Stockholm.

| *Timber!*

Wood has many attractions as a construction material, apart from its aesthetic qualities. A wooden building is about a quarter of the weight of an equivalent reinforced-concrete structure, which means foundations can be smaller. Timber is a sustainable material and a natural "sink" for CO₂, as trees lock in carbon from the atmosphere. Tall steel-and-concrete buildings

tend to have a large carbon footprint, in part because of the amount of material required to support them. Using wood could reduce their carbon footprint by 60-75%, according to some studies.

There are two main concerns about using wood to build high. The first is whether wood is strong enough. In recent years there have been big advances in “engineered” wood, such as cross-laminated timber (CLT) made from layers of timber sections glued together with their grains at right angles to one another. In much the same way that aligning carbon-fibre composites creates stronger racing cars, aircraft and golf clubs, CLT imparts greater rigidity and strength to wooden structures.

A recent experiment by Skidmore, Owings & Merrill, a firm of architects, and Oregon State University, shows how strong engineered wood can be. The researchers used CLT in a hybrid form known as concrete-jointed timber. This featured an 11-metre wide CLT floor section with a thin layer of reinforced concrete spread across the surface. Thicker sections of concrete were added where the floor was supported by pillars. It was put into a giant test rig where a powerful hydraulic press pushed with increasing force onto the surface. The researchers wanted to see how the structure moved under load, but kept pressing in order to find its limits. The floor finally began to crack when the load reached a massive 82,000 pounds (37,200kg), around eight times what it was designed to support.

The concrete covering the floor was mainly for sound insulation, but it helps to deal with the second worry: fire. The concrete adds a layer of fire protection between floors. In general, a large mass of wood, such as a CLT floor, is difficult to burn without a sustained heat source—for the same reason that it is hard to light a camp fire when all you have is logs. Once the outside of the timber chars it can prevent the wood inside from igniting. The big urban fires of the past, such as the Great Fire of London, which occurred 350 years ago in September, were mostly fuelled by smaller

sections of timber acting as kindling. Prospective tenants would doubtless need lots of reassurance. But with other fire-resistant layers and modern sprinkler systems, tall wooden buildings can exceed existing fire standards, reckons Benton Johnson, a project leader with Skidmore, Owings & Merrill.

He says the test showed that not only can wood be made strong enough for tall buildings but that “it makes sense to use it”. Although a cubic metre of concrete is cheaper than an equivalent volume of timber, wooden buildings can be built faster. Mr Johnson thinks the appeal of wood, both visually and as a sustainable material, will make it commercially attractive to property developers.

What about woodworm and rot? “If you don’t look after it, steel and concrete will fail just as quickly as timber,” says Michael Ramage, head of the Centre for Natural Material Innovation at the University of Cambridge in Britain. Dr Ramage and his colleagues are also testing wooden materials for tall buildings, including for an 80-storey, 300-metre wooden skyscraper (see illustration) presented as a conceptual study to the City of London. Designed with PLP Architecture and Smith and Wallwork, an engineering company, it would, if built, become the second-highest building in London after the Shard.

For a busy city such as London, there are yet more advantages to building higher with timber, adds Dr Ramage. For a start, the construction site would be a lot quieter without the heavy plant required to pound deep foundations, pump concrete and install steel supports. There would also be less construction traffic. Dr Ramage calculates that for every lorry delivering timber for a wooden building, five lorries would be needed to deliver concrete and steel. All these things may mean that once the total construction costs are calculated, a wooden building can work out cheaper.

Anders Berensson, the Swedish architect who designed Trätoppen, believes

engineered wood will become the cheapest way to construct tall buildings in the future. Another benefit of the material, he says, is the ability to carve the wood readily. In his current design the number of each floor is cut into the building's exterior.

One big obstacle to this wooden renaissance is regulation. Building codes vary around the world. In America cities can restrict wooden buildings to five or six storeys (about the height of a fire engine's ladder). Exemptions can be made, however, and proponents of wood are hoping that as taller timber buildings emerge, city planners will adjust the rules. If they do, an old-fashioned branch of architecture might enjoy a revival. ■



建筑材料

树木之巅

用木材建造摩天大楼并非疯狂之举

日本奈良县法隆寺的五重塔是世界上最古老的木结构建筑之一，历经1400年的风吹雨打、火灾与地震仍安然矗立。塔内的中心柱支撑起32米高的结构，对其年轮进行分析后发现，用来制造这根木柱的树木砍伐于公元594年。人们推测这之后不久便开始了整座塔的建设。

在这个钢铁与混凝土的时代，这座塔提醒着人们，木材作为建筑材料的历史有多么久远。有了新技术，如今木材也可以用来建造比从前高得多的建筑——其实在世界上一些城市中，已有几幢这样的建筑建造起来。其中一栋名为Treet的14层公寓楼是目前最高的木结构建筑，位于挪威的卑尔根。而在加拿大，不列颠哥伦比亚大学的18层木结构宿舍楼Brock Commons项目将于2017年完工。同年，一座名为Haut的21层建筑预计也将在阿姆斯特丹开工建设。负责该项目的工程顾问公司奥雅纳（Arup）称，这一建筑将使用可持续木材欧洲松木建造。一些建筑师甚至已经开始设计木结构的摩天大楼。在斯德哥尔摩，一栋40层的住宅楼Tratoppen（“树顶”，见图）正处在设计阶段。

| 木材！

作为一种建筑材料，除却审美意义，木材在很多方面都具吸引力。木结构建筑与同等规模的钢筋混凝土结构相比，重量约为后者的四分之一，这就意味着地基可以建得更小。木材是一种可持续性材料，因树木能存储大气中的二氧化碳，还是二氧化碳天然的“汇”。以钢材及混凝土建造的高层建筑多容易产生大量的碳足迹，部分原因是这种建筑的承重需使用大量建材。一些研究表明，采用木结构或许可将碳足迹减少60%到75%。

人们对用木材建造高楼主要有两方面的疑虑。首先是木材是否足够结实。近些年来，“工程”木制品——例如由彼此纹理交错垂直的多层木板胶合而成的交错层压木材（CLT），已取得了重大进步。用类似的方法将碳纤维

复合材料集束在一起，能制造出更加坚固的赛车、飞机和高尔夫球杆。与之类似，CLT也可赋予木结构更高的硬度和强度。

建筑事务所SOM（Skidmore, Owings & Merrill）和俄勒冈州立大学近期开展的一项测试显示了工程木材能有多结实。研究人员将CLT用于一种被称为“由混凝土接合的木材”（concrete-jointed timber）的混合结构中。该结构由11米宽的CLT楼板及其表面一层薄薄的钢筋混凝土构成，下方有支柱支撑的位置混凝土则更厚。这一混合结构被置于一个大型试验装置之中，一台强力液压机向其表面施压，强度逐渐升高。研究人员希望能观察到此结构在负载之下会有怎样的变形，同时持续加力以探明其极限。最终当负载高达8.2万磅（3.72万公斤）时被测试楼板开始断裂，这个数字约为设计负载的八倍。

在楼板之上覆盖混凝土主要是为了隔音，但这还可以用来应对人们的第二个担忧：耐火性。楼板间的混凝土提供了额外的防火保护层。一般来说，若没有持续的热源，像CLT楼板那样体积庞大的木材并不容易燃烧，这和光有一堆原木是点不起篝火的道理相同。一旦木材的外部烧焦，就会阻断木材内部的燃烧。过去发生的城市重大火灾，如伦敦大火（发生在350年前的9月），多是由成为引火物的小型木材引起的。木结构建筑的潜在房客无疑需要足够的安全保证。但SOM的项目负责人本顿·约翰逊（Benton Johnson）认为，有了额外的防火层以及现代的自动喷水灭火系统，木结构高层建筑完全可以超越现有消防标准。

他说，这项测试不仅表明木材可以成为足够坚固的高层建筑建材，而且还显示出“用木材建筑高楼的合理性”。虽然一立方米的混凝土要比同体积的木材便宜，但木结构建筑建造起来会更快。约翰逊认为木材既美观，又是一种可持续性材料，因而对房地产开发商来说，木材将会展现出商业上的吸引力。

那虫蛀和腐烂的问题怎么解决？“如果不加以维护，钢铁和混凝土会坏得跟木材一样快。”英国剑桥大学天然材料创新中心（Centre for Natural Material Innovation）负责人迈克尔·拉梅奇（Michael Ramage）如此说

道。他和同事也正在对用来建造高层建筑的木质材料进行测试，其中包括一栋300米高的80层木结构摩天大楼所使用的建材（见图）。作为一项关于伦敦金融城的概念研究，此建筑由PLP建筑事务所及工程公司Smith and Wallwork共同设计。一旦建成，它将成为仅次于碎片大厦（Shard）的伦敦第二高建筑。

拉梅奇补充道，对于像伦敦这样繁忙的城市而言，用木材建造更高的建筑还有其他很多好处。首先，没有了需要用来打深层地基、抽送混凝土以及安装钢支架的重型机械，建筑工地的噪声会更小。此外因建筑工作而产生的交通量也将会减少。据拉梅奇计算，木结构建筑所需运送的木材，体量仅为钢筋混凝土建筑的五分之一。这一切也许意味着以全部建筑成本计算，木结构建筑算下来会更便宜。

设计了Tratoppen的瑞典建筑师安德斯·贝伦森（Anders Berensson）相信，未来使用工程木材将成为建造高层建筑最便宜的方法。他说，这种材料的另一好处是木料易于雕刻。在他目前的设计中，每层楼对应的层数都被刻在了建筑物的外立面上。

木材的复兴还需面对监管这一大障碍。全世界范围内，建筑规范各不相同：在美国，城市可将木结构建筑的高度限制在五或六层内（大概相当于消防车云梯的高度）。当然，豁免还是可以获得的。木材的拥护者们希望随着木结构高层建筑的出现，城市规划者会相应调整规则。若真能如此，建筑学的一个古老分支也许将重获新生。■



Nutrition

Bittersweet

Why sugar is bad for you. Really bad

CHRISTMAS is the most fattening time of the year. There are claims that the average Westerner will consume 6,000 calories on December 25th, well over twice the recommended daily intake for men and more than that for women. He or she could put on nearly two kilos in the last week of the year. Short winter days and too much slouching in front of the television accounts for some of that. But the main cause of festive obesity may well be sugar, an essential ingredient in Christmas pudding, brandy butter, chocolate, marzipan, mince pies and alcohol.

“Sugar spoils no dish,” averred a 16th-century German saying. But it certainly spoils and savages people’s health, says Gary Taubes, an American science writer who has focused heavily on the ills of sugar over the past decade and is the co-founder of an initiative to fund research into the underlying causes of obesity. In “The Case Against Sugar” he argues that dietary fat was fingered for decades as the perpetrator of obesity, diabetes and heart disease. Abetted by an industry that funded scientific research linking fat with coronary disease, sugar, the real culprit according to Mr Taubes, was allowed to slip off the hook.

The author sets out to prove that because of its unique metabolic, physiological and hormonal effects, sugar is the new tobacco. It is detrimental to health, yet also defended by powerful lobbies. If, as he contends in one example, the most significant change in diets as populations become Westernised, urbanised and affluent is the amount of sugar consumed, then the conventional wisdom linking fat with chronic disease does not square up. Cultures with diets that contain considerable fat, like the Inuit and the Maasai, experienced obesity, hypertension and

coronary disease only when they began to eat profuse amounts of sugar. Likewise, diabetes—virtually unknown in China at the turn of the 20th century, but now endemic in 11.6% of the adult population, 110m in total.

Sugar is intoxicating in the same way that drugs can be, writes Mr Taubes. Was it not Niall Ferguson, a British historian, who once described sugar as the “uppers” of the 18th century? A medieval recipe even suggests sprinkling sugar on oysters. The craving seems to be hard-wired: babies instinctively prefer sugar water to plain.

As sugar shifted from being a “precious product” in the 11th century to a cheap staple in the 19th century, the food industry proceeded to binge on it, with unheeded consequences. The biggest consumers today are Chilean (see chart). The Dutch, Hungarians, Belgians and Israelis are not far behind. Saudi Arabians also have a sweet tooth. In only ten countries do people eat fewer than 25 grams of sugar a day.

Sugar lurks in peanut butter, sauces, ketchup, salad dressings, breads and more. Breakfast cereal, originally a wholegrain health food, evolved into “breakfast candy”—sugar-coated flakes and puffs hawked to children by cartoon pitchmen like Tony the Tiger and Sugar Bear. A 340ml (12-ounce) fizzy drink contains about ten teaspoons of sugar. Even cigarettes are laced with it. Bathing tobacco leaves in a sugar solution produces less irritating smoke; it is easier and more pleasant to inhale.

Woe, however, to the scientist incautious enough to challenge the party line exonerating sugar. Mr Taubes tells the story of John Yudkin, a nutritionist at the University of London. In the 1960s, Yudkin proposed that obesity, diabetes and heart disease were linked with sugar consumption. Though he acknowledged that existing research, his own included, was incomplete, he became embroiled in a scientific spitting match with Ancel Keys, a well-known American researcher. Keys, whose work on dietary fat

as the prime cause of coronary disease had been supported by the Sugar Association for years, ridiculed Yudkin, calling his evidence a “mountain of nonsense.” The clash—Mr Taubes calls it a “takedown” of Yudkin—is a sad chapter in what Robert Lustig, a paediatric endocrinologist at the University of California, San Francisco, calls “a long and sordid history of dietary professionals in the U.S. who have been paid off by industry”. When Yudkin retired as chair of his department in 1971, the university replaced him with an adherent of the dietary-fat theory.

Because research specific to sugar’s deleterious effects is wanting, the science, Mr Taubes concedes, is not definitive. But it is compelling. The case against sugar is gaining traction. In October the World Health Organisation urged all countries to impose a tax on sugary drinks. Mexico had already done so in 2013. In America cities including Chicago, Philadelphia and San Francisco are following suit. Britain will implement a soft-drink levy in 2018. South Africa and the Philippines have measures under consideration. Perhaps at long last, sugar is getting its just desserts. ■



营养

又苦又甜

为什么糖对人有害，非常有害

圣诞节是一年中让人增肥的日子。据称一个普通西方人在12月25日这一天会摄入6000卡路里的热量，是男性每日建议摄入量的两倍还多，对于女性来说就超出更多了。一个人在一年的最后一周可能会增重近两公斤。冬季白天短，人们窝在电视前的时间太长，这是增重的部分原因。但节日肥胖的主要原因很可能还是糖，它是圣诞布丁、白兰地黄油、巧克力、杏仁蛋白软糖、肉末馅饼和酒类中的关键成分。

16世纪的一句德国俗语笃定地称：“菜里加糖准没错。”但美国科学作家加里·陶布斯（Gary Taubes）认为糖确实会损害甚至摧残人们的健康。他在过去十年中一直专注探究糖的危害，并且与他人共同创建了一个项目，为研究肥胖的根本原因提供资助。在《糖的罪行》（The Case Against Sugar）一书中，陶布斯指出几十年来膳食脂肪一直被视为导致肥胖、糖尿病和心脏病的元凶。食品行业资助那些将脂肪与冠心病联系在一起的科学研究，使得糖这个陶布斯眼中真正的罪魁祸首得以逍遥法外。

作者在书中尝试证明由于其独特的代谢、生理和激素效应，糖就是新的烟草。糖对健康有害，但同样受到强大游说组织的捍卫。陶布斯在一个例子中提出，在人们不断西化、城市化和日益富足的过程中，膳食中发生的最大变化就是糖的摄入量增加。果真如他所说，那么认为脂肪与慢性疾病有关联的传统观念就说不通了。饮食中摄入大量脂肪的族群（如因纽特人和马赛人）只在他们开始摄入大量糖分时才出现了肥胖、高血压和冠心病。同样，糖尿病在20世纪初的中国几乎是闻所未闻，但现在中国成年人糖尿病患病率已高达11.6%，患病人数共计1.1亿。

糖像毒品一样会让人兴奋，陶布斯写道。英国历史学家尼尔·弗格森（Niall Ferguson）不就曾把糖描述为18世纪的“兴奋剂”吗？一个中世纪的食谱甚至建议在牡蛎上撒糖。对糖的渴望似乎与生俱来：比起白开水，婴

儿本能地更喜欢糖水。

糖在11世纪是“珍贵的产物”，到19世纪则转变为廉价的基本原料。随着这一变化的发生，食品工业开始不计后果地大肆用糖。今天，摄入糖分最多的是智利人（见图），荷兰人、匈牙利人、比利时人和以色列人紧随其后，沙特阿拉伯人也很嗜甜。只有十个国家的人均日摄糖量低于25克。

糖还潜藏在花生酱、调味汁、番茄酱、沙拉酱、面包等食品中。早餐谷物原本是一种健康的全麦食品，如今却演变成“早餐糖果”（包了糖衣的麦片和酥球），由托尼虎和糖糖熊之类的卡通“推销员”兜售给孩子们。一瓶340毫升（12盎司）的碳酸饮料中约含有十茶匙的糖。就连香烟里都掺了糖。在糖液中浸泡烟叶可令其减少刺激性烟气，让烟更易吸入且吸入时更舒服。

然而，曾有科学家轻率地向“糖无害”这种标准教条发起挑战而招来灾祸。陶布斯在书中讲述了伦敦大学营养学家约翰·尤德金（John Yudkin）的故事。20世纪60年代，尤德金提出肥胖、糖尿病和心脏病与糖摄入有关。虽然他承认现有的研究——包括他自己的在内——都还不完整，却还是卷入了与美国知名研究人员安塞尔·基斯（Ancel Keys）的一场科学界口水战。基斯关于膳食脂肪是冠心病主要原因的研究工作多年来一直受到美国糖业协会的支持，他对尤德金冷嘲热讽，称他的证据是“一派胡言”。加州大学旧金山分校的儿科内分泌学家罗伯特·拉斯特格（Robert Lustig）曾提到“美国膳食营养专家被行业收买的漫长而肮脏的历史”，而被陶布斯称为“打倒”尤德金的那场冲突是其中令人悲哀的篇章。1971年，尤德金从系主任的位置上退休后，伦敦大学选择了一个膳食脂肪理论的追随者取代了他。

由于针对糖的有害影响尚研究不足，陶布斯承认目前在科学上还没有最终定论，但已十分有说服力，针对糖的指控也正逐渐获得认同。去年10月，世界卫生组织敦促所有国家对含糖饮料征税。墨西哥已经在2013年实施这一政策；美国的芝加哥、费城和旧金山等城市也都纷纷效仿；英国将于2018年征收软饮税；南非和菲律宾也正在考虑相关措施。也许，糖终于要

掉进自己的甜蜜陷阱了。■



Nestlé

A life less sweet

As rivals nibble at its business, Nestlé's new boss must find a formula for growth

LARGE food companies have long been among the world's most solid, with reassuringly consistent returns even in hard times. None would seem steadier than Nestlé, based in the Swiss town of Vevey, on a lake near snowy peaks. For its 150th anniversary in 2016 it opened a new museum filled with corporate heirlooms: the first written notes about a new product called milk chocolate, laid out in black cursive; an old tin of Nescafé, used by soldiers as a stimulant in the second world war; and an early can of Henri Nestlé's infant formula, which in 1867 saved the life of a premature baby.

It has come a long way since then. It sold goods worth nearly \$90bn in 189 countries in 2015. Of the 30,000 cups of coffee sipped around the world each second, Nestlé estimates, one-fifth are cups of Nescafé. But the industry it presides over is in upheaval. On January 1st a new chief executive, Ulf Mark Schneider (pictured), took over. He is the first outsider to get the top job since 1922, and his background—running a health-care firm, not selling chocolate bars or frozen pizza—suggests the main source of worry for the business.

More and more consumers are snubbing packaged food's sugar, salt and unpronounceable preservatives. Meanwhile, swarms of smaller firms, emboldened by the ease of peddling goods online, are touting supposedly healthier options. From 2011 to 2015 big sellers of consumer-packaged goods, mainly food and drink companies, lost three percentage points of market share in America—a lot in the industry's context—according to a study by the Boston Consulting Group, a consultancy, and IRI, a data provider.

As super-sized companies swat at such tiny attackers, another foe is gaining ground. 3G, a Brazilian private-equity firm, likes to buy big, slow-growing food and drinks companies and slash their costs. Targets have included Kraft and Heinz, two giants which 3G helped merge into one group in 2015, as well as several of the world's biggest brewers. Other food companies are scrambling to make cuts of their own, lest they become 3G's next meal. That has prompted a debate over whether such cuts wreck firms' growth prospects even further, or whether, in fact, they are best off accepting that robust expansion is a thing of the past and wringing out profits.

Nestlé is not immune to such pressures. In recent years it has often missed its goal of 5-6% sales growth. Excluding acquisitions, its numbers have not met investors' expectations in 11 of the past 17 quarters. In the most recent quarter, the firm registered organic sales growth of 3.2%.

Changing consumer tastes explain some of these shortfalls. So does a shifting retail landscape. Managing a giant portfolio of brands, from KitKat and Nespresso to DiGiorno pizza and Purina dog food, has become harder. Mr Schneider will have to master online ways to market and deliver its well-known brands. The firm needs to coax customers to pay more for premium products as ordinary ones get commoditised, and discounted by firms such as Germany's Lidl and Aldi.

The firm can still boast impressive staying power—its global market share across its entire range of products has remained near 20% for the past decade. François-Xavier Roger, Nestlé's chief financial officer, points out that the group's sales growth in the first nine months of 2016 was among the fastest of the top ten biggest food and drink companies. Yet a detailed examination of its position by Sanford C. Bernstein, a research firm, shows that when growth from acquisitions is excluded, it lost share in all but three of its top 20 product categories between 2007 and 2015. Some of its

core offerings, such as bottled water and single-serve coffee, fared the worst. (Keurig, Nestlé's arch-rival in coffee pods, slurped share in America.)

Such results are likely to attract particular censure from investors because of Nestlé's past heavy emphasis on growth and market share, which sometimes came at the expense of the firm's profits. In 2015 its operating-profit margin was 15%, better than the 13% at Danone, a French competitor, but far below the 21% at Kraft-Heinz. Shareholders in the firm are waiting to see whether Mr Schneider will shake things up. Some want him to sell off businesses that seem most at risk of long-term decline, such as frozen food, as shoppers look for fresher fare.

| *Food for life?*

For now, Nestlé is defiant. "We started 150 years ago having a product that actually—there's symbolism there—saved the life of a child," says Paul Bulcke, the outgoing chief executive. He and his colleagues say that investment in health and related innovation will produce strong growth at the company for years to come. Mr Schneider, who used to run Fresenius, a big German firm that offers kidney-dialysis products and other medical services, will certainly emphasise that message. Nestlé differentiates itself from 3G, with its keen focus on cuts. Mr Roger says he respects what 3G does, but that "they have a strategy which is very different from ours."

Still, few observers would call Nestlé a health company. Many of its products are perfectly healthy, including bottled water and coffee. Many are not—milk chocolate and ice cream, to name but two. And for now, the purest forms of Nestlé's focus on health contribute relatively little to its sales. A business unit called Nestlé Health Science, for example, sells nutritional products for medical needs, such as vitamin-packed drinks for the elderly and for cancer patients. It contributes less than 5% of revenue.

The firm has a research institute devoted to studying food's role in the

management and prevention of disease—for example, better understanding nutrition’s ability to promote brain health. It may bring growth but probably only in the long term. Nestlé has also partnered with young drugs firms, including one that is testing a treatment for ulcerative colitis.

More immediately rewarding may be its efforts to make best-selling but unhealthy foods a bit more wholesome. In November the company said it had created hollow sugar crystals that taste sweet but contain fewer calories than the usual stuff. It will begin to put the new ingredient in its chocolate in 2018.

It is also proud of changes to the millions of frozen dinners it sells every week in America. Shoppers had been avoiding the frozen-food aisle. Nestlé first tried discounts, and then in 2015 introduced new versions of its Lean Cuisine products, stripping out unpalatable ingredients and replacing them with organic ones. At Stouffer’s, another frozen brand, Nestlé decided to target men with easy, protein-packed meals that are more nutritionally valuable. It worked—its frozen-food sales in America grew faster. In November 2015 they were 6% above what they had been a year earlier. But Bernstein’s Andrew Wood points out that the revival of frozen food now looks wobbly again.

Nor is Nestlé ignoring 3G’s strategy entirely: it is trying to trim expenses. “We are very much in an investment position, not in a cost-cutting exercise,” says Mr Roger, “but that doesn’t mean that we don’t want to be cost-efficient in what we do.” One effort, which includes trimming waste at factories, is credited with saving about SFr1.5bn (\$1.5bn) a year. Last year Nestlé announced organisational changes, such as consolidating procurement, which will save about SFr2bn each year from 2020.

Whatever else Mr Schneider has on the menu for Nestlé, radical changes

may be somewhat limited by the fact that so many of those who built the company into what it is now are sticking around. Mr Bulcke is expected to become its chairman. The outgoing chairman, Peter Brabeck-Letmathe, a former Nestlé chief executive, may become honorary chairman. Mr Bulcke, for one, seems sure that the company should maintain its strong emphasis on the long term. He taps his hand on the table, rattling some Nespresso cups, as he insists that growth is still the key. ■



雀巢公司

如蜜生活甜意减

对手步步蚕食，雀巢新老板必须找到增长配方

大型食品公司长期以来都属于世界上最坚实的企业之列，即使在艰难时期也有令人安心的稳定回报。似乎没有哪家企业比总部位于瑞士雪山湖畔韦威镇（Vevey）的雀巢公司更稳固了。2016年雀巢成立150周年之际，其新揭幕的博物馆展示了众多“传家宝”：有关新产品“牛奶巧克力”的首份书面记录，用黑色草体书写；一罐陈年的雀巢咖啡，在二战时士兵们曾用它来提神；还有一罐早期的亨利雀巢婴儿配方奶粉——它在1867年挽救了一名早产儿的生命。

自那以后，雀巢已有长足发展。2015年，该公司在189个国家的销售额近900亿美元。雀巢估计，全球每秒有三万杯咖啡被人们捧到嘴边，其中五分之一是雀巢咖啡。但是，其主导的行业正经历巨变。1月1日，雀巢新首席执行官乌尔夫·马克·施奈德（Ulf Mark Schneider，见图）上任。他是自1922年以来首位担任这一最高职位的外部人士，而他之前管理医疗保健企业（而不是卖巧克力棒或冷冻披萨）的工作背景是导致人们忧虑雀巢前景的主要原因。

包装食品中的糖、盐以及各种名称拗口的防腐剂正受到越来越多消费者的冷落。同时，大批小公司借助网络销售之便，推广据称更为健康的食品。据波士顿咨询公司及数据提供商IRI的一份研究，从2011年到2015年，包装消费品的销售大户（主要为食品及饮料公司）在美国的市场份额损失了三个百分点，这对该行业来说相当可观。

巨头企业在大力回击这些小型袭击者之时，另一个敌人也开始抢占地盘。巴西私募股权公司3G喜欢购入增长缓慢的大型食品及饮料企业，并削减它们的经营成本。其目标包括卡夫及亨氏两大巨头（2015年，3G促成这两家企业合并为一个集团），还有几家全球最大的啤酒公司。其他食品公司正在争相自行削减成本，以免成为3G的下一个猎物。这引发了一个争论：这

样的成本削减会不会进一步破坏公司的增长前景，还是说，强劲扩张已经过时，企业最好能接受这一点并挤出利润。

面对这些压力，雀巢也未能幸免。近年来，该公司经常达不到销售增长5%至6%的目标。不包括收购，在过去17个季度中，该公司有11个季度的增速没有达投资者预期。最近一个季度，雀巢的有机销售增长率为3.2%。

之所以增长乏力，消费者口味改变是部分因素，零售业大环境的转变也是原因之一。要管理包含KitKat巧克力、Nespresso咖啡、DiGiorno比萨、普瑞纳狗粮在内的庞大品牌组合已变得愈加艰难。施奈德必须掌握线上手段来营销和传达公司的知名品牌。在普通产品被德国连锁超市Lidl及Aldi等公司变成日常商品又折价销售的情况下，雀巢公司需要劝诱客户为高端产品支付更高的价格。

雀巢仍能以其持久的实力为傲——过去十年间，其全线产品的全球市场份额一直保持在接近20%。首席财务官弗朗索瓦-泽维尔·罗杰（Francois-Xavier Roger）指出，雀巢集团在2016年前九个月的销售增长是全球十大食品饮料企业中最快的。但市场研究公司盛博（Sanford C. Bernstein）对该公司的详细研究表明，除去收购带来的增长，2007年至2015年间，集团最大的20个产品品类中仅有3类的市场份额未下跌。瓶装水和单杯咖啡等一些核心产品表现最差。雀巢咖啡包产品的劲敌Keurig在美国抢占了份额。

这种业绩很可能会惹来投资者的指责，毕竟雀巢过去强调增长和市场占有率，有时还不惜为此牺牲利润。2015年，它的营业利润率为15%，优于其法国对手达能公司的13%，但远低于卡夫亨氏的21%。雀巢的股东们正在观望施奈德能否改变现状。有人希望他卖掉业绩最有可能长期下滑的业务，例如冷冻食品，因为消费者如今偏好更新鲜的食品。

| 生命之食？

目前来看，雀巢并不服气。“我们始创于150年前，当时的一款产品实际上救了一个孩子的命，这是有象征意义的。”即将离任的首席执行官保罗·

薄凯（Paul Bulcke）说道。他和同事们表示，投资于健康及相关创新会为公司未来带来强劲增长。施奈德曾掌管提供肾透析产品及其他医疗服务的大型德国企业费森尤斯（Fresenius），他肯定会强调这一点。雀巢将自己与专注削减成本的3G区别开来。罗杰表示，他尊重3G的做法，但“他们的战略和我们的相去甚远”。

然而，少有观察者会认为雀巢是一家保健公司。它有很多非常健康的产品，包括瓶装水和咖啡。但也有许多产品并不健康，在此只举两例：比如牛奶巧克力和冰激淋。而现在，雀巢最纯粹专注健康的业务对销售额的贡献相对很少。例如，名为“雀巢健康科学”的业务部门销售面向医疗需求的营养产品，比如供老年人和癌症患者饮用的富含维生素饮料，而该部门贡献的收入还不到5%。

雀巢设有一家研究所，专门研究食物在管理和预防疾病中的作用，例如要更好地了解营养物质如何能够促进大脑的健康。这也许会带来增长，但可能要许久才能见效。雀巢也与一些新兴制药公司合作，包括一家正在测试某种溃疡性结肠炎疗法的公司。

雀巢还努力将旗下畅销但不健康的食品改良得相对健康一些，这也许更有可能带来立竿见影的回报。去年11月，该公司表示已创制出一种空心的糖晶体，味道甜但含卡路里较常规糖晶体低。公司将在2018年采用这一新原料制作巧克力。

雀巢另一项引以为豪的改变是冷冻快餐（在美国每周卖出数百万份）。之前，冷冻食品受到消费者冷落。雀巢先是尝试折价促销，然后又在2015年推出新版的“瘦身特餐”（Lean Cuisine）系列，以有机食材替换掉之前难吃的成分。对于旗下另一个冷冻食品品牌Stouffer，雀巢决定针对男性消费者推出富含蛋白质、更具营养价值的速食简餐。这些努力取得了成效——其冷冻食品的销售在美国增长加快。2015年11月的销售额同比增长6%。但盛博的安德鲁·伍德（Andrew Wood）指出，冷冻食品的复兴如今似乎又变得摇摆不定。

雀巢也没有完全忽视3G的战略：公司正努力缩减支出。“我们的战略是投资，而非削减成本。”罗杰说，“但那不意味着我们不想在经营中实现成本效益。”一项包括工厂减少浪费在内的改革一年为公司节省了约15亿瑞士法郎（15亿美元）。去年，雀巢公布了一系列组织变革，如采购整合，将从2020年起每年为公司节省约20亿瑞士法郎。

无论施奈德还将为雀巢准备怎样的菜单，彻底变革也许多少都会受到限制，因为令雀巢发展到如今这模样的人大多还留在公司内。薄凯预计会成为集团的董事长。即将离任的董事长、雀巢前首席执行官包必达（Peter Brabeck-Letmathe）则可能成为名誉董事长。薄凯似乎确信雀巢应保持着力于长远发展。他手敲着桌子，震得一些Nespresso杯子当当作响，坚称增长仍是关键。■



Humans and decision-making

Thinking about thinking

Michael Lewis dissects the enduring friendship between Daniel Kahneman and Amos Tversky

DURING the second world war a young Jewish boy was caught after curfew on the streets of Nazi-occupied Paris by an SS soldier. The soldier picked him up, hugged him, showed him a photograph of another boy and gave him money. The young Daniel Kahneman left more certain than ever that his mother was right: “People were endlessly complicated and interesting.” His curiosity about human thinking would lead him to a pioneering career in psychology, exploring the systematic flaws of decision-making, in a remarkable partnership with his collaborator, Amos Tversky. In 2002 Mr Kahneman (pictured) won a Nobel prize in economics, for work on how people overvalue losses relative to gains. Tversky would have shared it had he not died in 1996.

This is the terrain of Michael Lewis’s new book, “The Undoing Project: A Friendship that Changed our Minds”. It is part biography of a friendship and part account of psychology’s impact, while also taking in much of modern Israel’s history. It is a fine showcase of Mr Lewis’s range.

Mr Kahneman was introverted, formal and pessimistic, and worked conventional hours; Tversky was extroverted, informal and incorrigibly optimistic, keeping the hours of a bat. But the two shared a fascination with how people repeatedly make the same kinds of irrational mistakes. “We study natural stupidity,” Tversky quipped. At times, the two were “sharing a mind”, Mr Kahneman said, sitting at the typewriter together and blissfully unaware of who had contributed what to their work. They also had their tensions: Mr Kahneman was, for example, envious of Tversky, who attracted far more attention. But they remained so close that when Tversky

was diagnosed with cancer, Mr Kahneman was the second person he told.

Academic work can be intellectual navel-gazing. But the Kahneman-Tversky partnership was always engaged in the real world, thanks to both men's early experiences in Israel. At 21 Mr Kahneman was assigned to the army's psychology unit. He overhauled the assessment of recruits, improving judgments by reducing the weight given to gut feelings; the methods have barely been tweaked since. During the Yom Kippur war in 1973, the two psychologists told the army to see what food soldiers threw into the rubbish in order to give them food they really wanted, and persuaded the air force to scrap investigations into a squadron suffering terrible losses: with a small sample size, the extra deaths were probably random. As their work on irrational decision-making has made its way into the wider world, it has also irritated incumbent pundits. When Daryl Morey, the general manager of the Houston Rockets basketball team, used behavioural economics to influence his choice of players, Charles Barkley, a commentator and former NBA star, denounced him and those like him: "They never got the girls in high school and they just want to get in the game." In decision-making certain flaws are much easier to identify than amend, it seems.

Some governments have tried to act on these insights. Barack Obama hired Cass Sunstein, a scholar heavily influenced by Mr Kahneman and Tversky, to design behavioural "nudges" that encourage people to do the right thing without forcing them. Britain created its own "nudge unit", which for example reworded a request for organ donation by first asking people if they would want to receive an organ if they needed one. Positive response rates jumped by enough to increase the donor rolls by 100,000 per year.

Like Mr Lewis's 13 previous books, "The Undoing Project" is a story of remarkable individuals succeeding through innovative ideas. Here, the balance is geared more towards the ideas, and the pace is slower than, say,

“Liar’s Poker”, his first book. Yet, with his characteristic style, Mr Lewis has managed the unusual feat of interweaving psychology and the friendship between the two men. Two decades after he died, Tversky’s partnership with Mr Kahneman is still changing the world. ■



人类与决策

对思考的思考

迈克尔·刘易斯剖析丹尼尔·卡尼曼和阿莫斯·特沃斯基之间长青的情谊

第二次世界大战期间，在被纳粹占领的巴黎街头，一个年轻的犹太男孩在宵禁时被党卫军士兵抓到了。这名士兵把他抱起来，拥抱他，给他看了另一个男孩的照片，还给了他钱。这让年轻的丹尼尔·卡尼曼（Daniel Kahneman）前所未有地确信他的母亲是对的：“人的复杂和有趣是无止境的。”正是出于对人类思维的好奇心，造就了他在心理学上的开创性工作。他与阿莫斯·特沃斯基（Amos Tversky）成了杰出的搭档，共同探索决策中的系统性缺陷。2002年，卡尼曼（如图）因对人们更看重损失而非收益的研究获得诺贝尔经济学奖。要不是特沃斯基已于1996年去世，他也会分享这一奖项。

这正是迈克尔·刘易斯（Michael Lewis）在新书《回退工程：一场改变人类思维的友谊》（The Undoing Project: A Friendship that Changed our Minds）中所描述的。该书一部分是这场友谊的传记，另一部分讲的是心理学的影响，此外还谈到了很多以色列近代史。这很好地展现了刘易斯的涉猎之广。

卡尼曼内敛、严肃而悲观，工作时间也很传统；特沃斯基则外向、随性且乐观得不可救药，像蝙蝠一样昼伏夜出。但两人对为什么人们会反复犯下同一种非理性错误这个问题都十分迷恋。“我们研究与生俱来的愚蠢。”特沃斯基打趣说。卡尼曼说，有时两人会“共用一个大脑”，一起坐在打字机前，而对谁为工作做了多少贡献毫不在意。他们也有关系紧张的时候：比如特沃斯基吸引了比卡尼曼多得多的关注，卡尼曼对此心怀妒忌。但二人却仍然如此亲近——特沃斯基被确诊患癌时，卡尼曼是他告知的第二个人。

学术工作完全可能只是在智力上钻牛角尖，但卡尼曼与特沃斯基的搭档则总是着眼于现实世界，这要归功于二人早期在以色列的经历。卡尼曼21岁

时被分配到军队的心理学部门。他全盘推翻了新兵的考核方法，降低了直觉所占的权重，由此改进了判断；这些方法自此以后几乎再未变过。在1973年的赎罪日战争中，两位心理学家告诉军队去看看哪些食物被士兵扔进了垃圾桶，以此提供给他们真正想要的食品，并说服空军放弃调查一个遭受重大损失的中队：样本量如此小，过多的死亡很可能是随机的。随着他们关于非理性决策的工作进入了大众视野，这也惹恼了在位的权威。当休斯敦火箭队的总经理达里尔·莫雷（Daryl Morey）用行为经济学来影响球员的选择时，评论员兼前NBA球星巴克利谴责他和他的同类：“这些人在高中时就没追到过女生，只是想混进比赛而已。”看来修正决策中的某些缺陷比单单找出缺陷要难多了。

一些政府已经尝试根据这些观点来采取行动。奥巴马聘请了深受卡尼曼和特沃斯基影响的学者卡斯·桑斯坦（Cass Sunstein）来设计行为“助推”——鼓励而非强迫人们做正确的事情。英国政府设立了自己的“助推小组”，比如将器官捐献的请求换了个说法：先问人们如有需要是否想得到器官。正面响应的比率由此大幅飙升，以至于每年的登记捐献者增加了10万人。

与刘易斯先前的13本书一样，《回退工程》是关于杰出人士通过创新理念获得成功的故事。在这本书中，天平更向思想倾斜，节奏也要舒缓一些，比如就比他的第一本书《说谎者的扑克牌》（Liar's Poker）来得要慢。然而，刘易斯以其特有的风格，完成了将心理学与两个男人之间的友谊交融在一起的非凡壮举。在特沃斯基去世二十年后，他与卡尼曼的合作仍然改变着世界。 ■



Why Europe became rich

Ideas matter

An unusual economics book on the “great divergence”

IN THE year 1000 the average person in western Europe was slightly poorer than their counterparts in China or India. By 1900, things were very different. Western Europe was five times richer. Explaining the reasons behind this “great divergence” has occupied many an economic historian. In a new book, Joel Mokyr of Northwestern University offers his own take.

It is not a conventional economic history. The book contains few numbers, let alone regressions. This is because Mr Mokyr focuses on culture—something not easily quantified. For Mr Mokyr, “culture” means beliefs, values and preferences. And he argues that all three changed fundamentally in Europe after 1500.

To structure his argument, Mr Mokyr speaks of a “market for ideas”, a system in which people “try to persuade an audience of the correctness of their beliefs”. Like any market, it can “fail”—and, for most of history, it did. People in power stopped upstarts from challenging received wisdom. Manipulating nature was considered akin to defying God’s will. For potential intellectual innovators, the fear of being called a heretic (or worse) created a disincentive to think big.

Then, almost by accident, Europe stumbled into an arrangement whereby the “market for ideas” flourished. The Royal Society, a club for scientific exchange founded in London in 1660, started a journal in which everyone from Christopher Wren to Robert Boyle battled over ideas. Its motto was “*nullius in verba*”—roughly, “take nobody’s word for it”. A transnational community known as the “Republic of Letters” sprang up. Many of its members never met in person, but with the printing press and improved

postal networks, they could create knowledge more efficiently than ever before.

There were no sacred cows. When Leonhard Euler, a mathematician, thought that Isaac Newton had erred, the Royal Society asked a self-taught optician to see who was right. The greatest mathematical mind of his age, challenged by a nobody: what better example of what Mr Mokyr calls the “principle of contestability”?

This went along with a reassessment of what science was. Mr Mokyr sees the new approach encapsulated in the work of Francis Bacon (1561-1626). Bacon was a poor scientist and knew no mathematics, says Mr Mokyr. But he pushed scientific inquiry away from the mindless piling up of facts and towards making a difference to people’s lives. “The true and legitimate goal of the sciences is to endow human life with new discoveries and resources,” Bacon said. With this sort of science, useful, wealth-creating things were invented.

Why Europe, and not anywhere else, developed in this way is tricky to answer. Luck is surely part of it. Another explanation concerns Europe’s geography. With Europe fragmented into lots of states, an intellectual who challenged received wisdom, and thus incurred the wrath of the authorities, could move elsewhere. Thomas Hobbes wrote “Leviathan” in Paris; for years René Descartes lived in the Netherlands. Rulers eventually came round to the idea that “progress” could not be stopped. By contrast, in China, says Mr Mokyr, free thinkers had few escape routes.

This book is not for someone looking for a general introduction to the “great divergence”. Mr Mokyr barely considers other theories of why Europe grew first—that its people were relatively immune from disease; or that it was the first region systematically to colonise others. And his arguments are often highly abstract.

Those familiar with the historiography will have their own grumbles. Mr Mokyr's theory is, ironically, untestable. When he asserts that Bacon "was of unique importance to the development of the West", it is impossible to prove otherwise. He assigns monumental importance to the "Republic of Letters" but offers frustratingly little detail on how it actually worked.

The sheer elegance of Mr Mokyr's theory, however, has much to commend it. And it is refreshing that an economist is taking seriously the idea that ideas and culture make a difference to economic growth. Mr Mokyr has not fully explained the "great divergence", but he has offered some tantalising insights. ■



欧洲致富经

想法很重要

关于“大分流”的另类经济学书籍

公元1000年，普通西欧人比普通中国人或印度人略穷。但到了1900年，情况已大不相同。西欧的财富是中印的五倍。这一“大分流”背后的原因一直是许多经济史学家苦心研究的课题。美国西北大学的乔尔·莫基尔（Joel Mokyr）在新书中提出了自己的见解。

这不是一本常规的经济史著作。书中没什么数字，更不必说用到回归分析这类统计法了。这是因为莫基尔专注的是不易量化的文化。对莫基尔而言，“文化”是指信仰、价值观和偏好。他认为，1500年后这三者在欧洲发生了根本性的改变。

架起莫基尔论点的基础是他所说的“想法市场”的概念，意指一个人们“试图说服别人其信仰正确性”的体系。像任何市场一样，“想法市场”也可能“失灵”，而且在历史上大部分时间里，它确实是失灵的。当权者阻止新上位的人挑战公认的信条。操纵自然被视为近似于藐视神旨。由于担心被扣上异端（或更糟）的帽子，潜在知识创新者受到抑制，不敢大胆畅想。

后来几乎是在机缘巧合之下，欧洲的一次无意之举让“思想市场”得以蓬勃发展。1660年在伦敦创立的科学交流俱乐部皇家学会（Royal Society）创办了一本杂志，从建筑师克里斯多佛·雷恩（Christopher Wren）到物理学家罗伯特·博伊尔（Robert Boyle）等各领域专家都可以通过该杂志进行思想交锋。杂志的拉丁文座右铭是“nullba in verba”，大概意思就是“谁的话也别盲信”。后来，被称为“文人共和国”的跨国知识分子群体诞生，其中许多成员从未谋面，但有了印刷机和业已完善的邮政网络，知识分子们可以以前所未有的效率来创造知识。

人们不再迷信绝对的权威。数学家莱昂哈德·欧拉（Leonhard Euler）认为牛顿出了错，皇家学会让一个自学成才的光学家来评判孰对孰错。无名

小辈挑战一个时代最伟大的数学家：这正是莫基尔称之为“可竞争原则”的最佳例证。

在鼓励挑战权威的同时，科学的内涵也被重新审视。莫基尔认为对科学新的认识在弗朗西斯·培根（Francis Bacon, 1561-1626）的著作中得到了很好的概括。莫基尔说培根是一个蹩脚的科学家，不懂数学。但他让科学探究从盲目的事实堆砌转向为人类生活带来改变。培根说：“科学真正的、合理的目标是赋予人类新的发现和资源。”有了这样的科学，人们逐渐发明出有用的、能创造财富的东西。

为什么欧洲得以这样发展，而其他地方却不行？这个问题很难回答。运气肯定是原因之一，另一个解释则涉及欧洲的地理。欧洲分为许多国家，一个知识分子如果因挑战公认的信条而触怒当权者，他大可以移居别国。托马斯·霍布斯（Thomas Hobbes）在巴黎写下了《利维坦》（Leviathan）；勒内·笛卡尔（René Descartes）在荷兰居住了多年。统治者最后终于明白“进步”是无法阻止的。莫基尔说，相比之下，在中国自由思想者几乎无路可逃。

这本书的目标读者不是想要大致了解“大分流”的人。莫基尔几乎没有考虑欧洲能够先行崛起的其他任何理论，比如欧洲人相对来说受疾病之苦不多；又或欧洲是第一个有组织地殖民他国的地区。而且他的论证往往是高度抽象的。

熟悉史学的人会有他们的不满之处——莫基尔的理论居然无法证实。他宣称培根“对西方的发展具有独一无二的重要作用”，但却没法证明没有培根会如何。他认定“文人共和国”有着巨大的重要性，但对其实际起作用的方式却几乎没有提供任何细节，令人遗憾。

然而，莫基尔的理论十分简洁利落，值得称道。令人耳目一新的是，一位经济学家如此认真地探讨了思想和文化对经济增长有所贡献这一理念。莫基尔对“大分流”解释得并不充分，但却也提出了一些引人入胜的见解。■



Free exchange

You had to be there

Labour mobility and cultural mixing are fundamental components of economic integration

“WHAT’S the model? Have cake and eat it.” So read handwritten notes, snapped in the hands of an official of Britain’s ruling Conservative Party, as she left a meeting in Downing Street on Brexit strategy in late November. Britons seem keen to pick and choose from a menu of ties with Europe—in particular, to retain access to the single market while gaining more control over migration. Angela Merkel, the chancellor of Germany, is unwavering. In a speech in Berlin on December 6th she reiterated that Europe’s “four freedoms” are inseparable and inviolable. Countries hoping to share in the free movement of goods, services and capital must accept the free movement of labour as well.

The European project was meant above all to be a process of economic integration (intended, in the words of the Schuman declaration in 1950, “to make war [within Europe] not merely unthinkable but materially impossible”). Dissatisfaction with the EU often boils down to the suspicion that its original mission of economic integration has morphed into a misguided push for political union. Which one of these agendas does the free movement of people advance?

Some economists argue that though the free movement of people is essential to Europe’s political project, it is not necessary to accomplish the sort of deep economic integration that reduces wage inequality across countries. In the simplest trade models, such as the one developed by Bertil Ohlin and Eli Heckscher in the early 20th century, this is certainly true. Such models suppose that countries’ comparative advantages are determined by their relative abundance of resources. Countries with lots of

low-wage labour, for instance, tend to export goods that use a lot of low-wage labour in production. Building on this theory, Paul Samuelson pointed out that opening trade between two countries ought to cause the price of traded goods to equalise across markets. That, in turn, should cause the return to the factors used in production, including the wages paid to labour, to converge, even if those factors could not move across borders. Free trade alone is enough to generate convergence.

Yet this is an impoverished view of integration. New models of trade do not imply that close economic integration should cause incomes to converge. Firms and places are often subject to economies of scale: they become more productive as they grow larger. As freer trade expands the size of the market, producers with initial size advantages outcompete rivals. In an integrated market one country might specialise in a high-wage industry with increasing returns to scale (like skilled manufacturing or finance) and others in areas in which wages are lower. In fact, the conditions needed to bring about convergence go well beyond what free trade alone is likely to achieve. For incomes to equalise, different countries must use similar sorts of technology, for instance. Yet achieving comparable levels of technological capability across countries may require more than just free trade: supranational standards, for example, and the flow of knowledge in other ways—such as through the movement of individuals.

In 1961, in his book, “The Theory of Economic Integration”, Bela Balassa, a Hungarian economist, offered a more satisfying definition of his subject. He suggested it was an “absence of various forms of discrimination” between economic units in different countries. A free-trade agreement, he noted, is a step towards economic integration, but just a step. Harmonising external tariffs is a further leap, and setting common internal standards and regulations is yet another move along the continuum.

Using discrimination as a metric strongly implies that limits on movement

of labour inhibit economic integration. Such limits directly prevent competition among providers of in-person services from different countries; Polish doctors cannot easily treat British patients from surgeries in Poland. And constraints on labour mobility undermine the formation of social ties across borders: relationships that play an important economic role. A paper published in 2013 examined the fortunes of different regions in West Germany after the fall of the Berlin Wall, and found that where households maintained close social ties to East Germany, the fall of the wall led to more cross-border investment and a higher return to entrepreneurial activity. It is costly to gain valuable economic information about unfamiliar places. Social ties reduce that cost. Borders, which frustrate the creation of those ties, necessarily mean that firms on one side of the line will be at a disadvantage when investing or operating on the other.

| *Now you're talking*

Indeed, it may be the very logic of economic integration, with its attendant erosion of discriminatory barriers, that truly irks Eurosceptics. Cultural differences of all sorts, from language barriers to tastes and habits, make it harder for people and firms from one country to do business in others: for French-language newspapers to sell in Frankfurt or for Spaniards to network with Czechs. Complete economic integration implies the smoothing away of these differences, and the formation of something closer to a European identity. Pro-Brexit voters were not wrong to fear that European economic integration threatened the primacy of their unique culture, or to worry that in the big, cosmopolitan cities—where people from many countries mix to build ties and share knowledge—a broader, post-national identity is being forged.

The goal of ending war within Europe through deep economic integration is not so different from that of ending war by eliminating the pesky

nationalism of individual states. As enthusiasts and critics of the European project should know, closer economic, political and cultural ties are indivisible. Putting up barriers to labour mobility is not just a political choice. It implies a halt to—and perhaps even the reversal of—economic integration. ■



自由交流

你得身处其中

劳动力流动和文化融合是经济一体化的基本要素

“按什么模式？要鱼和熊掌兼得。”这是英国执政党保守党的一位官员笔记上写的一句话。去年11月下旬她在唐宁街开完一场关于英国脱欧策略的会议后，手中的笔记本被拍了下来。英国人似乎热衷于在和欧洲的种种关系里挑挑拣拣，尤其是既想保持对欧盟单一市场的准入，同时又要在移民问题上获得更大的控制权。德国总理默克尔则毫不动摇。12月6日在柏林的一场演讲中，她重申了欧洲的“四个自由”是不可分割也不容侵犯的。希望分享商品、服务和资本自由流动的国家必须也要接受劳动力的自由流动。

欧洲计划最主要的意义在于经济一体化的过程。用1950年《舒曼宣言》中的话来说，就是旨在“让战争（在欧洲内部）不仅无法想象而且实质上也没有发生的可能”。对欧盟的不满常常可归结为这样一种怀疑：经济一体化的初衷已经误入歧途，演化为对政治联盟的推动。人的自由流动推进的是哪个目标呢？

有些经济学家认为，尽管人员自由流动对于欧洲政治计划来说至关重要，但要实现能减少各国间工资差距的经济深度融合，并不一定需要人的自由流动。在最简单的贸易模型中，如20世纪初由贝蒂·俄林（Bertil Ohlin）和伊莱·赫克歇尔（Eli Heckscher）提出的模型，这的确没错。这类模型认为国家的相对优势由它们资源的相对丰富程度决定。比如，拥有大量低工资劳动力的国家往往出口生产过程中需要大量低工资劳动力的产品。在这一理论的基础上，保罗·萨缪尔森（Paul Samuelson）指出，两国之间开展贸易应当会导致所交易商品的价格在两边的市场达到均等。这继而应该会导致对生产要素的回报也趋同，包括劳动力工资，即便这些要素无法跨越国境流动。单是自由贸易就足以产生趋同。

不过，这种一体化观点粗糙而又不全面。新的贸易模式并不意味着紧密的经济一体化就会导致收入趋同。公司和地方往往受制于规模经济：它们规

模越大就越多产。当更自由的贸易扩大了市场规模时，拥有初始规模优势的生产商就会胜过对手。在一个一体化的市场中，一个国家可能专注于某个高工资行业，这一行业的收益随规模递增（例如高技术制造业或金融业），而其他国家则专注于一些工资较低的领域。其实，实现趋同所需要的条件远非只靠自由贸易就能达到。比方说，要实现收入均等，不同国家必须使用类似的技术。而要在各国之间实现技术能力水平相当，可能不仅仅需要自由贸易，还要有其他条件，如超国家标准，以及通过其他形式——比如个体的迁移——发生的知识流动。

1961年，匈牙利经济学家贝拉·巴拉萨（Bela Balassa）在其著作《经济一体化理论》（The Theory of Economic Integration）中对所研究的主题做出了更令人满意的阐释。他认为这是指不同国家的经济单元之间“不存在各种形式的歧视”。他指出，一个自由贸易协定是通向经济一体化的一个步骤，但也只是一步而已。协调对外关税是进一步的飞跃，而设定共同的内部标准和法规则是整个连续进化体系的又一步。

用歧视作为衡量标准，这强烈地表明限制劳动力流动会阻碍经济一体化。这样的限制直接阻止了来自不同国家的供应商在需要和客户面对面交流的服务中展开竞争；波兰的医生就不太可能会在本国的诊室里收治英国病人。对劳动力流动的限制也破坏了跨境社会纽带的形成：这样的关系扮演着重要的经济角色。2013年发表的一篇论文研究了柏林墙倒塌之后西德不同地区的命运，发现在家庭与东德保持紧密社会联系的地方，柏林墙的倒塌带来了更多的跨境投资，创业活动的回报也更高。要获得关于陌生地方有价值的经济信息，代价高昂。社会联系降低了这一成本。而边境阻碍了这些联系的建立，这必然意味着边境线一边的公司在另一边投资或运作时会处于劣势。

| 这才像话

其实，真正让疑欧派不满的也许正是经济一体化的逻辑，加上随之而来的对歧视性壁垒的移除。各种各样的文化差异，从语言障碍到口味和习惯，都让一个国家的人和公司更难在其他国家做生意：无论是在法兰克福卖法语报纸还是让西班牙人与捷克人建立工作关系。完全的经济一体化意味着

消除这些差异，形成一种更接近“欧洲认同”的东西。赞同英国退欧的选民担心欧洲经济一体化威胁到了他们独特文化的主体地位，或者担心来自很多国家的人在大都市里互相结交、建立纽带、分享知识，正在形成一种更宽泛的后民族认同感，这样的想法并没有错。

通过深层的经济一体化在欧洲内部达到终结战争的目的，这与通过消除每个国家的极端民族主义来终止战争没有太大不同。热衷或批评欧洲计划的人都应当明白，更紧密的经济、政治和文化纽带是不可分割的。在劳动力流动上设置障碍不仅仅是个政治选择。这意味着停止经济一体化，甚至可能逆转这一进程。 ■



Censusing fisheries

Where's the catch?

Counting sea creatures is hard. But there is now a new way to do it

ABOUT 90% of the world's fish stocks are being fished either to their limit or beyond it. Monitoring fish numbers reliably, though, is no easy matter. Official catch data are often incomplete and sometimes untrustworthy. Moreover, large tracts of the sea are not monitored at all. In order to know which species to conserve, and where, it would be handy to be able to establish fish numbers cheaply and reliably. Now, as they write in *PLOS ONE*, Philip Thomsen of the Natural History Museum of Denmark, in Copenhagen, and his colleagues think they have taken a step towards this goal.

Scientific surveys of deepwater fish are often carried out by trawling the ocean bed. This means towing a net over a set distance and then hauling it up to count the catch within. That, when due allowance is made for the size of the net's mouth, yields a figure for the number of each fish species per square kilometre.

Every year a research vessel called *Paamiut* carries out surveys of this sort in the Davis Strait off south-west Greenland. This year it also had one of Dr Thomsen's colleagues on board. At each of the 21 places *Paamiut* dropped her nets, he collected two litres of seawater from the bottom. The team's aim was not to sample sea life directly, but rather to examine the fragments of floating DNA which fish slough off in slime or scales, or excrete into the water. They hoped they would be able to link the quantity of this "environmental" DNA to those species' abundances, as measured by the trawl.

This they more or less did. Given the fragmentary nature of environmental

DNA, they found it easier to recognise families than species (a family, in this context, is the taxonomic level above a genus; herring, sardines and shad, for example, all belong to the family Clupeidae). The trawls picked up fish from 28 families. The team found DNA from members of 26 of these in their samples, and also detected three families that had no representatives entangled in *Paamiut's* nets.

Both methods agreed that the most abundant individual species was the Greenland halibut (family Pleuronectidae, the “right-eye” flounders, which was also the most abundant family). Sebastidae, a group sometimes known vulgarly as “rockfish”, were the second most abundant family according to the trawl data, and were ranked third by DNA. By contrast, DNA from Greenland sharks (family Somniosidae, pictured) ranked second by the DNA analysis, yet only one such shark was caught by the trawls. In this case, the portrait painted by DNA is probably the more accurate one. Greenland sharks are thought to excel at escaping from nets and may be present in greater numbers than conventional surveys indicate.

Taken together, these results suggest Dr Thomsen’s technique has great potential for keeping track of fish populations. Overall, the correlation between DNA concentrations and catch size was too weak to infer one from the other. But, as the Greenland-shark data hint, it is quite likely that it is the trawls, rather than the DNA, which are out of whack. Trawl nets cannot be dragged over ground that is too sandy or too rocky, so they may miss important habitats. And other fish than sharks may also be able to detect and evade them.

Dr Thomsen acknowledges that there is some way to go before his technique would permit an accurate census of the world’s oceans. The temperature and salinity of seawater, which affect DNA’s stability, would have to be accounted for. And big fish may not, as might reasonably be expected, ooze proportionately more DNA into the water than small fish do.

That could lead to underestimates in the population sizes of some whoppers. He would therefore like to conduct his experiment over a larger area and repeat the measurements several times over the course of a week or two. He would also like to sample the little-explored intermediate zones between the ocean's bottom and its shallows. Sinking to new depths, then—but in the best possible way. ■



鱼类普查

海产在哪儿？

海洋生物的数量难以统计，但现在有了新方法

地球上鱼类资源的约九成都已达到或超过捕捞限额。但要可信地监测鱼的数量却非易事。官方的捕获量数据常常不完整，有时还不可靠。而且还有大片海洋完全没被监测到。如果能以低成本的方式建立起可靠的鱼类数据库，就能帮助我们弄明白该在哪里保护哪种鱼。现在，来自哥本哈根丹麦自然历史博物馆的菲利普·汤姆森（Philip Thomsen）及其同事在科学与医学类在线期刊《PLOS ONE》上发表研究称，他们已经向这个目标迈进了一步。

海底拖网捕捞是常见的对深海鱼类的科学统计方式：每隔一段固定的距离撒一张网，然后将其捞起后数数网里有多少鱼。适当计入拖网的开口大小，就得到了每平方公里海域内每种鱼的数量。

一艘名叫“帕缪特”（*Paamiut*）的科研船每年都在格陵兰岛西南面的戴维斯海峡（Davis Strait）开展这种统计。今年，汤姆森博士的一名同事也在这艘船上。“帕缪特”在21个地点撒网，每到一个点，他都从海底收集两升海水。汤姆森团队的目标不是直接对海洋生物取样，而是监测漂浮在海水中的、从鱼的粘液、鳞或排泄物中脱落的DNA片段。他们希望能在这种“环境DNA”的数量和拖网统计的鱼的数量间找到联系。

他们多少做到了。鉴于环境DNA片段化的特性，他们发现识别“科”要比识别“种”更简单些（“科”是比“属”更高级的分类单位；比如，鲱鱼、沙丁鱼和河鲱都属于鲱科）。拖网共打捞起了28科的鱼。汤姆森团队在他们的水样里发现了其中26科的DNA，同时还发现了在拖网中未打捞到的三科。

两种方法都发现数量最多的单个鱼种是格陵兰大比目鱼（这种鱼属于双眼都位于身体右侧的鲽科；鲽科也是数目最大的一科）。拖网捕捞统计出的第二大科是平鲈科，有时也被俗称为“岩鱼”，而DNA统计将其列为第三

名。然而，被DNA分析列为第二大鱼种的格陵兰鲨（睡鲨科，见图）在拖网中却只打捞到了一条。在这个案例中，也许DNA描绘的图景更为准确。据信格陵兰鲨擅长逃过渔网，其真实数量可能要超过传统的统计。

整体来看，这些结果显示汤姆森博士的方法在追踪鱼的数量上极富潜力。总体而言，DNA密度和捕捞数量间的关联过小，并不能相互推导。但是，正如格陵兰鲨的数据所显示，出错的很可能是捕捞数字而非DNA数据。海床上沙子或岩石过多的地点无法撒网，因而可能会错过重要的鱼类聚居地。而除鲨鱼外，其他鱼也可能察觉和逃脱拖网。

汤姆森博士承认，自己的方法若要能完成对全球海洋的准确普查还有一段路要走。海水的温度和咸度都会影响DNA的稳定性，也需要被计入考虑。而大鱼可能不像人们想当然的那样比小鱼释出按比例更多的DNA，这可能会使海中某些庞然大物的数量被低估。因此他想在更大面积的水域开展实验，并在一两周内重复测量两三次。他还想对海底和浅水间很少被探测的中间地带取样。潜入新的深度——但要以最佳的方式。■



Medicine and computing

The shoulders of gAInts

Artificial intelligence may help unpick the complexity of biology

IN A former leatherworks just off Euston Road in London, a hopeful firm is starting up. BenevolentAI's main room is large and open-plan. In it, scientists and coders sit busily on benches, plying their various trades. The firm's star, though, has a private, temperature-controlled office. That star is a powerful computer that runs the software which sits at the heart of BenevolentAI's business. This software is an artificial-intelligence system.

AI, as it is known for short, comes in several guises. But BenevolentAI's version of it is a form of machine learning that can draw inferences about what it has learned. In particular, it can process natural language and formulate new ideas from what it reads. Its job is to sift through vast chemical libraries, medical databases and conventionally presented scientific papers, looking for potential drug molecules.

Nor is BenevolentAI a one-off. More and more people and firms believe that AI is well placed to help unpick biology and advance human health. Indeed, as Chris Bishop of Microsoft Research, in Cambridge, England, observes, one way of thinking about living organisms is to recognise that they are, in essence, complex systems which process information using a combination of hardware and software.

That thought has consequences. Whether it is the new Chan Zuckerberg Initiative (CZI), from the founder of Facebook and his wife, or the biological subsidiaries being set up by firms such as Alphabet (Google's parent company), IBM and Microsoft, the new Big Idea in Silicon Valley is that in the squidgy worlds of biology and disease there are problems its software engineers can solve.

| *Drug money*

The discovery of new drugs is an early test of the belief that AI has much to offer biology and medicine. Pharmaceutical companies are finding it increasingly difficult to make headway in their search for novel products. The conventional approach is to screen large numbers of molecules for signs of pertinent biological effect, and then winnow away the dross in a series of more and more expensive tests and trials, in the hope of coming up with a golden nugget at the end. This way of doing things is, however, declining in productivity and rising in cost.

One explanation suggested for why drug discovery has become so hard is that most of the obvious useful molecules have been found. That leaves the obscure ones, which leads to long development periods and high failure rates. In theory, growing knowledge of the basic science involved ought to help. The trouble is that too much new information is being produced to be turned quickly into understanding.

Scientific output doubles every nine years. And data are, increasingly, salami-sliced for publication, to lengthen researchers' personal bibliographies. That makes information hard to synthesise. A century ago someone could still, with effort, be an expert in most fields of medicine. Today, as Niven Narain of BERG Health, an AI and biotechnology firm in Framingham, Massachusetts, points out, it is not humanly possible to comprehend all the various types of data.

This is where AI comes in. Not only can it "ingest" everything from papers to molecular structures to genomic sequences to images, it can also learn, make connections and form hypotheses. It can, in weeks, elucidate salient links and offer new ideas that would take lifetimes of human endeavour to come up with. It can also weigh up the evidence for its hypotheses in an even-handed manner. In this it is unlike human beings, who become unreasonably attached to their own theories and pursue them doggedly.

Such wasted effort besets the best of pharmaceutical firms.

For example, Richard Mead, a neuroscientist at the University of Sheffield, in England, says BenevolentAI has given him two ideas for drugs for ALS, a neurodegenerative disease that he works on. Both molecules remain confidential while their utility is being assessed. One is bang in the middle of what he and his team are doing already. To him, this confirms that the artificial intelligence in question is generating good ideas. The other, though, is complicated and not obvious, but mechanistically interesting. Without the AI to prompt them, it is something his team might have ignored—and that, he admits, might in turn be a result of their bias.

For now, BenevolentAI is a small actor in the theatre of biology and artificial intelligence. But much larger firms are also involved. Watson, a computer system built by IBM, is being applied in similar ways. In particular, IBM has gone into partnership with Pfizer, an American pharma company, with the intention of accelerating drug discovery in immunoncology—a promising area of cancer therapy that encourages the body's own immune system to fight tumours.

Artificial intelligence will also move into clinical care. Antonio Crimini, who, like Dr Bishop, works at Microsoft Research in Cambridge, observes that today the process of delineating the edges of tumours in images generated by MRI machines and CT scans is done by hand. This is tedious and long-winded (it can take up to four hours). AI can reduce the time taken to minutes, or even seconds—and the results are completely consistent, unlike those arrived at by human doctors.

Another example of AI's move into the clinic is described in a recent paper in *JAMA*, an American medical journal. This paper showed that it is possible to use AI to detect diabetic retinopathy and macular oedema, two causes of blindness, in pictures of the retina. Enlitic, a new firm based in

San Francisco, is using AI to make commercial software that can assist clinical decisions, including a system that will screen chest X-rays for signs of disease. Your.MD, a firm based in London, is using AI, via an app, to offer diagnoses based on patients' queries about symptoms. IBM is also, via Watson, involved in clinical work. It is able to suggest treatment plans for a number of different cancers. All this has the potential to transform doctors' abilities to screen for and diagnose disease.

| *The power of networking*

Another important biological hurdle that AI can help people surmount is complexity. Experimental science progresses by holding steady one variable at a time, an approach that is not always easy when dealing with networks of genes, proteins or other molecules. AI can handle this more easily than human beings.

At BERG Health, the firm's AI system starts by analysing tissue samples, genomics and other clinical data relevant to a particular disease. It then tries to model from this information the network of protein interactions that underlie that disease. At that point human researchers intervene to test the model's predictions in a real biological system. One of the potential drugs BERG Health has discovered this way—for topical squamous-cell carcinoma, a form of skin cancer—passed early trials for safety and efficacy, and now awaits full-scale testing. The company says it has others in development.

For all the grand aspirations of the AI folk, though, there are reasons for caution. Dr Mead warns: "I don't think we are in a state to model even a single cell. The model we have is incomplete." Actually, that incompleteness applies even to models of single proteins, meaning that science is not yet good at predicting whether a particular modification will make a molecule intended to interact with a given protein a better drug or not. Most known protein structures have been worked out from crystallised

versions of the molecule, held tight by networks of chemical bonds. In reality, proteins are flexible, but that is much harder to deal with.

More work at the molecular level is therefore needed before AI will be able to crack open the inner workings of a cell. One of CZI's first projects is generating just such basic data. That, in itself, is a massive undertaking—but it is one which collaboration with artificial intelligence will also speed up. AI will nudge people to generate new data and run particular experiments. Those people will then ask the AI to sift the results and make connections. As Isaac Newton put it, "If I have seen further, it is by standing on the shoulders of giants." If the brains of those giants happen to be made of silicon chips, so be it.





医药与计算

人工智能巨人的肩膀

人工智能可能有助将生物学化繁为简

在伦敦的尤斯顿路（Euston Road）旁边不远有一个皮革厂旧址，一家雄心勃勃的公司正在这里创业。BenevolentAI的大办公室相当宽敞，采用开放式布局，科学家和程序员坐在工位上各忙各事。然而，该公司的明星却有一间私人恒温办公室。这位明星是一部性能强大的计算机，它所运行的软件是BenevolentAI的业务核心。这套软件是一个人工智能系统。

人工智能简称AI，有几种形式。而BenevolentAI的AI是一种机器学习的形式，可根据已学的东西举一反三。它尤其可以处理自然语言，并根据所读内容形成新的想法。它的工作是筛选海量的化学库、医学数据库和常规途径发表的科学论文，寻找潜在的新药物分子。

BenevolentAI也并非绝无仅有的公司。越来越多的人和公司相信AI有助于破解生物学的奥秘，促进人类健康。事实上，正如微软剑桥研究院的克里斯·毕晓普（Chris Bishop）所说，看待生物体的一种方式就是认识到它们本质上是综合利用硬件和软件来处理信息的复杂系统。

这种想法产生了影响。无论是Facebook的创始人和他的妻子新创的陈-扎克伯格计划（Chan Zuckerberg Initiative, CZI），还是由诸如Alphabet（谷歌母公司）、IBM和微软等公司设立的生物子公司，硅谷新的大设想是，在生物和疾病的湿黏世界里，有些问题是软件工程师能够解决的。

| 医药成本

AI是否真的能为生物学和医学做出巨大贡献，寻找新药便是一个初步考验。制药公司越来越难以在寻找新产品方面取得突破。常规的方法是筛选大量的分子以寻求相关的生物效应迹象，然后通过一系列成本越来越高的测试和临床试验来淘汰废品，以期在最后提炼出金子。然而，这种方式的

生产率在下降，而成本却在上升。

新药物的发现变得异常艰难，原因之一是大多数明显有用的分子已被发现，只剩下了不明显的那些，这导致开发周期长，失败率高。理论上来说，人们对所涉及的基础科学认识逐渐加深，应该有所帮助。但麻烦的是太多新信息不断生成，无法快速转化成人们能理解的知识。

科学成果的数量每九年翻一番。数据越来越多地被切分用于发表，以增加研究人员的个人著述量，这令信息难以综合。一个世纪前，在大多数医学领域里，还有人可以通过努力成为专家。今天，正如马萨诸塞州弗雷明汉（Framingham）的AI和生物技术公司BERG Health的尼文·纳拉因（Niven Narain）所指出的，要理解所有不同类型的数据已非人力所及。

这就是AI可以发挥作用的地方。它不仅可以通过“摄取”从论文到分子结构、基因组序列和图像的一切信息，还能自主学习，建立关联，形成假设。AI可以在几周内阐明突出的关联，提供新的想法，而人类可能要穷毕生之力才能取得这些成果。它还能客观地审视支持其假设的证据，在这方面AI与人类不同：人类会不理性地偏向自己的理论，固执地沿一条路走下去，这种无用功让最好的制药公司也深受其扰。

例如，英国谢菲尔德大学的神经科学家理查德·米德（Richard Mead）说，BenevolentAI为他所研究的神经退行性疾病ALS（肌萎缩性侧索硬化症）提供了两种药物方面的建议。这两种分子的效用正在接受评估，目前仍然保密。其中一个分子正好是他和团队正在研究的对象。对他来说，这证实了该AI系统能够产生有用的结果。另一个分子虽然复杂，又不明显，但在机制上很有趣。如果没有AI的提示，米德的团队可能就会忽略这一分子，而他承认，这可能反倒是他们偏见的结果。

目前，BenevolentAI还只是生物和AI这出大戏中的小角色，而更大的公司已参与其中。IBM构建的计算机系统沃森（Watson）正被应用于相似的项目。尤其值得注意的是，IBM已经与美国制药公司辉瑞建立了合作伙伴关系，意图加速免疫肿瘤学药物的发现。这是一个很有前景的癌症治疗领

域，可促进机体自身的免疫系统与肿瘤斗争。

AI还将进入临床护理。和毕晓普一样在微软剑桥研究院工作的安东尼奥·克里米尼西（Antonio Crimini）指出，现在对核磁共振和CT扫描结果中肿瘤边缘的确定是由人工完成，这是一项乏味而耗时的的工作（可能长达四个小时）。而AI只需花几分钟甚至几秒钟的时间，且与人类医生的劳动成果不同的是，AI的操作结果完全稳定一致。

AI进入临床医疗的另一个例子在《美国医学会杂志》（JAMA）最近发表的一篇论文中有所描述。文章表明，AI可用来检测视网膜照片中糖尿病性视网膜病变和黄斑水肿这两种致盲病因的发病迹象。位于旧金山的新公司Enlitic利用AI制作商业软件来辅助临床决策，其中包括一种可以筛查胸部X光片中疾病征兆的系统。位于伦敦的公司Your.MD通过一个应用程序，利用AI根据患者对症状的查询提供诊断。IBM也在通过沃森参与临床工作，能为多种不同的癌症建议治疗方案。所有这些都很有可能改变医生筛查和诊断疾病的能力。

| 网络的力量

AI可以帮助人们跨越的另一个重要的生物学障碍是复杂性。实验科学通过每次控制一个变量来获取进展，但在处理基因、蛋白质或其他分子的网络时，这种方法时有困难。AI处理这些复杂情况时要比人类更轻松。

BERG Health公司的AI系统从分析组织样本、基因组和其他与特定疾病相关的临床数据着手，然后基于这些信息，尝试对蛋白质相互作用的网络（造成这种疾病的根源）进行建模。这个时候，人类研究人员可以进行干预，在真实的生物系统中检验模型的预测结果。BERG Health通过这种方式发现了多种潜在药物，其中之一用于治疗局部鳞状细胞癌（一种皮肤癌），已经通过早期安全性和有效性试验，正在等待全面测试。该公司说其他新药正在研发之中。

然而，尽管AI行业的人们志向高远，他们仍需谨慎。米德警告说：“我认为我们连对一个细胞进行建模都还做不到。我们的模型是不完整的。”实

际上，即使是单一的蛋白质模型也还不完整，这意味着科学尚不能预测某种药物分子修饰是否会让一个将与特定蛋白质相互作用的分子成为更好的药物。大多数已知的蛋白质结构都是在蛋白质分子的结晶状态下测定的，此时其结构被化学键网络固定。而在现实中，蛋白质是灵活的，这要难处理得多。

因此，需要在分子水平上做更多的研究，AI才能破解细胞的内部运作。陈-扎克伯格计划的首批项目之一就是生成这样的基本数据。这本身就是一个巨大的任务，但利用AI同样将加快这项工作。AI将逐步推动人们生成新的数据并开展特定的实验。然后，他们会请AI筛选结果，建立关联。正如牛顿所说，“如果我比别人看得更远，那是因为我站在了巨人的肩上。”如果这些巨人的大脑碰巧是由硅芯片制成的，那也没关系。





Schumpeter

Capitalism and democracy

The West confronts a future of slow growth, social division and populist revolt

IT WAS in 1942 that Joseph Schumpeter published his only bestseller, “Capitalism, Socialism and Democracy”. The book was popular for good reason. It was a tour de force of economics, history and sociology. It coined memorable phrases such as “creative destruction”. But it was a notably dark book. At a time when people were looking for hope during the life-and-death struggle with Nazism, Schumpeter offered only gloom. “Can capitalism survive?” he asked. “No, I do not think it can.”

This column was inspired by the young Schumpeter’s vision of the businessperson as hero—the *Übermensch* who dreams up a new world and brings it into being through force of intellect and will. On its debut in September 2009, we argued that Schumpeter was a perfect icon for a business column because, unlike other economists, he focused on business leaders rather than abstract forces and factors. But as Schumpeter grew older, his vision darkened. He became increasingly preoccupied not with heroism but with bureaucratisation, and not with change but with decay. The same is true of the outgoing author of this column.

It would be going too far to echo the master and warn that capitalism cannot survive. The socialist alternative that loomed large back in 1942 has imploded. The emerging world has capitalism to thank for its escape from millennia of poverty. But in the West the problems that led Schumpeter to worry have grown. And to them are appended new difficulties that he never foresaw.

His biggest worry was that capitalism was producing its own gravediggers in the form of an anti-capitalist intelligentsia. Today that very elite, snug in

Los Angeles canyons and university departments, has expanded. Hollywood studios denounce the wolves of Wall Street and the environmental vandals at large in the oil industry. The liberal sort of academic (meaning the type that favours big government) far outnumbers the conservative kind, by five to one, according to one recent study.

Another of Schumpeter's concerns was that the state activism of Roosevelt's New Deal was undermining the market. But in 1938 the American government was spending only a fifth of GDP. Today it is spending 38%—and that constitutes neoliberalism of the most laissez-faire kind compared with Italy (51% of GDP) or France (57%). Big regulation has advanced more rapidly than big government. Business is getting visibly flabbier, too. European industry has been old and unfit for years and now stodge is spreading to America. The largest firms are expanding and smaller ones are withering on the vine. The share of American companies that are 11 years old or over rose from a third in 1987 to almost half in 2012.

There is nothing necessarily bad about this. One of Schumpeter's great insights, from his later years, was that big firms can be more innovative than startups if given the right incentives. But today's incentives favour stasis. Many big firms thrive because of government and regulation. The cost per employee of red tape—endless form-filling and dealing with health-and-safety rules—is multiples higher for companies that have a few dozen staff than for those with hundreds or thousands. Schumpeter called for owner-entrepreneurs to lend dynamism to economies. Today capitalism exists without capitalists—companies are “owned” by millions of shareholders who act through institutions that employ professional managers whose chief aim is to search for safe returns, not risky opportunities.

Some light flickers on the horizon. America's economy is beginning to stretch its limbs. High-tech companies are overhauling an ever wider slice

of the economy, including shopping and transport, which should be good for growth (though it also means power is being concentrated in the hands of fewer big firms). But these are mere flashes in the advancing darkness. The rate of productivity growth across the rich world has been disappointing since the early 1970s, with only a brief respite in 1996-2004 in the case of America. There, and in other rich countries, populations are ageing fast. Meanwhile, the fruits of what growth there is get captured by an ever narrower section of society. And those who succeed on the basis of merit are marrying other winners and hoarding the best educational opportunities.

At the same time democracy is becoming more dysfunctional. Plato's great worry about representative government was that citizens would "live from day to day, indulging the pleasure of the moment". He was right: most democracies overspend to give citizens what they want in the short run (whether tax cuts or enhanced entitlements) and neglect long-term investments. On top of that, lobbyists and other vested interests have by now made a science of gaming the system to produce private benefits.

| *Storm clouds gather*

The result of this toxic brew is a wave of populism that is rapidly destroying the foundations of the post-war international order and producing a far more unstable world. One of its many dangers is that it is self-reinforcing. It contains just enough truth to be plausible. It may be nonsense that "the people" are infallible repositories of common sense, but there is no doubt that liberal elites have been smug and self-serving. And populism feeds on its own failures. The more that business copes with uncertainty by delaying investment or moving money abroad, the more politicians will bully or bribe them into doing "the right thing". As economic stagnation breeds populism, so excessive regard for the popular will reinforces stagnation.

These comforting thoughts are the last that this columnist will offer you as

Schumpeter, though not his last as a scribe for *The Economist*. From April he will write the Bagehot column on Britain and its politics. One of the many extraordinary things about joint-stock firms is that they are potentially immortal: the people who run them come and go but the company itself keeps going. The same is true of our columns. The Schumpeter column will return in 2017 with a new (and possibly more optimistic) author. ■



熊彼特

资本主义与民主

西方世界面临增长缓慢、社会分化和民粹主义反抗的未来

1942年，约瑟夫·熊彼特出版了他唯一一本畅销书《资本主义、社会主义和民主》（Capitalism, Socialism and Democracy）。这本书广受欢迎有充分的理由。这是一部关于经济学、历史和社会学的力作，创造了一些令人难忘的词汇，如“创造性破坏”。然而这也是一本格外沉重的书。那时人们正在与纳粹主义的殊死较量中寻找希望，而熊彼特给出的却只有一片悲观。“资本主义还能延续下去吗？”他问道，“不，我认为不能。”

年轻的熊彼特所憧憬的商人是英雄人物，是构想出全新世界、并通过智力和意志将之实现的超人。本专栏的设立正是受他彼时这种观念的启发。

2009年9月本专栏首次亮相时，我们解释说熊彼特是商业专栏的完美代言人，因为与其他经济学家不同，他关注的是商业领袖，而不是抽象的力量和因素。但随着熊彼特年龄渐长，他的憧憬变得黯淡了。他越来越关注官僚化和衰败，而不是英雄主义和变革。本专栏即将卸任的作者也是如此。

在此呼应这位大师、警告资本主义无法延续似乎有些过头。在1942年风起云涌、有取代资本主义之势的社会主义已经分崩离析。新兴世界多亏了资本主义才得以摆脱延续数千年的贫困。但在西方，熊彼特当年担心的问题已经加重，还出现了一些他未曾预见到的新困难。

熊彼特最担心的是，资本主义正在培养自己的掘墓人，那就是反资本主义的知识分子。今天，这些精英（他们在洛杉矶的山谷和大学院系中过着舒适的日子）的队伍已经扩大。好莱坞电影公司谴责华尔街之狼以及破坏环境却逍遥法外的石油商人。根据最近的一项研究，自由派知识分子（即支持大政府的那一类）的人数远远超过了保守派（五比一）。

熊彼特的另一个担忧是，随罗斯福新政而来的国家行动主义正在破坏市场。但在1938年，美国政府的支出只占GDP五分之一。如今政府支出占比

达到38%，但相比意大利的51%和法国的57%，这已经算是最放任市场自由发展的新自由主义了。大监管的发展比大政府更快。商业发展也明显越发乏力。欧洲工业老化和过气已持续多年，现在这种滞塞正蔓延到美国。最大的企业在扩张，小公司则在萎缩。成立11年或以上的美国公司占比从1987年的三分之一上升到2012年的近一半。

这也不见得有多糟。熊彼特晚年有一个伟大见解，那就是如果能得到正确的激励，大公司会比创业公司更具创新力。但今天的激励措施更倾向于维持现状，许多大公司正因为政府干预和监管而壮大。在只有几十名员工的公司里，为应对种种繁冗监管（除了填不完的表格，还得遵守健康和安全规则）而付出的人均成本要数倍于拥有成百上千名员工的公司。熊彼特呼吁企业主（既是投资者又是经营者）为经济提供活力。但在今天，资本主义的存在脱离了资本家——公司由数百万股东所“拥有”，股东通过特定的公司治理结构来参与公司的经营和决策。这种结构雇用职业经理人来管理企业，但经理人的主要目标是寻求安全回报，而不是带有风险的机会。

未来隐约有曙光闪现。美国经济开始伸展拳脚。高科技公司正在变革越来越更广泛的经济领域（包括购物和运输），这应该有利于增长（虽然这也意味着权力越来越集中在少数大公司手中）。但这些只是弥漫的黑暗中零星的闪光。自上世纪七十年代初以来，富裕国家的生产力增长率一直令人失望，只有在1996年至2004年期间在美国有过短暂的改善。在美国和其他富裕国家，人口正在快速老龄化。与此同时，只有越来越少的社会群体能从增长的成果中受益。而那些凭借实力成功的人又和其他赢家联姻，垄断了最好的教育机会。

同时，民主越来越运转不灵。柏拉图对代议制政府的极大担心是，公民将“日复一日，及时行乐”。他的担心是对的：大多数民主国家都会过度支出来满足公民的短期要求（无论是减税还是增加福利），而忽视长期投资。除此之外，游说组织和其他既得利益者还把操控体制以谋私利做成了一门学问。

| 风雨欲来

所有这一切结合在一起酿出的毒酒便是民粹主义的浪潮，它正在迅速破坏战后国际秩序的基石，制造出一个远为动荡的世界。民粹主义的众多危险之一是自我强化，只需部分事实就能看似合理。虽然“人民”是绝对可靠的常识库这一说法可能是胡说八道，但自由派精英一直都自以为是、一心谋私这一点却是毫无疑问。民粹主义以自己的失败为养料。企业越是用延迟投资或将资金转移到国外来应付不确定性，政客就越会威逼利诱它们做“正确的事”。经济停滞滋生民粹主义，而过度尊重民意又将强化停滞。

这些“令人欣慰”的想法是本专栏作者以熊彼特之名奉上的最后一期内容，不过这并不是他最后一次为《经济学人》撰稿。从4月起，他将执笔关于英国及其政治的白芝浩专栏。股份制公司有众多非凡之处，其中之一便是它们可能长存不朽：管理公司的人来来去去，但公司本身会持续发展下去。我们的专栏也是如此。熊彼特专栏将在2017年由新的（同时也许是更为乐观的）作者执笔。■



Indian economics

Many rupee returns

The impact of India's radical monetary reform is becoming clearer

MOST economists might hazard a guess that voiding the bulk of a country's currency overnight would dent its immediate growth prospects. On November 8th India took this abstruse thought experiment into the real world, scrapping two banknotes which made up 86% of all rupees in circulation. Predictably, the economy appears indeed to have been hobbled by the sudden "demonetisation". Evidence of the measure's costs is mounting, while the benefits look ever more uncertain.

At least the new year has brought a semblance of monetary normality. For seven weeks queues had snaked around banks, the main way for Indians to exchange their old notes for new ones or deposit them in their accounts. That is over, largely because the window to exchange money closed on December 30th. The number of fresh notes that can be withdrawn from ATMs or bank counters is still curtailed, but the acute cash shortage is abating, at least in big cities.

As data trickle through, so is evidence of the economic price paid for demonetisation. Consumers, companies and investors all wobbled in late 2016. Fast-moving consumer goods, usually a reliable growth sector, retrenched by 1-1.5% in November, according to Nielsen, a research group. Bigger-ticket items seem to have been hit harder. Year-on-year sales at Hero Motocorp, the biggest purveyor of two-wheelers, slid by more than a third in December.

A survey of purchasing managers in manufacturing plunged from relative optimism throughout 2016 to the expectation of mild contraction. Firms' investment proposals fell from an average of 2.4trn rupees (\$35bn) a quarter

to just 1.25trn rupees in the one just ended, according to Centre for Monitoring Indian Economy, a data provider. As a result, corporate-credit growth, already anaemic, has reached its lowest rate in at least 30 years (see chart).

All this amounts to “a significant but not catastrophic” impact, says Shilan Shah of Capital Economics, a consultancy. Annual GDP growth forecasts for the fiscal year ending in March have slipped by around half a percentage point, to under 7%, from an actual rate of 7.3% in the last full quarter before demonetisation. Other factors, such as the rise in the oil price and the surge in the value of the dollar after the election of Donald Trump, are also at play.

Whether the costs of the exercise justify the benefits depends, of course, on what those benefits are. In his speech announcing the measure, Narendra Modi, the prime minister, highlighted combating corruption and untaxed wealth. Gangsters and profiteers with suitcases full of money would be left stranded. But reports suggest that nearly 15trn rupees of the 15.4trn rupees taken out of circulation are now accounted for. So either the rich weren't hoarding as much “black money” as was supposed, or they have proved adept at laundering it. The Indian press is full of tales of household staff paid months in advance in old notes, or of bankers agreeing to exchange vast sums illegally.

Fans of demonetisation point to three beneficial outcomes. First, banks, laden with fresh deposits, will lend this money out and so boost the economy. Big banks cut lending rates early this month (quite possibly nudged by government, the largest shareholder of most of them). But their lending recently has not been constrained by a lack of deposits, so much as by insufficient shareholder capital to absorb potential losses, and by the over-borrowed balance-sheets of many industrial customers.

Second, Indians will move from living cash in hand into the taxed formal

economy. Mr Modi has recently promoted the idea of a cashless, or “less-cash”, India (not something mentioned at the outset), as one reason for demonetisation. Progress towards getting Indians to pay for things electronically is indeed being made, but from an abysmally low base.

The third upshot is the most controversial. Now that the demonetised bank notes are worthless, the government is intent on in effect appropriating the proceeds. The procedure requires trampling on the credibility of the Reserve Bank of India (RBI), the central bank, which must first agree to dishonour the promise, on all banknotes, to “pay the bearer” the value. If it does so, “extinguishing” the notes and its liability for them, it can transfer an equivalent amount to the government budget.

With so much cash handed in at banks, the amount remitted to government by the RBI might amount to perhaps 0.2-0.3% of GDP. Proceeds from a tax-amnesty scheme for cash-hoarders may swell the figure. Even so, it will not be enough to justify the costs of demonetisation—or even, perhaps, the damage to the reputation of the RBI, which is already facing questions about its independence. But having imposed the costs, Mr Modi will be keen to trumpet whatever benefits he can find. ■



印度经济

大量卢比返还

印度激进货币改革的影响日渐清晰

大多数经济学家可能都会大胆猜测，假如突然废除一个国家的大部分货币，将会损害其短期增长前景。去年11月8日印度将这一匪夷所思的思维实验付诸实践，废除了两种面额的纸币，共占卢比流通总量的86%。不出所料，该国经济似乎的确因为突如其来的“废钞令”而步履蹒跚。这一举措造成损失的证据正逐渐增加，而好处看起来则更不确定。

至少新的一年来临时，货币使用貌似已恢复正常。此前连续七周，银行门前都排起蜿蜒的长龙，这是印度人以旧币换新币或是将旧币存入自己账户的主要途径。如今此景不再，主要是因为兑换旧币的窗口已在12月30日关闭。能从自动取款机或银行柜台提取的新币数量仍然有限，但至少在大城市，严重的现金荒已在缓解。

随着数据慢慢积累，为废钞令付出经济代价的证据也不断增多。2016年底，消费者、公司和投资者的信心都有所动摇。根据调研集团尼尔森（Nielsen）的数据，通常增长稳定的快速消费品行业去年11月缩减了1%至1.5%。价格更高的商品似乎遭受了更大的冲击。最大的摩托车供应商英雄摩托公司（Hero Motocorp）的销售额去年12月同比下跌超过三分之一。

对制造业采购经理的一项调查显示，他们的心态从2016年全年的相对乐观骤变为对温和紧缩的预期。根据数据提供商印度经济监测中心（Centre for Monitoring Indian Economy）的统计，公司投资计划从每季度平均2.4万亿卢比（350亿美元）下跌至刚结束这一季度的仅1.25万亿卢比。这导致本已疲软的公司信贷增长率跌至至少30年来的最低点（见图表）。

咨询公司凯投宏观（Capital Economics）的希兰·沙阿（Shilan Shah）指出，所有这些集合在一起，造成了“严重但并非灾难性的”影响。对将于3月

截止的财政年度GDP年增长率的预测已下降约0.5个百分点，至7%不到，而实施废钞令前最后一个完整季度的实际增长率还是7.3%。油价上涨和特朗普当选后美元飙升等其他因素也起到了作用。

当然，这次行动的好处是否可以弥补所付出的代价取决于这些好处是什么。总理莫迪在宣布这一举措时强调了打击腐败和逃税。拥有成箱现金的黑帮分子和投机商将会陷入窘境。但报告显示，退出流通的15.4万亿卢比中，目前已有近15万亿入账。这样看来，要么富人所囤积的“黑钱”数额并不如先前以为的那么大，要么他们不愧为洗钱老手。印度媒体上各种故事满天飞，有的说一些佣人提前几个月就拿到了以旧币支付的工资，也有的说银行人员同意非法兑换巨额货币。

废钞令的支持者们指出了三大正面的结果。第一，新增大量存款的银行会借出这些钱，继而促进经济。大型银行在本月初降低了贷款利率（很可能由政府推动，政府是多数大型银行最大的股东）。但是它们的贷款近来并没有太受存款短缺的限制，对其影响更多的是用以吸收潜在损失的股东资本不足，以及很多工业客户负债过度。

第二，印度人将从拿着现金过日子步入征税的正规经济。莫迪最近宣称要创造一个无现金或“少现金”的印度是废钞行动的原因之一（这在该行动伊始并未提及）。让印度人实现电子支付的确有所进展，但它是从一个极低的基础上起步的。

第三点结果最富争议。既然被废止流通的纸币已一文不值，政府实际上是意图侵占这些收入。这么做需要践踏印度央行的信誉，该行须首先同意不履行“向持有人支付”所有纸币面值的承诺。如果它这么做，即“销毁”了这些纸币及它对此应承担的义务，那么它就能将相应的金额转移到政府预算中。

如此之多的现金交入银行，由印度央行缴汇到政府的金额可能为GDP的0.2%至0.3%。而对现金囤积者的税收赦免计划带来的收益可能会让这一数字增加。即便如此，也不足以证明废钞令利大于弊，甚至可能不足以抵

得过对印度央行声誉的损害——它已经面临对其独立性的质疑。但是既然已付出代价，莫迪必定会对任何他能找到的好处大吹大擂。■



Buttonwood

The third regime

The world is changing and investors may be too optimistic about the results

THANKS to Brexit and the election of Donald Trump, 2016 is widely viewed as a political turning-point. But it may also come to be seen as an economic turning-point, marking the third big change of direction since the second world war.

The post-war period from 1945 to 1973 was the era of the Bretton Woods system of fixed exchange rates and capital controls. It was a time of rapid economic growth in the rich world as countries rebuilt themselves after the war and as the technological innovations of the first half of the 20th century—cars, televisions, and so on—came into widespread use. High taxes reduced inequality; fiscal policy was used to control the economic cycle. It all came crashing down in the early 1970s as the fixed-currency system collapsed, and an oil embargo imposed by Arab producers ushered in stagflation (ie, high unemployment combined with inflation).

By the early 1980s, a new system had emerged. Currencies floated, capital controls were abolished, the financial sector was liberalised, industry was privatised and tax rates on higher incomes were cut. In this system inequality widened again (although economists still debate how to parcel out the blame between technological change and globalisation, as China and other countries took a full part in trade). Growth was slower than in the Bretton Woods era but inflation was reined in. Monetary measures replaced fiscal ones as the main policy tool. This era suffered its defining crisis in 2007-08 and has come to an end.

The final years of both periods were marked by a degree of monetary experimentation. In the late 1970s many policymakers were converted to

the doctrine of monetarism—the idea that by setting a target for the growth of the money supply governments could control inflation (and that controlling inflation should be the main aim of their policies). But monetarism proved harder to implement than its proponents thought; the monetary targets behaved unpredictably. By the mid-1980s, monetarism had been quietly dropped.

Since the 2008 crisis, monetary policy has had to be rethought again, with central banks grappling with the “zero bound” for interest rates. Their first move was to adopt quantitative easing, the purchase of assets to drive down longer-term borrowing costs. Some have since followed this up with negative rates on bank reserves.

Financial-market trends have played out against the backdrop of these two policy eras. Equities did very well for 20 years under the Bretton Woods regime, but started to falter in the mid-1960s, well before the system’s collapse. Perhaps investors already took fright at signs of inflation; bond yields had been trending upwards since the end of the second world war.

In the era of globalisation a great equity bull market began in 1982 but declined in 2000-02 with the bursting of the dotcom bubble. That was a portent of the bigger crisis of 2007-08. Both showed how investors could be prey to “irrational exuberance” and push asset prices to absurd levels. Just as rising bond yields in the 1960s presaged the inflationary battles of the 1970s, so falling bond yields in the 1990s and 2000s foreshadowed today’s struggles with deflation and slow growth.

Financial markets seem to expect that political turmoil will indeed lead to another change of economic regime. Since the American election the MSCI World equity index has rallied and the Dow Jones Industrial Average has hit record highs. Valuations reflect this optimism. In the early 1980s price-earnings ratios were in single digits. In contrast, the S&P 500 now trades on

an historic price-earnings ratio of 25. Another contrast with the 1980s is that, back then, short-term interest rates were at double-digit levels and equity valuations were able to climb as rates fell. That cannot happen now.

So what kind of economic regime are investors expecting? They seem to be cherry-picking the best bits from the previous two regimes—the tax cuts and deregulation of the 1980s with an expectation that (as under Bretton Woods) fiscal, rather than monetary, policy will be used to smooth the ups and downs of the cycle.

But the populist revolt is, in large part, a reaction against the free movement of capital and labour that has made so many financiers rich. A much bleaker outcome is possible, whereby rising nationalism leads to trade wars and an ageing workforce makes it impossible for the rich world to regain the growth rates of past decades. Change is coming. But rather than resembling the 1980s, the new regime could look more like the 1930s. ■



梧桐

第三体系

世界在变，投资者对结果可能过于乐观

由于英国脱欧及特朗普当选美国总统，2016年普遍被认为是一个政治转折点。但这一年也可能将被视为一个经济转折点，标志着自二战以来的第三次大转向。

1945年至1973年的战后时期是实施固定汇率和资本管制的布雷顿森林体系时代。这一时期，随着各国战后重建及20世纪上半叶的技术创新（汽车、电视等等）得以广泛应用，富裕世界经济增长迅猛。高税收减轻了不平等；政府运用财政政策控制经济周期。但20世纪70年代初，随着固定汇率体系崩溃，这一切土崩瓦解，阿拉伯产油国实施的石油禁运更是带来了滞胀（即高失业率加上通货膨胀）。

到了20世纪80年代初，一套新的体系已经出现。汇率浮动，资本管制取消，金融部门自由化，工业私有化，高收入人群获得减税。在这一体系中，不平等再次扩大（但由于中国等国家开始充分参与全球贸易，这种不平等有多少是缘于技术变革，又有多少是因全球化所导致，经济学家仍在争论）。相比布雷顿森林时代，这一时期的经济增速较慢，但通胀受到抑制。货币政策取代财政政策成为主要的政策工具。这个时代在2007至2008年遭遇决定性的危机，已然走到尽头。

上述两个时期的最后几年都出现了一定程度的货币政策试验。在20世纪70年代末，许多政策制定者转而信奉货币主义，即政府可通过设定货币供给增长的目标来控制通货膨胀（而且控制通胀应成为政府政策的主要目标）。但事实证明货币主义实践起来比其倡导者所想的更难，因为货币的流通状态难以预测。到80年代中期，货币主义已悄然退场。

自2008年金融危机以来，人们不得不重新考虑运用货币政策，央行纷纷努力应对利率“零下限”的问题。其第一步是采取量化宽松，购买资产以压低

长期借贷成本。部分央行随后还对银行准备金实施负利率。

在这两个政策的时代背景下，金融市场趋势显现。在布雷顿森林体系下，股市红火20年，但在20世纪60年代中期，即早在该体系崩溃很久之前就已开始萎靡不振。也许投资者已惊觉到了通胀的迹象；债券收益率自二战结束后一直呈上升趋势。

在全球化时代，股票市场的一轮大牛市始于1982年，但在2000年至2002年随着互联网泡沫的破灭而疲软。那是2007年至2008年那场更大的危机的先兆。两次危机均显出现投资者可能成为“非理性繁荣”的受害者，把资产价格推高至荒谬的水平。正如20世纪60年代债券收益的上升成了70年代通胀战的前兆，90年代和21世纪初债券收益的下降也预示着今天各国陷入通缩和增长放缓。

金融市场似乎预期政局改换真的会引致经济体系的又一次变革。自美国大选以来，MSCI世界股票指数回升，道琼斯工业平均指数更是屡创历史新高。公司估值反映了这一乐观氛围。上世纪80年代初，股票市盈率仅为个位数。相比之下，标普500目前的市盈率为25，达历史性高位。另一个和80年代的对比是，当时短期利率处于两位数，而股票估值会随着利率的下降而上升。如今，这已不可能发生。

那么投资者正在期望什么样的经济体系？他们似乎是在拣选前两个体系的最优点——既有80年代的减税及放松管制，又希望政府能（像在布雷顿森林体系下那样）运用财政而非货币政策来平滑经济周期的起伏。

然而，民粹主义的抬头在很大程度上是对资本和劳动力自由流动的反击，而这种自由流动正是众多金融家赖以发家致富的条件。未来的结果可能黯淡得多——民族主义情绪高涨导致贸易战爆发，劳动力老龄化使得富裕世界不可能重拾过去几十年的增长率。变化即将来临。但新体系可能并不与80年代类似，而会更像30年代时的情形。■



The Big Mac index

The all-meaty dollar

Burgernomics gets to grips with a strong greenback

IT IS perhaps not surprising that the worst-performing major currency in the world this year is the Turkish lira. Many emerging-market currencies have taken a battering since the election in November of Donald Trump raised expectations of faster monetary tightening in America and sent the dollar soaring. But the lira has many other troubles to contend with, too: terrorist bombings, an economic slowdown, alarm over plans by the president, Recep Tayyip Erdogan, to strengthen his powers, and a central bank reluctant to raise interest rates to defend the currency. It has plunged to record lows. According to the Big Mac index, our patty-powered currency guide, it is now undervalued by 45.7% against the dollar.

The Big Mac index is built on the idea of purchasing-power parity, the theory that in the long run currencies will converge until the same amount of money buys the same amount of goods and services in every country. A Big Mac currently costs \$5.06 in America but just 10.75 lira (\$2.75) in Turkey, implying that the lira is undervalued.

However, other currencies are even cheaper. In Big Mac terms, the Mexican peso is undervalued by a whacking 55.9% against the greenback. Last week it also plumbed a record low as Mr Trump reiterated some of his campaign threats against Mexico. The peso has lost a tenth of its value against the dollar since November. Of big countries, only Russia offers a cheaper Big Mac, in dollar terms, even though the rouble has strengthened over the past year.

The euro zone is also prey to political uncertainty. Elections are scheduled this year in the Netherlands, France and Germany, and possible in Italy. The

euro recently fell to its lowest level since 2003. Britain's Brexit vote has had an even bigger effect on the pound, which has fallen to \$1.21, a 31-year low. According to the Big Mac index, the euro and the pound are undervalued against the dollar by 19.7% and 26.3%, respectively.

One of the drawbacks of the Big Mac index is that it takes no account of labour costs. It should surprise no one that a Big Mac costs less in Shanghai than it does in San Francisco, since Chinese workers earn far less than their American counterparts. So in a slightly more sophisticated version of the Big Mac index, we take account of a country's average income.

Historically, this adjustment has tended to raise currencies' valuations against the dollar, so emerging-market currencies tend to look more reasonably priced. The Chinese yuan, for example, is 44% undervalued against the dollar according to our baseline Big Mac index, but only 7% according to the adjusted one. The deluxe Big Mac index has typically made rich-world currencies look more expensive. Because western Europeans have higher costs of living and lower incomes than Americans, the euro has traded at around a 25% premium against the dollar in income-adjusted burger terms since the euro's inception.

But what once seemed to be an immutable axiom of burgernomics is true no longer. So strong is the dollar that even the adjusted Big Mac index finds the euro undervalued. The dollar is now trading at a 14-year high in trade-weighted terms. Emerging-world economies may struggle to pay off dollar-denominated debts. American firms may find themselves at a disadvantage against foreign competition. And American tourists will get more burgers for their buck in Europe. ■



巨无霸指数

肥厚的美元

“汉堡经济学”着手应对强势美元

今年世界上表现最差的主要货币是土耳其里拉，这也许并不令人意外。去年11月唐纳德·特朗普的胜选推高了对美国加快实行货币紧缩政策的预期，引发美元飙升。随后，许多新兴市场的货币便遭到重创。不过，里拉还要应对其他许多麻烦：恐怖炸弹袭击、经济放缓、总统埃尔多安为加强自身权力而采取的各种计划引发恐慌，以及土耳其央行不愿提高利率来捍卫本国货币。里拉已暴跌至历史低位。根据我们以汉堡肉饼为灵感的货币指南——巨无霸指数，如今里拉相对于美元被低估了45.7%。

巨无霸指数以购买力平价这一理念为理论基础，即长远来看，不同货币的汇率会自动调整，直到相同数量的商品和服务在所有国家中都售价相同。一个巨无霸汉堡在美国售价为5.06美元，但在土耳其只卖10.25里拉（2.75美元），这就意味着里拉的价值被低估。

然而，其他的货币对美元的估值还要更低。根据巨无霸指数，墨西哥比索相对美元被低估高达55.9%。上周，因特朗普重提竞选时曾向墨西哥发出的某些威胁，比索也跌至纪录低位。自去年11月以来，比索兑美元已贬值10%。在大国中，以美元计，只有俄罗斯的巨无霸卖得更便宜，尽管过去一年中卢布已经走强。

同样受政治不确定因素影响的还有欧元区。荷兰、法国、德国（也许还会有意大利）都预定在今年举行大选。欧元近来已跌至2003年来的最低水平。英国脱欧公投对英镑的冲击还要更大，其兑美元的汇率已跌至1.21，为31年来的最低水平。根据巨无霸指数，欧元与英镑相对于美元分别被低估19.7%和26.3%。

巨无霸指数的缺点之一就是它并未计入各国劳动力成本的差异。人们应该不会因上海的巨无霸要比旧金山的便宜而意外，因为中国工人的薪水要

比美国工人低得多。因此，在一个稍微复杂些的巨无霸指数中，我们将一个国家的平均收入考虑在内。

在过去，这种调整往往会令各国货币相对美元估值升高，新兴市场的货币估值因而看起来会更趋于合理。例如，依照“基础版”的巨无霸指数，人民币对美元的估值低了44%，而据调整过的指数，这个数字仅为7%。“加强版”巨无霸指数通常都令富裕国家的货币显得更为昂贵。由于西欧人较美国人生活成本高而收入低，根据收入调整的巨无霸指数来衡量的话，自欧元面世后其兑美元汇率的溢价约达25%。

然而，“汉堡经济学”中一度看似颠扑不破的公理再也站不住脚了。美元如此强势，连调整过的巨无霸指数也显示欧元被低估。按照贸易加权计算，如今美元的汇率为14年来的最高水平。新兴经济体要偿还以美元计价的债务也许会很艰难。美国的公司或许会发觉自己在面对外来竞争时处于不利地位。而美国游客将会在欧洲用美元买到更多的汉堡。■



The future of Alphabet

Still searching

Alphabet is still looking for its next big moneymaker, and its current cash cow faces a big challenge of its own

“JUDGE a man by his questions, rather than his answers,” Voltaire advised. Google has become one of the most successful firms in history by heeding that advice. It evaluates the intention of web-surfers’ queries and returns relevant advertising alongside search results. But for years there has been a lingering question about Google: can it create a new, highly profitable unit to rival its search business?

Not yet. In the past five years, Alphabet, formed as a holding company for Google and other disparate projects in October 2015, has spent \$46bn on research and development (see chart). Much has gone to so-called “moonshot” projects, such as self-driving cars, smart contact lenses and internet delivered via balloons. Its British artificial-intelligence unit, DeepMind, also falls into the category of other projects. Since the start of 2015, these bets have together recorded a loss of \$6bn.

Advertising still accounts for nearly 90% of Alphabet’s revenues and almost all of its profits, according to Brian Wieser of Pivotal Research Group in New York. Search advertising in particular makes up around three-quarters of Alphabet’s total ad revenues. (YouTube, a video site, and a business that places ads on non-Google-owned sites are other contributors.)

On December 12th Alphabet put its self-driving car project into a separate unit called Waymo so staff can better focus on achieving commercial viability. In truth it is not much of a separation, as the firm will still be inside Alphabet and will not disclose more financial details. Other splits have been more drastic. In the past six months executives overseeing

several initiatives, including those focused on venture capital, drones, self-driving cars, high-speed internet and smart thermostats, have left. Alphabet has also been trying to sell its malfunctioning robotics business, Boston Dynamics.

The reason for these departures is Alphabet's ambivalence about how tightly it should manage costs, say people close to the firm. When Nest, the thermostats maker, was acquired for \$3.2bn in 2014, its executives were promised they could invest and expand their business for years. But when the Alphabet structure was suddenly adopted, the message changed. Overnight, units were expected to pay for their share of overhead, which irked some executives who remembered how the parent company had itself doled out big salaries and other luxuries (like free food). Few at the firm are optimistic that Alphabet is closer to devising a business as lucrative and large as search continues to be. As one former executive says, "You're unlikely to win the lottery twice."

Meanwhile, the way that people navigate their way around the internet is also changing, which could eventually pose a threat to Google's search-advertising business. There are two big impending shifts. One is the use of voice as a way to get information, and the other is the rise of virtual assistants. Already, around a fifth of searches on Android devices are done by voice (as opposed to text), and that share will grow as speech recognition improves. Voice will also become more important with the spread of stand-alone devices that answer questions, such as Amazon's Echo and Google's own new product, Google Home, which do not support advertising.

As interactions with devices like these become more complex, people will be able to rely on them to complete tasks they might have done online, such as ordering gifts, booking flights and locating nearby stores. Although Google has helped bring about this future with its Home device, its snazzy virtual assistant that predicts users' needs and its messaging app, called

Allo, it is unclear that these offerings will be healthy for its bottom line. In future, “searches” will be more focused on completing tasks and fetching information in environments where it will feel dissonant for ads to appear, such as in messaging apps or on smart-home devices. “As Google shifts more away from being a search engine to an answer service, its utility will go up. But the business model will fall apart,” argues Ben Thompson, who writes *Stratechery*, a blog on technology.

As well as the fact that Amazon delivers ad-free information via the Echo, the retail giant poses a direct threat to Google because more people are starting searches for electronics and other kit directly on its site, rather than through a general search engine. By one estimate, 55% of internet users now begin researching products on Amazon, depriving Google of the opportunity to deliver an ad.

Alphabet has confronted worrisome transitions before, such as the shift from desktop PCs to mobile. Its ad business is still booming, because it devised a way to deliver ads on small screens. It is possible that Google’s ad model could in future shift to taking a fee for each transaction it facilitates. This is already the case in air travel: people searching for flights scan options via one of Google’s tools, and airlines pay if a person books a ticket. Google could do the same if someone said to their phone, “order me a pizza”. But how it would choose which firm to place the order with, and whether consumers would be happy with that order being routed to the firm that paid most, are tricky questions, to which it is unlikely that even Google knows the answer. ■



Alphabet的未来

仍在搜索

Alphabet还在找寻它的下一棵摇钱树，而它目前的现金牛自身正面临巨大挑战

“评判一个人要看他的提问，而不是他的回答。”伏尔泰如是忠告。谷歌遵循了这一建议，并已成为史上最成功的公司之一。它评估上网者的提问透漏出何种意图，并在搜索结果的旁边展示相关广告。但是多年来关于谷歌始终有一个问题萦绕不去：它能创造出一个堪比其搜索业务的全新高利润部门吗？

目前还没有。2015年10月，Alphabet作为谷歌和其他不同项目的控股公司成立，过去五年它已经在研发上投入了460亿美元（见图表）。很多资金投向了所谓的“登月”项目，如自动驾驶汽车、智能隐形眼镜、通过气球提供互联网等。它在英国的人工智能部门DeepMind也属于其他项目之列。自2015年年初，这些押注总共已亏损60亿美元。

纽约Pivotal Research Group的布莱恩·威泽（Brian Wieser）称，广告仍占Alphabet收入的近90%、利润的近100%。尤其是搜索广告，约占Alphabet总体广告收入的四分之三。（视频网站YouTube和另一项在非谷歌所有的网站上投放广告的业务贡献了剩下的收入。）

12月12日Alphabet为自动驾驶汽车项目成立了一个名为Waymo的独立公司，这样员工就可以更专注于实现商业可行性。实际上，这不是严格意义上的剥离，因为该公司还是会留在Alphabet旗下，而且并不会披露更多财务细节。其他的剥离则更为激烈——过去半年来多个项目的负责人纷纷离职，包括那些专注于风险投资、无人机、自动驾驶汽车、高速互联网和智能恒温器的高管们。Alphabet也曾经试图出售经营不善的机器人业务波士顿动力（Boston Dynamics）。

知情人士称，他们之所以离去是因为Alphabet对该在多大程度上收紧成本举棋不定。2014年恒温器制造商Nest被谷歌以32亿美元收购时，其高管得

到的承诺是他们可以持续多年投资并拓展业务。但是当公司突然采用Alphabet架构时，传达的信息发生了改变。一夜之间，母公司期望这些部门自行负担日常运营开支，这激怒了一些高管——他们还记得母公司自己是如何慷慨分发高薪以及其他优厚待遇的（比如免费餐饮）。搜索业务仍在继续盈利、规模宏大，而对于Alphabet是否离发展一项堪比搜索的业务更近了一步，公司里极少有人持乐观态度。正如一位前高管所言，“彩票不太可能中两次”。

与此同时，人们在互联网上获取信息的方式也在改变，这最终可能会威胁到谷歌的搜索广告业务。两大转变即将来临：一是用语音作为获得信息的方式，二是虚拟助手的兴起。安卓设备上的搜索已经有约五分之一是通过语音而非文字来完成的，随着语音识别的改善，这一比例还将上升。由于不支持广告、能回答问题的独立设备逐渐普及，如亚马逊的Echo和谷歌自己的新产品Google Home，语音还会变得更加重要。

随着与类设备展开互动变得越来越复杂，人们将会依赖它们去完成原先可能会上网去做的事，如订购礼物、订机票、找到附近的商店等。尽管凭借它的Home设备、能预测用户需求的时髦虚拟助手，以及通讯应用Allo，谷歌已经在帮助实现这一未来，但这些服务是否会有助于盈利还未可知。未来，“搜索”将更注重在如即时通讯应用或智能家居设备之类的环境中完成任务、获取信息，而在这些环境中出现广告会让人觉得别扭。“随着谷歌从搜索引擎向应答服务转变，它的实用性会增强。但是商业模式将会瓦解。”科技博客Stratechery的博主本·汤姆森（Ben Thompson）这样说道。

除了通过Echo提供无广告的信息外，零售巨头亚马逊还对谷歌产生了直接的威胁，因为更多人开始直接在亚马逊的网站上搜索电子产品和其他装备，而不再通过综合搜索引擎。有预测显示，现在有55%的互联网用户开始在亚马逊上了解产品，不给谷歌发送广告的机会。

之前Alphabet曾经直面过多次令人担忧的转变，例如从台式电脑转向移动设备。它的广告业务仍在蓬勃发展，因为它创造了在小屏幕上投放广告的

方法。也许谷歌未来的广告模式会转变为对它促成的每笔交易收费。它在航空旅行上已经这么做了：搜索航班的人通过谷歌的一个工具浏览选项，如果有人订了机票，航空公司就会向谷歌付费。如果有人对着电话说“帮我点个披萨”，谷歌似乎也可以这么操作。但是它该怎么选择在哪家公司下订单，若将订单转给向它付费最多的公司消费者是否会满意，这些都是棘手的问题，即使是谷歌也不太可能知道答案。■



Buttonwood

Not passing the buck

Global capital flows have slowed down

FOR more than two decades after the early 1980s, it seemed as if the financial markets were moving in only one direction. More and more money was flowing across borders; capital markets were becoming increasingly integrated.

Since the 2008 financial crisis this particular aspect of globalisation has stalled, and even partly retreated. The reversal is illustrated by the triennial survey of foreign-exchange markets, conducted by the Bank for International Settlements (BIS). Daily turnover in April was \$5.1trn, down from \$5.4trn in April 2013.

That is still a huge number compared with the turn of the century, when daily turnover was around the \$1trn mark. But it is a sign that markets are getting a little less frenetic; spot (or instant) currency trading has fallen by 19% in three years.

Other data from the BIS confirm the trend. Cross-border banking claims peaked in the first quarter of 2008 at \$34.6trn. By the second quarter of 2010, they had dropped to \$27.9trn, and they have never recovered their pre-crisis levels. In the second quarter of last year (the most recent data), claims were \$28.3trn. Part of this may be a consequence of events in the euro zone, where the sovereign-debt crisis caused banks to cut back their lending to weaker economies. Add up all financial flows, including direct investment, and in 2015 cross-border volumes were only half 2007's level, according to McKinsey, a consultancy (see chart).

This is not necessarily bad news. After all, as Asian countries found out in

the 1990s, too much “hot money” flowing into an economy can be destabilising. It can drive exchange rates out of line with economic fundamentals, making a country’s exporters less competitive. A rising currency may also tempt domestic companies to borrow abroad. Then, when the hot money flows out and the exchange rate collapses, those borrowers will struggle to repay their debts. The result can be a financial crisis.

The implications of deglobalisation depend on why the slowdown is happening. There may be a link to economic fundamentals. World trade volumes were regularly growing at an annual rate of 5-10% in the run-up to the crisis; in recent years they have managed only 2% or so. In 2015 exports were a smaller proportion of global GDP than they were in 2008. If trade is growing less rapidly, so is the demand for credit to finance it.

However, as the BIS points out, trade accounts for only a small proportion of capital flows. The downturn is mainly because of events within the financial sector itself.

Before the crisis, cross-border banking activity was closely correlated with measures of risk appetites. When the economic outlook was good, banks were happy to lend abroad; in the face of shocks, they retreated back to their home base. Research by the Bank of England shows that the picture changed after the crisis; there was simply a more general retreat by the banking sector from foreign commitments.

Part of this may reflect a lack of demand for loans from companies and individuals that had overstretched during the boom years. But the biggest reason is probably the weakness of the banking sector. It has been deprived of some sources of funding (money-market mutual funds, for example) and has been forced by the regulators to rebuild its balance-sheet.

In the currency markets, the BIS says, there has been a shift in the type of people that are participating. Institutional investors such as pension funds and insurance companies are being more active. They may decide to buy, say, Japanese equities without wanting to be exposed to fluctuations in the yen, so they will hedge this exposure in the currency markets. In contrast, there has been a reduction in risk-taking activity by hedge funds and bank trading desks, which suffered a big shock in January 2015 when the Swiss National Bank suddenly abandoned its policy of capping the franc's exchange rate. The sharp jump in the value of the franc that followed caused turmoil for some brokers, forcing them to raise their fees and cut their client lists.

A market less in thrall to speculators might seem like an unalloyed boon. But the retreat of banks from currency trading (and from market-making in other instruments such as corporate bonds) may not be quite such good news. In a crisis, the banks may not be around to trade with investors seeking to offload their positions; the BIS notes signs of “volatility outbursts and flash events”. Lots of investors and companies want to hedge their currency exposure. They need an institution to take the other side of the trade. ■



梧桐

莫再推诿

全球资本流动已放缓

20世纪80年代初以后的二十多年里，金融市场似乎只是朝着单一方向发展。越来越多资金跨境流动，资本市场日益一体化。

自2008年金融危机以来，全球化在这一方面已经停滞，甚至部分倒退。这种逆转从国际清算银行（BIS）对外汇市场所做三年一度的调查中可以显现。去年4月的日交易额为5.1万亿美元，低于2013年4月的5.4万亿美元。

相比世纪之交时的情况，这仍是个巨大的数字，当时的日交易额仅为一万亿美元左右。但数字下跌表明市场的狂热正在减退：现货（或称即期）外汇交易在三年内下降了19%。

来自国际清算银行的其他数据印证了这一趋势。跨境银行信贷在2008年首季度达到了34.6万亿美元的高点。到了2010年第二季度，已下降至27.9万亿美元，而且一直未能重回危机前水平。去年第二季度（最新数据）的跨境信贷额为28.3万亿美元。一部分原因也许因为欧元区的连串事件，主权债务危机导致银行削减了对较弱经济体的贷款。据咨询公司麦肯锡的数据，将直接投资在内的所有资金流都算上，2015年的跨境资金流动只有2007年的一半（见图表）。

这不一定是坏事。毕竟，正如亚洲国家在上世纪90年代的经历所证明的那样，过多“热钱”流入一个经济体可能破坏其稳定性。这会推高汇率脱离经济基本面，令该国的出口商竞争力减弱。货币汇率上升还可能诱使国内公司从境外借款。然后，当热钱外流，汇率崩盘，这些借款人将难以偿还债务。其结果可能会是一场金融危机。

去全球化的影响取决于目前低迷状态的原因。也许与经济基本面有关系。在金融危机前，世界贸易年增长率一般为5%至10%，近年来则仅为2%左

右。2015年出口占全球GDP比例较2008年为低。假如贸易增速减慢，相应的融资信贷需求也将趋缓。

然而，正如国际清算银行指出的，贸易仅占资本流动的一小部分。目前的低迷主要是因为金融业本身的变化。

在危机爆发前，跨境银行业务与对风险偏好的衡量密切相关。经济前景向好时，银行乐于向境外贷款；面临危机时，银行便退守国内业务。英国央行的研究表明，危机后的形势发生了变化；银行业更普遍地直接减少各项海外业务。

原因之一可能是在经济繁荣期过度扩张的公司和个人目前缺乏贷款需求。不过最大的原因也许是银行业变得疲弱。其部分资金来源已被剥夺（例如货币市场共同基金），还被监管机构责令重组资产负债表。

国际清算银行表示，货币市场交易的参与者类型也发生了变化。养老基金及保险公司等机构投资者变得更为活跃。举例来说，它们可能决定买入日本股票但不希望受日元波动的影响，所以会在货币市场对冲这一风险。相比之下，对冲基金和银行交易柜台从事的高风险活动减少了，毕竟2015年1月瑞士央行突然放弃限定瑞士法郎汇率上限的政策，令它们遭受了巨大冲击。之后瑞士法郎汇率急剧上升，给部分券商造成混乱，迫使它们提高收费并精减客户。

市场受制于投机者的程度降低，这看似是真正的福音。但银行减少外汇交易（及削减诸如企业债等品种的做市业务），也许不是什么好消息。在危机中，银行可能不会和想降低自身头寸的投资者做交易；国际清算银行发现存在“波动性激增和闪电崩盘”的迹象。许多投资者和公司想对冲其货币风险。它们需要一家金融机构接盘。■



Trumponomics

Men of steel, houses of cards

The president elect's team needs to realise that America's economy is not like a steel mill

IT MUST seem to Donald Trump that reversing globalisation is easy-peasy. With a couple of weeks still to go before he is even inaugurated, contrite firms are queuing up to invest in America. Last week Ford cancelled a \$1.6 billion new plant for small cars in Mexico and pledged to create 700 new jobs building electric and hybrid cars at Flat Rock in Michigan—while praising Mr Trump for improving the business climate in America. Other manufacturers, such as Carrier, have changed their plans, too. All it has taken is some harsh words, the odd tax handout and a few casual threats.

Mr Trump has consistently argued that globalisation gives America a poor deal. He reportedly wants to impose a tariff of 5% or more on all imports. To help him, he has assembled advisers with experience in the steel industry, which has a rich history of trade battles. Robert Lighthizer, his proposed trade negotiator, has spent much of his career as a lawyer protecting American steelmakers from foreign competition. Wilbur Ross, would-be commerce secretary, bought loss-making American steel mills just before George W. Bush increased tariffs on imported steel. Daniel DiMicco, an adviser, used to run Nucor, America's biggest steel firm. Peter Navarro, an economist, author of books such as "Death by China" and now an adviser on trade, sees the decline of America's steel industry as emblematic of how unfair competition from China has hurt America.

But the steel business is not a model for trade policy in general and companies are capable of being tricky, too. Mr Trump may simply be looking for good headlines, but if he wants more, his plans threaten to be an expensive failure.

| *The miller's tale*

One reason is that Paul Ryan, the Speaker of the House of Representatives, said last week that Congress would not be raising tariffs. Executive orders are bad politics and can get Mr Trump only so far. Another is that Ford's plans are not as simple as they look. It will still build its new small car in Mexico—at an existing plant. But above all, Mr Trump gravely underestimates the complexity of messing with tariffs.

The men of steel are right to complain about China. Its government has indeed subsidised its steelmakers, leading to a glut that was dumped on the world market. Successive American governments have put up tariffs to protect domestic producers (in 2016 the Obama administration placed a tariff of 522% on cold-rolled Chinese steel), as has the European Union.

Yet this way of thinking fails to deal with the question of whether an ample supply of cheap steel courtesy of a foreign government is really so terrible: it benefits American firms that consume steel—and they earn bigger profits and employ more people as a result. Moreover, trade in most goods and services is not like steel. America's biggest import from China is electrical machinery. China's government does not subsidise the overproduction of iPhones which are then dumped on the market, causing iPhone-makers in America to be laid-off. Instead, a smartphone might be designed and engineered in California and assembled in China, using components made or designed in half a dozen Asian and European countries, using metals from Africa. Likewise, every dollar of Mexican exports contains around 40 cents of American output embedded within it. For producers of such goods, tariffs would be a costly disaster. American steelmakers might seek out government protection. Apple and its kind will not. ■



特朗普经济学

钢铁人，纸牌屋

当选总统的团队需明白，美国经济不是一座钢铁厂

特朗普肯定觉得逆转全球化易如反掌。离他正式就任尚有一两周，一家家幡然悔悟的公司已纷纷开始投资于美国本土。上周，福特取消了在墨西哥投资16亿美元建设小型车新工厂的计划，承诺在密歇根州的福拉特洛克（Flat Rock）创造700个生产电动车及混合动力车的新职位，同时还称赞特朗普改善了美国的商业环境。其他各家生产商，如开利（Carrier），也都已改变了计划。特朗普所做的只是说了几句难听的话，给了些莫名其妙的税收好处，信口威胁了几家企业。

特朗普一贯辩称全球化为美国带来的只是桩不划算的买卖。据说他想对所有进口商品施加5%甚至更高的关税。他集结了一些顾问，以助自己一臂之力。这些人都有钢铁产业的背景，而这个产业有着丰富的贸易战历史。特朗普提名罗伯特·莱特希泽（Robert Lighthizer）任贸易代表，此人职业生涯的相当一部分时间都在做律师保护钢铁企业免遭外来竞争。而获提名担任商务部长的威尔伯·罗斯（Wilbur Ross）则在小布什提高进口钢材关税之前大举收购亏损的钢铁厂。顾问丹尼尔·迪米科（Daniel DiMicco）曾掌管美国最大的钢铁企业纽柯（Nucor）。经济学家、《致命中国》（Death by China）等书的作者彼得·纳瓦罗（Peter Navarro）如今担任贸易政策的顾问。他认为美国钢铁产业的衰退是来自中国的不公平竞争伤害美国的典型表现。

然而钢铁产业并不是制定一般贸易政策时可参照的范本，而企业也能偷奸耍滑。特朗普或许只是想谋求些叫好的新闻头条，但如果他想要的不止于此，那么他的那些计划可能就会成为代价高昂的失败。

| 钢铁业的传说

一个原因是，众议院议长保罗·瑞安（Paul Ryan）上周表示国会并不会提高关税。行政命令是糟糕的政治手段，特朗普借此能达成的目的也很有

限。另一个原因是福特的计划并不像看上去那么简单，它仍将在墨西哥生产新的小型车——只不过是在现有的工厂里而已。然而最重要的问题还是特朗普严重低估了干涉关税这种行为的复杂后果。

钢铁业者有理由抱怨中国。中国政府确实向本国钢企提供了补贴，结果导致超量的钢铁倾销至世界市场。接连几届美国政府都提高关税以保护本国生产商（奥巴马政府在2016年曾向来自中国的冷轧钢材征收522%的关税），欧盟也曾采取过这样的措施。

不过上述这种思路并没有问过这样一个问题：承蒙一个外国政府为自己提供了充足的廉价钢铁，这事是不是真的那么糟糕。消耗钢材的美国公司从中受益，它们利润增加进而雇用了更多的员工。更重要的是，大多数产品及服务的贸易都与钢铁贸易不同。美国从中国进口最多的是电机。中国政府并未向iPhone的过量生产提供补贴，随后大量投放市场的iPhone也没有造成在美国制造该手机的工人失业。实际上，一款智能手机也许在加州设计开发，在中国组装，使用六七个亚洲和欧洲国家制造或设计的部件以及来自非洲的金属。同样地，从墨西哥进口的每一美元的商品中就包含着美国约40美分的产值。对于这种商品的生产者来说，关税就意味着代价惨重的灾难。美国的钢铁企业也许得寻求政府的保护，但苹果及其同类则不会。 ■



Driverless cars

Eyes on the road

How to miniaturise laser-scanning devices for cars that drive themselves

EXPERIMENTAL self-driving cars continue to make regular forays onto the roads. After a trial in Pittsburgh, Uber, a taxi-hailing-app company, launched several of its “autonomous” vehicles onto the streets of San Francisco on December 14th—and promptly ran into a row with officials for not obtaining an operating permit, which Uber insists is unnecessary as the vehicles have a backup driver to take over if something goes wrong. General Motors said it would begin testing self-driving cars in Michigan. For these and other trials one thing is essential: providing the vehicles with a reliable form of vision.

As no man-made system can yet match a pair of human eyes and the image-processing power of a brain, compromises have to be made. This is why engineers use a belt-and-braces approach in equipping vehicles with sensors that can scan the road ahead. That way, just as your trousers will stay up if one or other of belt and braces fails, if one system misses a potential hazard, such as an oncoming car or a pedestrian, the others might spot it and direct the car to take evasive action.

Three of the sensory systems currently in use in autonomous vehicles—cameras, ultrasonic detectors and radar—are reasonably cheap and easy to deploy. A fourth, lidar, is not. Lidar employs laser scanning and ranging to build up a detailed three-dimensional image of a vehicle’s surroundings. That is useful stuff as the lidar image can be compared with the data being captured by the other sensors. The problems are that lidar is bulky (it hides in the roof domes of Google’s self-driving cars and, as pictured above, in the revolving beacons that adorn Uber’s vehicles), mechanically complicated and can cost as much as the unadorned car

itself.

Smaller, cheaper lidars are being developed. One of the most promising comes in the minuscule form of a silicon chip. Prototypes have been delivered to several big automotive-component suppliers, including Delphi and ZF. If all goes well, within three years or so lidar chips should start popping up in vehicles.

| *A chip off the old block*

The company bringing these miniature lidars to market is Infineon, a German chipmaker. This firm is one of the biggest producers of the chips used in radar detectors. Radar works by sending out radio pulses and detecting the reflected signals that have bounced off objects. The time delay between emitting a pulse and noting its reflection is used to calculate how far away the reflecting object is. If that object is moving, then its speed can also be determined. This determination comes from a slight shift in the frequency of the reflected signal, caused by the Doppler effect (the phenomenon that also causes a passing fire-engine's siren to change pitch).

Around 15 years ago radar sensors were specialised pieces of kit and cost around \$3,000. Infineon found a way to make them using a standard silicon-based manufacturing process and, by integrating many of the functions of a radar onto a single chip, boost performance. That has brought the price down to a few hundred dollars. As a result, radar chips have become an essential part of an autonomous car and are increasingly used in conventional vehicles too, to provide safety features such as automatic emergency braking.

The race is now on to shrink lidar in a similar way. Lidar was developed as a surveying method following the invention of the laser in the 1960s. It employs a laser beam to scan an area and then analyses the reflections that bounce back. As light has a much shorter wavelength than radio waves do,

it is more readily reflected from small objects that radar might miss. Lidar is used to make maps, measure atmospheric conditions and by police forces to scan accident and crime scenes.

Typically, a lidar employs revolving mirrors to direct its laser beam, which is usually in the invisible near-infrared part of the spectrum, rather than the visible part. Commercial lidar can cost \$50,000 or so a pop, but smaller, lower-powered versions are now available for \$10,000 or less. A number of lidar makers, such as Velodyne, a Californian firm, are trying to develop what they call “solid-state” lidars, which are miniaturised versions with no moving parts. Some researchers are using a flash of laser light instead of a beam, and capturing the reflections with an array of tiny sensors on a chip.

Infineon, however, has taken a different tack and is using a micro-electro-mechanical system (MEMS). This particular MEMS was invented by Innoluce, a Dutch firm which Infineon bought in October 2016. The device consists of an oval-shaped mirror, just 3mm by 4mm, contained on a bed of silicon. The mirror is connected to actuators that use electrical resonance to make it oscillate from side to side, changing the direction of the laser beam it is reflecting. This, says Infineon, permits the full power of the laser to be used for scanning instead of its light being dispersed, as it would be in a flash-based system.

The MEMS lidar can scan up to 5,000 data points from a scene every second, and has a range of 250 metres, says Ralf Bornefeld, Infineon’s head of automotive sense and control. Despite its moving mirror, he thinks it should prove as robust and reliable as any other silicon chip. In mass production and attached to, say, a windscreen, the MEMS lidar is expected to cost a carmaker less than \$250. These tiny lidars would have other applications, too—in robots and drones, for example.

Many engineers, Mr Bornefeld included, reckon autonomous cars of the

future will use multiple miniature lidars, radars, ultrasonic sensors and digital cameras. Each system of sensors has advantages and disadvantages, he says. Combining them will provide a “safety cocoon” around an autonomous vehicle.

Radar measures distance and speed precisely, and works in the dark and in fog—conditions in which cameras might struggle—but the images it yields can be difficult to classify. Moreover, some materials (rubber, for example) do not reflect radar waves well, so radar could have difficulty noticing, say, a dangerous chunk of tyre from a blowout lying in the road. With good visibility, the car’s cameras should spot the bits of tyre. The cameras capture high-resolution pictures, use artificial-intelligence software to analyse them, and then apply image-recognition techniques to identify objects that need to be avoided. Lidar, with its ability to build detailed images of even small objects and operate in the dark, should spot the tyre, though it, too, might struggle to do so in dense fog. Ultrasonic detectors, meanwhile, will continue to play a part. They have been around for a while and work in a similar way to radar, but instead use high-frequency sound inaudible to humans. They would not see the tyre chunk—at least, not until too late—for they usually lack the range. But they are cheap and make excellent parking sensors.

Google, Uber and most carmakers who aspire to make autonomous vehicles already use lidar. They ought, therefore, to welcome its miniaturisation with open arms. But not everyone is convinced of lidar’s worth. Elon Musk, the boss of Tesla, a firm that makes electric cars, has spurned the technology. He has said the camera, radar and ultrasonic systems that provide the Autopilot autonomous-driving mode in Tesla’s vehicles are improving rapidly and will be all that is necessary.

| *The more eyes, the better*

Mr Musk may, though, change his mind. In Florida, in May 2016, the driver

of a Tesla using Autopilot at high speed was killed in a collision with a lorry turning across the road in front of him. Although Autopilot users are supposed to keep their hands on the wheel and their eyes on the road (just as, for now, the backup drivers in Google and Uber cars do), it appears the Tesla's cameras and radar either failed to spot the lorry—which was painted white and set against a brightly lit sky—or thought it was something else, such as an overhead sign. Whether lidar would have made the correct call, as some think it would, no one will ever know. But when more driverless cars venture onto the roads in earnest, having plenty of belts and braces might help reassure their passengers. ■



无人驾驶汽车

眼观前路

自动驾驶汽车的激光扫描设备如何实现微型化

自动驾驶试验车继续定期上路。在匹兹堡测试过后，网约车公司优步在12月14日推出多台“自主”汽车，开上旧金山的街道。但随即便受到官员们的阻挠，指其未获路试许可。然而优步坚称有后备司机在车上，系统有问题时司机可接管驾驶，因此不必另行申请许可。通用汽车公司表示将开始在密歇根州测试自动驾驶汽车。对于上述及其他测试而言，一件事情至关重要：赋予车辆可靠的视觉能力。

由于人造系统至今尚无法媲美人类眼睛及大脑的图像处理能力，只能做出一些妥协。所以，工程师在给车辆配置可探测前方路况的传感器时，采用了“腰带加背带”的双重保障。如此一来，正如腰带或背带之一如果松脱裤子并不会掉下来那样，即便一套系统错过了某处潜在危险，如迎面而来的汽车或行人，其他系统仍可能察觉并指示汽车做出闪避动作。

在自动驾驶汽车目前使用的传感系统中，有三套比较便宜且易于部署，它们分别是摄像头、超声波探测器和雷达。而第四套系统激光雷达则不然。激光雷达采用激光探测及测距技术来构建汽车所处环境的详细三维影像。这非常有用，因为激光雷达影像可与其他传感器捕获的数据作比较。问题在于激光雷达很笨重（隐藏于谷歌的自动驾驶车车顶内，或如上图所示，安装在优步自动驾驶车车顶的旋转信标台内），机械构造复杂，而且成本与一台未加装车顶系统的汽车一样高。

科研人员正在研发更小型廉价的激光雷达系统。在最具前景的技术中有一种是微型硅芯片系统。其原型产品已交付几家大型汽车零部件供应商，包括德尔福（Delphi）和采埃孚公司（ZF）。一切顺利的话，大约三年内，激光雷达芯片应该就会开始应用在汽车上。

| 旧模式，新芯片

研发这些微型激光雷达并将其投放市场的公司是德国芯片制造商英飞凌（Infineon）。该公司是雷达探测器芯片的最大制造商之一。雷达能发射无线电脉冲并接收物体反射回来的信号，从而发挥探测功能。发射脉冲和收到反射之间的延时被用于计算该反射物的距离远近。假如该对象正在移动，其速度也可被测算出来，因为反射信号的频率会出现轻微改变，这源于多普勒效应（该现象也导致消防车驶过时警笛音调发生改变）。

约15年前，雷达传感器属于专用配件，成本约为3000美元。英飞凌找到方法以标准化的硅基芯片制作工艺来生产这些传感器，还将雷达的多种功能集成到单一芯片上。产品性能因此提高，价格也随之下降到几百美元。结果，雷达芯片已成为自动驾驶汽车不可或缺的一部分，在常规汽车中也日益常见，提供自动紧急制动等安全功能。

目前各公司正竞相以类似方式缩小激光雷达的体积。在上世纪60年代发明激光之后，激光雷达作为一种测量手段面世。它使用激光束扫描一个区域，然后分析反射回来的光束。由于激光的波长比无线电波长短得多，更容易从雷达可能忽略的小物件上反射回来。现在，激光雷达被用于制作地图、测量大气状态，也被警方用于探测事故和犯罪现场。

一般来说，激光雷达使用旋转镜面引导激光束，这些光束通常处于光谱中不可见的近红外区，而不是可见光。一台商用激光雷达的价格可达五万美元左右，而目前在售的小型低功率版的价格则为一万美元或更低。加州公司Velodyne等多家激光雷达制造商正致力于开发所谓的“固态”激光雷达，即不含运动部件的微型版产品。有些研究人员使用激光闪光而非光束来探测，并利用芯片上的一系列微型传感器来捕捉反射光。

而英飞凌则采用了另一种方法：运用微机电系统（MEMS）。该公司使用的这套MEMS系统由荷兰公司Innoluce发明，后者在2016年10月被英飞凌收购。这一装置包含一面仅3mm×4mm大小的椭圆形镜面，装于硅基片上。镜面与致动器相连，通过电谐振使镜面左右往复摆动，从而改变其反射的镭射光束的方向。英飞凌表示，这使得设备可将激光的全部能量用于

扫描，而不像激光闪光系统那样分散光束。

英飞凌汽车感应与控制部门的主管拉尔夫·博恩费尔德（Ralf Bornefeld）表示，该MEMS激光雷达每秒可扫描一个场景中的5000个数据点，探测范围达250米。他认为，尽管这套装置包含运动镜面，但应该会和其他硅芯片一样坚固可靠。如果大规模投产并安装到挡风玻璃等位置，预计汽车制造商将为之支付不到250美元。这些微型激光雷达还会有其他用途，例如应用于机器人和无人机中。

包括博恩费尔德在内的许多工程师认为，未来的自动驾驶汽车将运用众多微型激光雷达、雷达、超声波传感器和数字摄像头。他说，各种传感系统各有优缺点，结合运用将会为自动驾驶汽车包裹上一层“安全茧”。

雷达能精确测量距离和速度，即使在黑暗和迷雾中也能工作（摄像头也许就费劲了），但雷达形成的图像可能难以辨别分类。而且，一些材料不能很好地反射雷达波，比如橡胶，所以雷达或许难以探测到道路中一大块危险的爆胎碎片。在可见度良好的情况下，汽车的摄像头应该能发现轮胎碎片。摄像头捕获高清图片，通过人工智能软件加以分析，然后运用图像识别技术辨别需要躲避的对象。激光雷达即使对小型物体也能形成详细图像，还可以在黑暗中运作，应该能探测到这块轮胎碎片，尽管遇到浓雾时可能也有困难。与此同时，超声波探测器将继续发挥作用。其应用已有一段时间，运作原理与雷达相似，只不过发射的是人类听不见的高频声波。它们是无法探测到轮胎碎片的（至少是不能及时探测到），因为其探测范围通常太小。但它们价格低廉，作为停车传感器效果出色。

谷歌、优步及有志制造自动驾驶汽车的大多数汽车厂商都已在使用激光雷达。因此，它们应该会敞开怀抱欢迎激光雷达的微型化。但并非所有人都深信激光雷达的价值。电动汽车制造商特斯拉的老板伊隆·马斯克已摒弃这项技术。他曾表示，特斯拉汽车为实现Autopilot自动驾驶模式而安装的摄像头、雷达及超声波系统技术提升迅速，将足以发挥作用。

| 眼睛越多越好

不过马斯克可能会改变主意。2016年5月，在佛罗里达，一辆特斯拉以自动驾驶模式高速行驶，与迎面而来在路口拐弯的一辆货车相撞，特斯拉司机死亡。虽说特斯拉自驾模式要求司机们仍保持手抓方向盘，眼观前路（就像目前谷歌和优步自动驾驶汽车里的后备司机一样），但这辆特斯拉的摄像头和雷达似乎并没有探测到那辆货车（白漆车身，背景是明亮的天空），不然就是将其误认作其他物体，例如公路指示牌。如果用的是激光雷达，是否就能和一些人认为的那样，做出正确的判断呢？这个问题永远没有答案。但随着更多的无人驾驶汽车正式上路，充分配置多重安全设备也许有助于人们更安心地搭乘。 ■



Buttonwood

Seeing through a glass darkly

What might be the big market surprises of 2017?

IF 2016 was a year of shocks, what will the next 12 months bring? It is time for the annual tradition (dating all the way back to 2015) when this column tries to predict the surprises of the coming year.

By definition, a surprise is something the consensus does not expect. A regular survey of global fund managers by Bank of America Merrill Lynch (BAML) points to what most people believe. Following the election of Donald Trump, investors are expecting above-trend economic growth, higher inflation and stronger profits. They have invested heavily in equities and have a much lower-than-normal exposure to bonds.

So it is not too difficult to see how the first surprise might play out. Expectations for the effectiveness of Mr Trump's fiscal policies are extraordinarily high. But it takes time for such policies to be implemented, and they may be diluted by Congress along the way (especially on public spending). Indeed, it may well be that demography and sluggish productivity make it very hard to push economic growth up to the 3-4% hoped for by the new administration. Neither fiscal nor monetary stimulus has done much to lift Japan out of its torpor, after all.

American profits, which were falling in early 2016, seem certain to rebound, particularly if the new administration pushes through corporate-tax cuts. But with the market priced on a cyclically adjusted price-earnings ratio of 28.3, according to Robert Shiller of Yale, a lot of good news is priced in. The ratio, which averages profits over the past ten years, is 70% above its long-term average.

Meanwhile, the Federal Reserve is pencilling in three rate increases in 2017, something that will probably push the greenback higher (and reduce the dollar value of foreign profits for American multinationals). So the surprise might be that Wall Street will not be that great a performer in 2017.

By extension, the second surprise may be that government bonds do not do that badly. The yield on ten-year Treasury bonds is already approaching the top of the 1.5%-3% range in which it has been trading in recent years. Private-sector borrowing costs, including corporate bonds and fixed-rate mortgages, tend to move in line with Treasury yields. Increased borrowing costs would have an adverse effect on economic activity. As a result, sharp rises in bond yields are often self-correcting, since weaker economic data tend to drive yields back down.

The third potential surprise of the year might be a dog that doesn't bark. The biggest worry of the fund managers polled by BAML is that of EU disintegration. As a result they have a lower-than-normal holding in European shares. But the EU might get through the year unscathed if Marine Le Pen is defeated in France's presidential vote and Angela Merkel is re-elected in Germany. Populism does not win every time, as the recent Austrian presidential poll demonstrated. Indeed, the euro-zone economies could grow at a respectable 1.6% next year, the OECD forecasts. The continent might even seem a safe haven, given events elsewhere.

Another potential surprise in 2017 could come from a big market disruption. There have been a few of these events in the past—from flash crashes to sudden leaps in bond yields. They seem to be the result of computer programs that trigger sales when specific price points are reached and a retreat by banks from trading, which has made markets less liquid. The trillions that flow through financial markets every day are also a tempting target for cyberwarfare and cybercrime. The big story of 2017 could be an inexplicable (if temporary) crash in a vulnerable market, such

as high-yielding corporate bonds.

The final surprise may be served up by that most enigmatic of metals—gold. Working out a target price for gold is a mug's game. You can understand why investors bought gold when central banks started expanding their balance-sheets after 2008. But it is harder to explain why the price more than doubled in less than three years before falling back since 2011.

As investors' inflation expectations have risen since the American elections, gold might have been expected to rally. Instead, it has fallen sharply—perhaps because investors see the metal as an inferior alternative to the surging dollar. But gold is not just a hedge against inflation, it is also sought out in periods of political risk. And with the Trump administration apparently poised to pursue a more aggressive approach towards China and Iran, it is hard to believe that gold won't find a few moments to shine in 2017. ■



梧桐

犹在镜中，模糊不清

2017年市场可能出现哪些始料未及的大事？

如果说2016年是屡经冲击的一年，那接下来的12个月又会发生什么？按历年传统（最早可追溯到2015年），又到了本专栏尝试预测今年意外事件的时候了。

所谓意外事件，就是为大众共识所始料不及的。美银美林（BAML）对全球基金经理的定期调查指出了大多数人都相信会出现的情况。特朗普当选后，投资者预料经济增长将超越大势，通胀和利润均会上升。他们已大量投资股票，而债券投资则大大低于正常水平。

因此，并不难看出第一个可能登场的意外会是什么。人们对特朗普财政政策的效力有着非常高的期望。但这些政策的实施需要时间，而且过程中也许会因国会的干预而力度减弱，尤其是在公共支出方面。美国新政府期望经济增速达3%至4%，不过人口结构及生产力低迷很可能使得这一目标相当难以实现。毕竟在日本，无论是财政还是货币刺激措施对摆脱经济停滞都没有太大作用。

2016年初，美国企业盈利下跌，未来似乎必然会反弹，如果新政府推动企业减税政策的话尤为如此。但耶鲁大学的罗伯特·希勒（Robert Shiller）称，目前市场按28.3的周期性调整市盈率来定价，已把大量利好消息计算在内。该市盈率采用的是过去十年的平均盈利，比其长期平均值高出70%。

同时，美联储预计在2017年将加息三次，这可能会进一步推高美元，美国跨国公司海外利润的美元价值也将因此而减少。所以，第一个意外可能是2017年华尔街的表现将不如想象般红火。

推演下来，第二个意外可能是国债的表现不至于那么差。十年期美国国债

的收益率近年来一直在1.5%至3%之间浮动，目前已接近这一区间的上限。包括公司债券和固定利率抵押贷款在内的私营部门借贷成本一般随美国国债收益率变化。借贷成本上升会对经济活动产生负面影响。结果，债券收益率的急剧上升通常会自我纠正，因为疲弱的经济数据往往会促使收益率回落。

2017年的第三个潜在意外可能是“黑天鹅不黑”。接受BAML问卷调查的基金经理们最担心的是欧盟解体，所以他们对欧洲股票的持仓低于正常水平。但假如玛丽娜·勒庞（Marine Le Pen）在法国总统选举中落败，而默克尔再次成功连任德国总理，欧盟在2017年便可能安然无恙。民粹主义不一定每次都会胜出，正如奥地利最近的总统竞选结果显示的那样。事实上，经合组织预测，欧元区经济2017年可能增长1.6%，还算体面。鉴于其他地方发生的事件，欧洲大陆甚至还可能是个安全的港湾。

2017年另一意料之外的情况可能是市场出现大乱。从股市闪电崩盘到债券收益率的突然跃升，过去已经发生过这样一些事件。原因大概有两个：计算机程序在市场价格到达特定点位时自动触发抛售，以及银行退出某些交易，令市场流动性恶化。每天流经金融市场的数万亿资金也是网络战和网络犯罪的诱人目标。2017年的大事件可能是某个脆弱市场莫名其妙暴跌（虽然可能是短暂的），比如高收益的企业债券市场。

最后一个意外也许是由那最神秘的金属所引发——黄金。为黄金预测目标价位无异于徒劳之举。你能明白投资者为何在2008年后各国央行开始扩大资产负债表时买入黄金，但很难解释为什么金价在不到三年内翻了一倍多，到2011年才出现回落。

美国大选结果揭晓以来投资者对于通胀的预期已然上升，人们因此以为金价可能回升。相反，目前金价跌势凌厉，也许是因为投资者认为相比飙升的美元，黄金是投资次选。然而黄金不但可对抗通胀，在政治风险时期也是热门的投资工具。眼看特朗普政府显然准备对中国和伊朗采取更强硬的态度，相信黄金在2017年必定会有闪耀时刻。■



Insuring talent

Death Star

When the famous die, it is increasingly costly for insurers

THE death of Carrie Fisher, a much-loved actor in the “Star Wars” movies, left a hole in the force for fans. It may also burn a hole in the pockets of underwriters, syndicated under Lloyds of London. They may have to fork out as much as \$50m to meet Disney’s claim for its loss. The studio, which owns the sci-fi saga, had wisely taken out so-called contractual-protection insurance (CPI) in case death thwarted a contractual obligation: in Ms Fisher’s case to film and promote future “Star Wars” episodes.

Contrary to the headlines, 2016 was not an especially lethal year to be a celebrity. Like the rest of us, they do die. But unlike most of us, their employers can be left with astronomic bills. When Paul Walker, an actor in “The Fast and the Furious”, a series of action movies, died in 2013 while filming the seventh instalment, Universal Pictures had to spend considerable effort (and dollars) to make his on-screen persona live on. This included hiring body-doubles and digitally inserting Mr Walker into the movie with hundreds of computer-generated images.

Most workers are easier to replace. Employers can take out simple life insurance that pays a fixed lump sum. But the value of a film star to a studio, or a striker to a football club, is harder to calculate in advance. It depends on all sorts of things, especially timing. This is where contingency insurance, such as CPI, comes in. Unlike a life policy, how much of the \$50m Disney receives depends on how it now calculates and justifies the losses caused by Ms Fisher’s death. This could include, for example, her role in boosting sales of storm-trooper figurines.

Insuring talent is becoming popular outside Hollywood. The aptly named

Exceptional Risk Advisors, a company based in New Jersey that reportedly brokered the Fisher policy, also helps insure against the deaths of hedge-fund managers, company executives and sports teams' star players. Publishers have taken out CPI in case bestselling authors die with books half-written.

Jonathan Thomas, from Munich Re, who has written contingency policies for over 30 years, says they are "exactly what Lloyd's is good at". The greatest change he has seen is in the sums involved. But some worry that underwriters are dropping their standards and taking on too much risk. This could well become a problem if contingency insurance grows much larger. But today it is still tiny compared with life insurance.

With rock stars remaining on stage into their dotage and long-running sequels one of the surest ways to make money in Tinseltown, the risks of losing a "key human" (or on occasion animal) are growing. That creates business opportunities for insurers, so long as they remain prudent and don't become star-struck. ■



为演员投保 死亡“星”

保险公司为名人离世付出的代价日益高昂

电影《星球大战》中备受喜爱的演员凯丽·费雪（Carrie Fisher）离世，让该系列电影的粉丝们“原力”受损，或许还会令保险公司元气大伤。伦敦保险交易市场劳合社（Lloyds）的会员可能不得不掏出高达5000万美元来满足迪士尼公司提出的索赔要求。拥有《星战》科幻系列电影版权的迪士尼公司此前为防范因死亡而无法履约的情形，明智地购买了所谓的“合约保护险”（CPI）。费雪的合约义务包括拍摄并宣传未来的《星战》续集。

不同于各种新闻头条给人的印象，2016年对于明星而言并非什么特别不幸的年份。和我们其他人一样，他们也终有一死。但和我们大部分人不同的是，他们的老板可能会因其死亡而花费天文数字。系列动作电影《速度与激情》的演员保罗·沃克（Paul Walker）在2013年拍摄该片第七部时死亡，环球影业不得不付出大量心血（和美元）让他在荧幕上“复活”：雇用替身，并用成百上千的电脑成像把“沃克”置入电影中。

大部分员工都更易取代。雇主可以购买简单的人寿保险，将会一次性获赠固定的数额。但是电影公司的一个明星或足球俱乐部的一名前锋的价值更难预先计算。其价值要视各种因素而定，尤其是时机。这里就轮到“合约保护险”这样的意外险登场了。不同于人寿保险，迪士尼最后会拿到5000万美元索赔中的多少，取决于它现在要如何计算和证明因费雪的死亡所造成的损失。比如，这可能包括她在提升帝国突击队人偶的销售量中所起的作用。

为人才投保在好莱坞以外的领域也流行起来。总部位于新泽西的“异常风险咨询”（Exceptional Risk Advisors）有一个很贴切的公司名字。据称它是费雪这一保单的中介。它还帮助为对冲基金经理人、企业高管、明星球员的死亡投保。出版商们也已经购买了合约保护险，以防畅销书作者写到一半就撒手而去。

慕尼黑再保险公司（Munich Re）的乔纳森·托马斯（Jonathan Thomas）签订意外险已逾三十年。他称这类保险“正是劳合社的优势所在”。他目睹的最大变化是其中涉及的金额。但一些人担忧，保险人正在丢弃自己的标准而背负太大的风险。如果意外险的规模扩大很多，这很可能会成为一个麻烦。但目前它和人寿险的规模相比仍然微不足道。

摇滚巨星们一把年纪还在舞台上疯狂；好莱坞最保险的赚钱方式之一便是没完没了地拍续集。失去“关键人物”（或者有时是动物）的风险正在上升。这为保险人创造了机遇，只要它们保持审慎行事，别让自己追星不成反而被死星砸到。 ■



Schumpeter

Against happiness

Companies that try to turn happiness into a management tool are overstepping the mark

LORD Percy of Newcastle, Britain's minister of education in 1924-29, was no fan of the fad for happy-clappy "progressive" education that spread among the country's schools on his watch. He declared that it was all nonsense: "a child ought to be brought up to expect unhappiness." This columnist feels the same suspicion of the fashion for happy-clappy progressive management theory that is rushing through the world's companies and even some governments.

The leading miscreant is Zappos, an online shoe shop. The firm expects its staff to be in a state of barely controlled delirium when they sell shoes. Pret A Manger, a British food chain, specialises in bubbly good humour as well as sandwiches. Air stewards are trained to sound mellifluous but those at Virgin Atlantic seem on the verge of breaking out into a song-and-dance routine. Google until recently had an in-house "jolly good fellow" to spread mindfulness and empathy.

A weird assortment of gurus and consultancies is pushing the cult of happiness. Shawn Achor, who has taught at Harvard University, now makes a living teaching big companies around the world how to turn contentment into a source of competitive advantage. One of his rules is to create "happiness hygiene". Just as we brush our teeth every day, goes his theory, we should think positive thoughts and write positive e-mails.

Zappos is so happy with its work on joy that it has spun off a consultancy called Delivering Happiness. It has a chief happiness officer (CHO), a global happiness navigator, a happiness hustler, a happiness alchemist and, for

philosophically minded customers, a happiness owl. Plasticity Labs, a technology firm which grew out of an earlier startup called the Smile Epidemic, says it is committed to supporting a billion people on their path to happiness in both their personal and professional lives.

The trend is not confined to the private sector. Several governments, including those of America, Britain, France and Australia, now publish for the benefit of their citizens regular reports on levels of national well-being. Bhutan has long measured its gross national happiness, and the United Arab Emirates boasts a brand-new Ministry of Happiness.

Businesspeople have long known there is money to be made in the field. Dale Carnegie, a leadership guru, said the best way to win friends and influence people was to seem upbeat. Disneyland is still “the happiest place on Earth”. American firms regularly bid their customers to “have a nice day”. One of the sharpest books published on the phenomenon is “The Managed Heart” from 1983, in which Arlie Hochschild, a sociologist at the University of California, Berkeley, noted that many employers demanded “emotional labour” from workers in the form of smiles and other expressions of “positive emotion”. Firms are keen to extract still more happiness from their employees as the service sector plays an ever greater role in the economy. Run-of-the-mill service firms are fighting for their lives against discounters. As customers, most people prefer their service with a smile rather than a snarl.

Some firms are trying to create some wellbeing, too, showering their employees with mindfulness courses, yoga lessons and anything else that proves that managers are interested in “the whole person”. Only happy fools would take that at face value. Management theorists note that a big threat to corporate performance is widespread disengagement among workers. Happy people are more engaged and productive, say psychologists. Gallup claimed in 2013 that the “unhappiness” of employees

costs the American economy \$500 billion a year in lost productivity.

One problem with tracking happiness is that it is such a vague metric: it is difficult to prove or disprove Gallup's numbers since it is not entirely clear what is being measured. Companies would be much better off forgetting wishy-washy goals like encouraging contentment. They should concentrate on eliminating specific annoyances, such as time-wasting meetings and pointless memos. Instead, they are likely to develop ever more sophisticated ways of measuring the emotional state of their employees. Academics are already busy creating smartphone apps that help people keep track of their moods, such as Track Your Happiness and Moodscope. It may not be long before human-resource departments start measuring workplace euphoria via apps, cameras and voice recorders.

| *Be miserable. It'll make you feel better*

The idea of companies employing jolly good fellows and “happiness alchemists” may be cringe-making, but is there anything else really wrong with it? Various academic studies suggest that “emotional labour” can bring significant costs. The more employees are obliged to fix their faces with a rictus smile or express joy at a customer's choice of shoes, the more likely they are to suffer problems of burnout. And the contradiction between companies demanding more displays of contentment from workers, even as they put them on miserably short-term contracts and turn them into self-employed “partners”, is becoming more stark.

But the biggest problem with the cult of happiness is that it is an unacceptable invasion of individual liberty. Many companies are already overstepping the mark. A large American health-care provider, Ochsner Health System, introduced a rule that workers must make eye contact and smile whenever they walk within ten feet of another person in the hospital. Pret A Manger sends in mystery shoppers to visit every outlet regularly to see if they are greeted with the requisite degree of joy. Pass the test and the

entire staff gets a bonus—a powerful incentive for workers to turn themselves into happiness police. Companies have a right to ask their employees to be polite when they deal with members of the public. They do not have a right to try to regulate their workers' psychological states and turn happiness into an instrument of corporate control. ■



熊彼特

快乐反调

企业以“快乐”为管理手段，过犹不及

1924年至1929年间任英国教育大臣的纽卡斯尔勋爵珀西（Lord Percy of Newcastle）并不支持在其辖下学校蔓延的那股“新式”快乐教育风。他宣称那全是胡说八道：“应该在小孩成长过程中让他们学会懂得不快乐。”同样，本专栏的作者对于如今风行全球企业甚至某些政府的那套快乐管理新论调也心存质疑。

这类异端之首当数网络鞋店Zappos。该公司希望员工在一种近乎欣喜若狂的状态下卖鞋。英国连锁快餐店Pret A Manger在专精三明治之外还擅长活泼幽默的待客之道。空乘人员受专门训练，为求言语悦耳，但维珍的空乘追求悦耳动听过了头，简直要唱唱跳跳起来了。谷歌之前还在内部设有专职的“快乐好伙伴”，传播正念和关怀，最近才撤销。

这一“快乐教派”的背后推手是一群古怪的大师和顾问。曾任教于哈佛大学的肖恩·阿克爾（Shawn Achor）如今正在世界各地大企业兜售如何化知足之心为竞争优势。他主张的原则之一是要构建“快乐心理卫生”。他的理论认为，就像每天要刷牙一样，我们应该正向思考，写正面积极的电子邮件。

Zappos对于自己营造快乐氛围的工作甚为得意，甚至单独成立了一家名为“传递快乐”（Delivering Happiness）的咨询公司。它设有首席快乐官（CHO）、全球快乐领航人、快乐骗子、快乐炼金术士，还有为富有哲学头脑的客户而设的“幸福猫头鹰”。前身为创业公司“流行微笑”（Smile Epidemic）的科技公司“可塑性实验室”（Plasticity Labs）表示，公司致力帮助十亿人在个人生活和职业生涯上走上幸福快乐之路。

这一趋势不仅局限在私营部门。包括美国、英国、法国及澳大利亚在内的多国政府出于国民利益考虑，现在都定期发布国民福祉水平报告。不丹长

期以来测量国民总幸福指数，而阿联酋则对全新设立的“幸福部”引而为之。

商人们早就知道这是有利可图的领域。领袖学大师戴尔·卡耐基（Dale Carnegie）说过，一副乐观向上的样子最有助结交朋友及施展影响力。迪士尼乐园依然是“地球上最快乐的地方”。美国公司总是祝愿客户“拥有美好的一天”。对这一现象分析得最为尖锐的图书之一是1983年出版的《被管理的心》（The Managed Heart）。加州大学伯克利分校的社会学家阿莉·霍克希尔德（Arlie Hochschild）在该书中指出，许多雇主要求员工以微笑及其他形式的“正向情绪”提供“情绪劳动”。随着服务业在经济中份量日重，公司更是热衷要求员工进一步展现快乐情绪。一般的服务公司正绝地反击来自折扣店的竞争。作为顾客，大多数人都喜欢得到微笑服务而非恶言怒吼。

一些公司也正努力为员工创造福祉，为他们提供正念课程、瑜伽课程以及其他证明管理层乐于把员工打造为“全人”的手段。只有不知愁的傻子才会相信这只是为了创造快乐。管理理论指出，公司绩效的一大威胁便是员工普遍散漫无心。心理学家说，快乐的人工作更投入、更有生产力。市场调查公司盖洛普称，在2013年，员工“不快乐”令美国经济因生产力下降而损失5000亿美元。

追踪计算快乐程度的一大问题是那是个模糊的指标：很难证实或反驳盖洛普的数据，因为你不完全清楚所测量的是什么。公司要是能舍弃“鼓励知足”这类模糊不定的目标，境况会好得多。它们应专注扫除具体的恼人问题，比如浪费时间的会议和毫无意义的备忘录。但相反，它们很可能会制定出越发繁琐的方式来测量员工的情绪状态。学者们已忙于创制智能手机应用来帮助人们记录自己的情绪变化，例如“追踪你的快乐度”（Track Your Happiness）及“情绪仪”（Moodscope）。也许在不久的将来，人力资源部就会开始采用应用、摄像头和录音设备来测量员工在职场的快乐指数。

| 苦一些，感觉会更好

企业聘用“快乐好伙伴”和“快乐炼金术士”的举动也许让人退避侧目，但除此之外是否还真有什么其他问题？各种学术研究表明，“情绪劳动”会带来显著的成本。员工越是被迫咧嘴微笑或对顾客挑选的鞋子表达愉悦赞美之情，他们就越容易感到倦怠。而且，公司一方面要求员工展现满足之情，另一方面却迫使他们签订可怜的短期合同，将其化为自雇形式的“合作伙伴”，矛盾愈加明显。

但这个“快乐教派”最大的问题是对个人自由的过度侵犯。许多公司已然过火。美国大型医疗服务供应商奥克斯纳医疗服务系统（Ochsner Health System）规定，无论何时，员工在医院里只要与他人距离在十英尺以内，就必须与之保持眼神交流及微笑。Pret A Manger每月定期派出“神秘顾客”到每家门店，检验店员是否按要求的愉悦程度招待顾客。通过考验的话，全体员工会得到奖金——这有力地激励了员工们互相督促保持快乐。公司企业有权要求员工礼貌地向公众提供服务。但它们没有权力规管员工的心理状态，也无权把快乐变为企业管理的手段。■



Silicon Valley and food

Pie in the sky

Technology companies may struggle to disrupt America's food industry

THE office parks of Silicon Valley boast many firms that are trying to change the world. But there are plenty with more modest goals. Zume Pizza, a tiny startup that is located a few miles from the sprawling headquarters of Google, wants to redesign the way pizzas are made. Zume has programmed robots to make pizzas that are then put into a van and baked as they hurtle towards customers. Ovens are timed to finish cooking in sync with the vehicles' arrival at their destination, so the pies are always piping hot.

In recent weeks spies from rival pizza companies and from food-delivery firms have been driving by in unmarked cars taking photographs of the office and the vans, says Julia Collins, one of Zume's co-founders. To protect its business, the startup has patented the whole process of cooking food in ovens while a vehicle is moving (the patent probably gives Zume defensible intellectual property, says one patent lawyer). The company only operates in Mountain View, but has expansion plans. Since its founding last year it has reportedly raised \$6m from investors, among them Jerry Yang, a co-founder and former boss of Yahoo, an early giant of the internet.

Tech entrepreneurs have not spared the food industry, but their principal focus has been on delivery services. Actually making the food represents a fresher opportunity. Restaurant chains have been slow to invest in technology themselves because the cost of labour is usually fairly cheap, says John Glass, an analyst at Morgan Stanley, a bank. They have spent money on mobile payments and on online ordering, but there is scope for more innovation.

Disrupting food is not easy, however. The Melt, a fast-food chain that specialises in grilled cheese sandwiches, has boasted about its proprietary technology, including a “smart box” that it developed with former engineers from NASA to keep sandwiches warm during deliveries. The chain has not been a great success and it has replaced its chief executive. Another startup, Hampton Creek, which has raised more than \$120m from venture capitalists in order to create a vegan, environmentally-conscious version of mayonnaise and other kitchen staples, is now reportedly facing an inquiry into whether it bought its own products to inflate lacklustre sales figures (its CEO has denied any such purpose).

It is entirely possible that Zume has anticipated the eventual, widespread adoption of robots in restaurants, together with new systems for cooking meals. But startups face several big hurdles to success.

Scale is hard to achieve. Zume may not be able to afford many robots, which move the pizzas off a conveyor belt in its office-cum-factory after spraying them with tomato sauce. Humans still add the toppings before the pies go into the vans. The robots cost around \$100,000 each, or the equivalent of hiring two experienced employees for a year, says Alex Garden, Zume’s other co-founder. He reckons that buying them will pay off rapidly. That may be true, but Zume’s strategy is a capital-intensive one by the standards of most digital companies; it also owns all of its vehicles.

Competition is of course fierce. It will take a long time for Zume to make any dent in the share of big established brands. The largest firms—Domino’s, Pizza Hut and Papa John’s—have in recent years taken even bigger slices of the pizza market, which is worth an estimated \$34bn in America. Such giants will surely start investing in technology properly in time. Tech-enabled delivery services also have lots of heft. One, Postmates, recently raised around \$140m.

And reinventing food can be fraught. Zume's product has the familiar taste of average pizza. But technologists can get things badly wrong. Soylent, a startup that offers drinkable meals that are popular among engineers who are too busy coding to eat, has recently stumbled. The algae it included in some of its products turned out to cause stomach problems. Food may be one realm where people do not mind getting stuck with version 1.0. ■



硅谷与食品

空中楼阁

科技公司要颠覆美国食品行业也许并不容易

硅谷的办公园区拥有许多正在努力改变世界的企业。不过，也有不少企业的目标更为切实。一家离谷歌庞大的总部几英里之遥的微型创业公司Zume披萨（Zume Pizza）想要重新设计披萨的制作方法。Zume用编程机器人来做披萨，然后将披萨放进面包车，一边烤制一边向客户飞驰而去。烤制完成的时间被设定为与车辆抵达目的地的时间同步，因此披萨总是热腾腾的。

Zume的联合创始人朱丽亚·柯林斯（Julia Collins）表示，最近几周，对手披萨公司和食品配送公司的暗探一直开着没有标志的汽车游荡，对着他们的办公室和面包车拍照。为了保护自己的业务，该创业公司为在车辆行进时用烤箱烹饪食物的全过程申请了专利（一位专利律师说，该专利可能会使Zume获得防御性知识产权）。该公司仅在山景城（Mountain View）经营，但也有扩张的计划。自去年成立以来，据说它已从投资者处融资600万美元，其中包括早期互联网巨头雅虎的联合创始人及前老板杨致远。

科技企业并没有放过食品行业，但他们主要关注的一直是配送服务。实际制作食品代表着一个比较新的机会。摩根士丹利的分析师约翰·格拉斯（John Glass）表示，连锁餐厅自身对技术的投资向来动作迟缓，原因是劳动力成本通常相当便宜。它们已经投资于移动支付和网上订餐，但仍有更多创新空间。

然而，要颠覆食品行业并不容易。专营烤芝士三明治的快餐连锁店The Melt夸耀其专利技术，包括一种它和美国航空航天局（NASA）前工程师共同研发的、用来在运输期间为三明治保温的“智能饭盒”。这家连锁店并没有取得很大成功，并且还更换了CEO。另一家创业企业Hampton Creek的目标是创造出富有环保精神的素食蛋黄酱和其他食品，已经获得了1.2亿

美元的风险投资。据称，该公司目前正面临调查，看其是否存在自购产品来推高低迷销售数字的情况（其CEO否认有任何此类意图）。

Zume完全有可能正在为这样的未来做准备：机器人以及新型烹饪系统最终会在餐厅广泛应用。但是创业公司要成功还需面临几大障碍。

规模化并不容易实现。在Zume的办公室兼工厂里，机器人为披萨喷完番茄酱后把它们搬离传送带。Zume可能无法负担那么多机器人。在披萨装进面包车之前，仍需要工人加上配料。Zume的另一位联合创始人阿历克斯·加登（Alex Garden）表示，一个机器人的成本约为10万美元，相当于聘用两名有经验的员工一年。他认为，购买机器人会迅速回本。这也许是真的，不过，以大多数数字公司的标准判断，Zume的战略为资本密集型；它还自己拥有所有车辆。

竞争当然很激烈。Zume想要对老牌大公司的市场占有率产生一点影响，将需要很长时间。美国披萨市场规模约为340亿美元，达美乐（Domino's）、必胜客和棒约翰等最大的公司近年来在其中的份额甚至更大了。这些巨头肯定会在适当的时机开始投资于技术。科技支持的配送服务也有很大影响力。一家名为Postmates的公司最近融资约1.4亿美元。

此外，改造食物可能会令人担忧。Zume的产品有着普通披萨的熟悉味道。但是，技术人员却可能会把事情搞砸。创业企业Soylent提供的可饮用餐食受到忙于写代码而无暇吃饭的工程师欢迎，但它最近却遭遇挫败。该公司一些产品中所含有的藻类会导致胃病。在有些领域，人们并不介意停留在1.0版本，食品可能正是这样。■



Foreign exchange

A losing battle

Why a cheaper currency can sometimes dampen economic growth

IN SEPTEMBER 2010 Brazil's then-finance minister, Guido Mantega, gave warning that an "international currency war" had broken out. His beef was that in places where it was difficult to drum up domestic spending, the authorities had instead sought to weaken their currencies to make their exports cheaper and imports dearer. The dollar had recently fallen, for instance, because the Federal Reserve was expected to begin a second round of quantitative easing. The losers in this battle were those emerging markets, like Brazil, whose currencies had soared. Its currency, the real, was then trading at around 1.7 to the dollar.

These days a dollar buys 3.4 reals, but no one in Brazil or in other emerging markets with devalued currencies is declaring a belated victory. A cheap currency has not proved to be much of a boon. Indeed new research from Jonathan Kearns and Nikhil Patel, of the Bank for International Settlements (BIS), a forum for central banks, finds that at times a rising currency can be a stimulant and a falling currency a depressant. They looked at a sample of 44 economies, half of them emerging markets, to gauge the effect of changes in the exchange rate on exports and imports (the trade channel) and also on the price and availability of credit (the financial channel).

They found a negative relationship between changes in GDP and currency shifts via the trade channel. In other words, net trade adds to economic growth when the currency weakens and detracts from growth when it strengthens, as the textbooks would have it. But they also found an offsetting effect of currencies on financial conditions. For rich countries, the trade-channel effect is bigger than the financial-channel effect. But for 13 of the 22 emerging markets in the study, the financial effect dominates: a

stronger exchange rate on balance speeds up the economy and a weaker one slows it down.

This attests to the growing influence of a “global financial cycle” that responds to shifts in investors’ appetite for risk. Prices of risky assets, such as shares or emerging-market bonds, tend to move in lockstep with the weight of global capital flows from rich to poor countries. These flows in turn respond to changes in the monetary policy of rich-country central banks, notably the Federal Reserve, which influences the scale of borrowing in dollars by governments and businesses outside America. Global financial conditions are thus responsive to attitudes to risk. When the Fed lowers its interest rate, it not only makes it cheaper to borrow in dollars but also drives up asset prices worldwide, boosting the value of collateral and making it easier to raise capital in all its forms. A few days before Mr Mantega declared a currency war, Brazil’s government was celebrating a bumper \$67bn sale of shares in Petrobras, its state-backed oil company, for instance.

The BIS researchers find the financial channel works mainly through investment, which relies more on foreign-currency borrowing than does consumer spending. Their results are sobering for emerging-market economies. They suggest that a cheap currency cannot be relied on to give a boost to a sagging economy. More worrying still, the exchange rate might not always act as a shock absorber; rather it may, through the financial channel, work to amplify booms and busts. ■



外汇

一场败仗

为何货币贬值有时会抑制经济增长

2010年9月，时任巴西财政部长的吉多·曼特加（Guido Mantega）发出警告，一场“国际货币战争”已经爆发。他抱怨道，在那些难以推高国内支出的地区，当局转而力图推动其货币贬值，以降低出口价格并提高进口价格。例如，当时美元刚刚经历下跌，因为人们预计美联储会开启第二轮量化宽松。这场战争的输家是巴西等货币飙升的新兴市场国家。巴西货币雷亚尔当时兑美元汇率约为1.7比1。

如今，1美元可兑换3.4雷亚尔，但在货币贬值的巴西或其他新兴市场里，没有谁会认为这是一个迟来的胜利。货币贬值并未被证明有多大好处。事实上，央行交流平台国际清算银行（BIS）的乔纳森·卡恩斯（Jonathan Kearns）和尼基尔·帕特尔（Nikhil Patel）的新研究发现，有时候，货币升值也许能刺激经济，而货币贬值则可能会抑制经济。他们研究了由44个经济体（其中一半是新兴市场）构成的样本，衡量汇率变动对出口和进口（贸易渠道）的影响，以及对信贷的成本和供应（金融渠道）的影响。

他们发现，通过贸易渠道的作用，GDP的变化和货币变动之间呈负相关关系。换句话说，正如教科书所述，净贸易在货币疲软时会加速经济增长，而在货币走强时会削弱经济增长。但他们也发现，货币对金融渠道的影响会抵销上述作用。对于富裕国家而言，贸易渠道的效应大于金融渠道。但在这次研究的22个新兴市场国家中，有13个国家的金融效应占据了主导地位：总体来说，汇率走强加快了经济增长，而汇率走弱则使经济放缓。

这证明，应投资者风险偏好而变的“全球金融周期”的影响越来越大。股票或新兴市场债券等风险资产的价格往往与从富国流向穷国的全球资本权重同步变动。这种流动反过来又随着富国央行货币政策的变化而变，尤其是美联储，它影响着美国以外政府和企业的美元借贷规模。因此，全球的金融环境反映了人们对风险的态度。美联储降息不仅使美元借贷变得更便

宜，而且还会推高全球的资产价格，提高抵押品的价值，并使各种形式的融资变得更容易。例如，曼特加宣称货币战争爆发的前几天，巴西政府还在庆祝其国有石油公司巴西国家石油公司（Petrobras）高达670亿美元的新股增发。

国际清算银行的研究人员发现，金融渠道主要通过投资发挥作用，而投资要比消费性开支更依赖外汇借贷。对于新兴市场经济体而言，他们的研究结果发人深省。他们认为不能依靠货币贬值来提振低迷的经济。更令人担忧的是，汇率不可能总是充当减震器；相反，它可能会通过金融渠道放大繁荣以及萧条。■



Technology and education

Lifelong learning

It is easy to say that people need to keep learning throughout their careers. The practicalities are daunting

WHEN education fails to keep pace with technology, the result is inequality. Without the skills to stay useful as innovations arrive, workers suffer—and if enough of them fall behind, society starts to fall apart. That fundamental insight seized reformers in the Industrial Revolution, heralding state-funded universal schooling. Later, automation in factories and offices called forth a surge in college graduates. The combination of education and innovation, spread over decades, led to a remarkable flowering of prosperity.

Today robotics and artificial intelligence call for another education revolution. This time, however, working lives are so lengthy and so fast-changing that simply cramming more schooling in at the start is not enough. People must also be able to acquire new skills throughout their careers.

Unfortunately, as our special report in this issue sets out, the lifelong learning that exists today mainly benefits high achievers—and is therefore more likely to exacerbate inequality than diminish it. If 21st-century economies are not to create a massive underclass, policymakers urgently need to work out how to help all their citizens learn while they earn. So far, their ambition has fallen pitifully short.

| *Machines or learning*

The classic model of education—a burst at the start and top-ups through company training—is breaking down. One reason is the need for new, and constantly updated, skills. Manufacturing increasingly calls for brain work

rather than metal-bashing. The share of the American workforce employed in routine office jobs declined from 25.5% to 21% between 1996 and 2015. The single, stable career has gone the way of the Rolodex.

Pushing people into ever-higher levels of formal education at the start of their lives is not the way to cope. Just 16% of Americans think that a four-year college degree prepares students very well for a good job. Although a vocational education promises that vital first hire, those with specialised training tend to withdraw from the labour force earlier than those with general education—perhaps because they are less adaptable.

At the same time on-the-job training is shrinking. In America and Britain it has fallen by roughly half in the past two decades. Self-employment is spreading, leaving more people to take responsibility for their own skills. Taking time out later in life to pursue a formal qualification is an option, but it costs money and most colleges are geared towards youngsters.

The market is innovating to enable workers to learn and earn in new ways. Providers from General Assembly to Pluralsight are building businesses on the promise of boosting and rebooting careers. Massive open online courses (MOOCs) have veered away from lectures on Plato or black holes in favour of courses that make their students more employable. At Udacity and Coursera self-improvers pay for cheap, short programmes that bestow “microcredentials” and “nanodegrees” in, say, self-driving cars or the Android operating system. By offering degrees online, universities are making it easier for professionals to burnish their skills. A single master’s programme from Georgia Tech could expand the annual output of computer-science master’s degrees in America by close to 10%.

Such efforts demonstrate how to interleave careers and learning. But left to its own devices, this nascent market will mainly serve those who already have advantages. It is easier to learn later in life if you enjoyed the

classroom first time around: about 80% of the learners on Coursera already have degrees. Online learning requires some IT literacy, yet one in four adults in the OECD has no or limited experience of computers. Skills atrophy unless they are used, but many low-end jobs give workers little chance to practise them.

| *Shampoo technician wanted*

If new ways of learning are to help those who need them most, policymakers should be aiming for something far more radical. Because education is a public good whose benefits spill over to all of society, governments have a vital role to play—not just by spending more, but also by spending wisely.

Lifelong learning starts at school. As a rule, education should not be narrowly vocational. The curriculum needs to teach children how to study and think. A focus on “metacognition” will make them better at picking up skills later in life.

But the biggest change is to make adult learning routinely accessible to all. One way is for citizens to receive vouchers that they can use to pay for training. Singapore has such “individual learning accounts”; it has given money to everyone over 25 to spend on any of 500 approved courses. So far each citizen has only a few hundred dollars, but it is early days.

Courses paid for by taxpayers risk being wasteful. But industry can help by steering people towards the skills it wants and by working with MOOCs and colleges to design courses that are relevant. Companies can also encourage their staff to learn. AT&T, a telecoms firm which wants to equip its workforce with digital skills, spends \$30m a year on reimbursing employees’ tuition costs. Trade unions can play a useful role as organisers of lifelong learning, particularly for those—workers in small firms or the self-employed—for whom company-provided training is unlikely. A union-

run training programme in Britain has support from political parties on the right and left.

To make all this training worthwhile, governments need to slash the licensing requirements and other barriers that make it hard for newcomers to enter occupations. Rather than asking for 300 hours' practice to qualify to wash hair, for instance, the state of Tennessee should let hairdressers decide for themselves who is the best person to hire.

Not everyone will successfully navigate the shifting jobs market. Those most at risk of technological disruption are men in blue-collar jobs, many of whom reject taking less "masculine" roles in fast-growing areas such as health care. But to keep the numbers of those left behind to a minimum, all adults must have access to flexible, affordable training. The 19th and 20th centuries saw stunning advances in education. That should be the scale of the ambition today. ■



科技和教育

终身学习

人们需要终身学习，这一点知易行难

当教育跟不上技术进步时，就会造成不平等。在创新到来之际，工人如果没有技能使自己对雇主仍然“有用”，他们就会遭殃。而如果落后的工人太多，社会就开始崩塌。这一根本性的洞见极大影响了工业革命时期的改革者，推动了国家资助全民教育的普及。后来，工厂和办公室自动化又引发了大学生人数猛增。教育和创新相辅相成，历经数十年，令繁荣之花耀眼绽放。

今天，机器人和人工智能呼唤又一场教育革命。而这一次，工作生涯如此漫长而又变化迅速，只在人生初期强加更多教育已经不足以应付。人们还必须能在整个职业生涯中获取新技能。

不幸的是，正如我们本期特别报道所述，目前的终身学习主要是令成功人士受益，因此更可能加剧而非减轻不平等。如果21世纪的经济体不想要产生一个庞大的底层阶级，政策制定者亟需制定措施，帮助国民在谋生的同时学习。而迄今为止，他们的抱负还小得可怜。

| 机器还是学习

在青少年时强化学习，之后通过公司培训加以补充，这种传统的教育模式正在失效。原因之一是需要新的技能，而且还要不断更新。制造业越来越多地需要脑力而非蛮力。从1996年到2015年，常规办公职位在美国劳动力中所占的比例从25.5%下降到21%。单一稳定的职业生涯已经像旋转式名片夹一样一去不返了。

在人生初期让人们接受更高层次的正规教育并非解决之道。仅有16%的美国人认为四年的大学教育足以让学生找到一份好工作。尽管职业教育能确保找到至关重要的第一份工作，但接受专门培训的人往往比接受普通教育的人更早退出劳动大军，可能是因为前者适应性较弱。

与此同时，在职培训也在萎缩。在美国和英国，在职培训在过去20年里下降了大概一半。自雇人群正在增多，令更多的人要为自己的技能负责。在年纪较大的时候抽出时间获得一个正规的资质是一种选择，但要投入成本，而且大多数院校是针对年轻人开设的。

市场正在创新以让工人能够有新的方法学习和赚钱。从General Assembly到Pluralsight，各类供应商纷纷以推动和重启职业生涯的承诺开创业务。大规模开放式在线课程（MOOC）不再讲授柏拉图或黑洞，而向帮助学生就业的课程倾斜。在优达学城（Udacity）和Coursera，进修者付费学习低价的短期课程，获得如自动驾驶汽车或安卓操作系统方面的“微证书”和“纳米学位”。大学也开始提供在线学位，帮助专业人士更方便地提升技能。单是佐治亚理工学院（Georgia Tech）的硕士课程就能把每年美国计算机科学硕士的毕业人数提高近10%。

这些革新显示了如何交织工作和学习。但是，如果任其自行发展，这一新生市场将会主要服务那些已经具备优势的人。如果你在年轻时就享受课堂学习，那么日后学习起来也会更容易：在Coursera，大约80%的学生已经拥有学位。在线学习需要一些IT知识，而在经合组织国家里，四分之一的成年人没有或只有很少的计算机经验。技能不用则退，但在很多低端工作中，工人基本没有机会实践技能。

| 招募洗发师

如果新的学习方式是要帮助那些最需要帮助的人，那么政策制定者应该寻求远为根本性的举措。因为教育是一种公益事业，其益处会延及整个社会，各国政府要发挥重要作用——不仅要增加投入，还得把钱花得明智。

终身学习始于学校。一般来说，教育不应该有狭隘的职业性。学生需要从课程中学会如何学习和思考。注重“元认知”将帮助学生日后更好地学习技能。

但最大的改变是让所有人都能常态化地进行成人学习。一个方法是向国民发放抵用券，可用于支付培训费用。新加坡就有这样的“个人学习账户”。

该国向所有25岁以上的国民提供资金，可用来选择学习500种经认可的课程。到目前为止，每个国民只领取了几百美元，但这才刚刚开始。

由纳税人付费的课程有可能被浪费。但企业界可以提供帮助，引导人们学习业界所需的技能，并和MOOC及大学院校合作设计有用的课程。企业还可以鼓励员工学习。电信公司AT&T希望员工具备数字技能，它每年支出3000万美元报销员工的学费。工会也可以发挥作用，组织终身学习，尤其是帮助那些小公司的员工或自雇人士，因为这些人不大可能有公费培训的机会。在英国，一个工会组织的培训项目同时得到了左右两派政党的支持。

要让所有这些培训有价值，政府需要大力降低执业资格要求以及其他阻碍新人入行的门槛。例如，与其要求有300小时的实习来获得做洗发工的资格，田纳西州应该让理发店自行决定雇谁最好。

并非每个人都能成功应付正在变化的就业市场。受技术颠覆威胁最大的是那些蓝领工人，其中很多人拒绝在医疗护理等快速发展的领域里承担不那么“男子汉”的工作。但是，若要尽量减少因时代改变而落伍的人数，那么所有成年人都必须能够获得灵活而又实惠的培训。在19和20世纪，教育有了令人震惊的进步。今天的抱负应当不逊当年。■



Conversational computing

Now we're talking

Voice technology is making computers less daunting and more accessible

ANY sufficiently advanced technology, noted Arthur C. Clarke, a British science-fiction writer, is indistinguishable from magic. The fast-emerging technology of voice computing proves his point. Using it is just like casting a spell: say a few words into the air, and a nearby device can grant your wish.

The Amazon Echo, a voice-driven cylindrical computer that sits on a table top and answers to the name Alexa, can call up music tracks and radio stations, tell jokes, answer trivia questions and control smart appliances; even before Christmas it was already resident in about 4% of American households. Voice assistants are proliferating in smartphones, too: Apple's Siri handles over 2bn commands a week, and 20% of Google searches on Android-powered handsets in America are input by voice. Dictating e-mails and text messages now works reliably enough to be useful. Why type when you can talk?

This is a huge shift. Simple though it may seem, voice has the power to transform computing, by providing a natural means of interaction. Windows, icons and menus, and then touchscreens, were welcomed as more intuitive ways to deal with computers than entering complex keyboard commands. But being able to talk to computers abolishes the need for the abstraction of a "user interface" at all. Just as mobile phones were more than existing phones without wires, and cars were more than carriages without horses, so computers without screens and keyboards have the potential to be more useful, powerful and ubiquitous than people can imagine today.

Voice will not wholly replace other forms of input and output. Sometimes it will remain more convenient to converse with a machine by typing rather than talking (Amazon is said to be working on an Echo device with a built-in screen). But voice is destined to account for a growing share of people's interactions with the technology around them, from washing machines that tell you how much of the cycle they have left to virtual assistants in corporate call-centres. However, to reach its full potential, the technology requires further breakthroughs—and a resolution of the tricky questions it raises around the trade-off between convenience and privacy.

| *Alexa, what is deep learning?*

Computer-dictation systems have been around for years. But they were unreliable and required lengthy training to learn a specific user's voice. Computers' new ability to recognise almost anyone's speech dependably without training is the latest manifestation of the power of "deep learning", an artificial-intelligence technique in which a software system is trained using millions of examples, usually culled from the internet. Thanks to deep learning, machines now nearly equal humans in transcription accuracy, computerised translation systems are improving rapidly and text-to-speech systems are becoming less robotic and more natural-sounding. Computers are, in short, getting much better at handling natural language in all its forms (see Technology Quarterly).

Although deep learning means that machines can recognise speech more reliably and talk in a less stilted manner, they still don't understand the meaning of language. That is the most difficult aspect of the problem and, if voice-driven computing is truly to flourish, one that must be overcome. Computers must be able to understand context in order to maintain a coherent conversation about something, rather than just responding to simple, one-off voice commands, as they mostly do today ("Hey, Siri, set a timer for ten minutes"). Researchers in universities and at companies large

and small are working on this very problem, building “bots” that can hold more elaborate conversations about more complex tasks, from retrieving information to advising on mortgages to making travel arrangements. (Amazon is offering a \$1m prize for a bot that can converse “coherently and engagingly” for 20 minutes.)

| *When spells replace spelling*

Consumers and regulators also have a role to play in determining how voice computing develops. Even in its current, relatively primitive form, the technology poses a dilemma: voice-driven systems are most useful when they are personalised, and are granted wide access to sources of data such as calendars, e-mails and other sensitive information. That raises privacy and security concerns.

To further complicate matters, many voice-driven devices are always listening, waiting to be activated. Some people are already concerned about the implications of internet-connected microphones listening in every room and from every smartphone. Not all audio is sent to the cloud—devices wait for a trigger phrase (“Alexa”, “OK, Google”, “Hey, Cortana”, or “Hey, Siri”) before they start relaying the user’s voice to the servers that actually handle the requests—but when it comes to storing audio, it is unclear who keeps what and when.

Police investigating a murder in Arkansas, which may have been overheard by an Amazon Echo, have asked the company for access to any audio that might have been captured. Amazon has refused to co-operate, arguing (with the backing of privacy advocates) that the legal status of such requests is unclear. The situation is analogous to Apple’s refusal in 2016 to help FBI investigators unlock a terrorist’s iPhone; both cases highlight the need for rules that specify when and what intrusions into personal privacy are justified in the interests of security.

Consumers will adopt voice computing even if such issues remain unresolved. In many situations voice is far more convenient and natural than any other means of communication. Uniquely, it can also be used while doing something else (driving, working out or walking down the street). It can extend the power of computing to people unable, for one reason or another, to use screens and keyboards. And it could have a dramatic impact not just on computing, but on the use of language itself. Computerised simultaneous translation could render the need to speak a foreign language irrelevant for many people; and in a world where machines can talk, minor languages may be more likely to survive. The arrival of the touchscreen was the last big shift in the way humans interact with computers. The leap to speech matters more. ■



会话式计算

现在，我们说上话了

语音技术让计算机不那么令人生畏，且更易接近

英国科幻作家亚瑟·克拉克（Arthur C. Clarke）曾说过，任何足够先进的科技看起来都与魔法无异。迅速兴起的语音计算技术证明了他的观点。使用语音就如念出咒语：对着空中说几个词，身旁的设备就能满足你的愿望。

亚马逊Echo是一台置于桌面、由语音驱动的圆柱形电脑，会对Alexa这个名字做出回应。它能播放音乐和广播、讲笑话、回答琐碎的问题，还会控制智能家电；圣诞节还没到它就已经入住了约4%的美国家庭。智能手机里的语音助手也在激增：苹果的Siri每周处理超过20亿条指令，美国安卓手机上20%的谷歌搜索由语音输入。现在语音输入电子邮件和短信的可靠程度已经足够使用。能说话的时候为什么还要打字呢？

这是个巨大的转变。尽管看似简单，但通过提供一种自然的互动方式，语音有能力改变计算的形态。说到和计算机打交道，先是视窗、图标和菜单，之后是触摸屏，都因为比输入复杂的命令行更为直观而受到欢迎。但是能对计算机说话彻底消除了对“用户界面”这一抽象概念的需要。正如手机远不只是无线电话，汽车远不只是无马之车，没有了显示屏和键盘的电脑有潜力变得比人们今天所能想像的更有用、更强大且无处不在。

语音不会完全取代其他形式的输入和输出。和机器交流，有时打字仍然会比说话更方便（据说亚马逊正在研发带嵌入屏幕的Echo）。但是在人们与身边科技设备的互动中，语音必将占据越来越大的份额，无论是与告诉你还需要多久洗完衣物的洗衣机互动，还是和企业热线的虚拟助手交谈。不过，要充分发挥潜能，这项技术还需要更多突破，而且必须解决由它引出的棘手问题——在便利性和隐私之间权衡。

| Alexa，深度学习是什么？

计算机语音识别系统已出现多年。但在以前它并不可靠，而且需要漫长的训练才能学会识别特定使用者的语音。如今计算机无需训练即能可靠识别几乎任何人的语音，这一新能力是“深度学习”力量的最新体现。深度学习是一种人工智能技术，用通常来自互联网的数百万个范例来训练某个软件系统。正因为有了深度学习，现在的机器将语音转为文字的准确度才堪比人类。计算机翻译系统也正迅速改进，而把文字转为语音的系统也变得越来越不那么机器腔，听起来更加自然。简而言之，计算机在处理各种形式的自然语言时表现大幅提升。

尽管深度学习能让机器能更可靠地识别语音、说话也不那么生硬，但它们还是无法理解语言的意思。这是这项技术最棘手的地方，而且如果语音驱动的计算要真正蓬勃发展，就必须克服这一难关。要进行一段连贯的对话，计算机必须能够理解上下文，而不是仅仅对简单的一次性语音指令做出回应——它们目前所做的大部分都是后者（比如，“Hey, Siri，设个十分钟提醒”）。各大院校和大小公司的研究人员都在钻研这一问题，努力开发能就更复杂的任务进行更详尽对话的“机器人”，无论是做信息检索、房贷咨询还是安排旅行。（亚马逊为能开发出进行“连贯生动地”谈话20分钟的机器人悬赏一百万美元。）

| 当咒语取代拼写

在决定语音计算如何发展上，消费者和监管机构也将扮演一定的角色。即便是在目前相对初级的阶段，这一技术也已陷入了进退两难的窘境：语音驱动系统若要发挥最大的作用，就得个人化并能获准访问各种数据源，如日历、电子邮件和其他敏感的信息。这引发了对隐私和安全的担忧。

让情况变得更加复杂的是，很多语音驱动设备始终在聆听，等待被启动。有些人已经担心在每个房间里、每台智能手机上时刻倾听的联网麦克风将产生怎样的影响。并非所有声音都被传到云端，在开始将用户的语音传到真正处理用户指令的服务器之前，设备在等待一句“触发指令”（“Alexa”、“OK, Google”、“Hey, Cortana”，或者“Hey, Siri”）。但说到储存声音，谁在何时记录了什么，我们并不清楚。

阿肯色州调查一宗谋杀案的警察认为一台亚马逊Echo可能无意中听到了凶案信息，因此要求亚马逊提供可能捕捉到的任何声音。亚马逊拒绝合作，称（在隐私保护拥护者的支持下）这些要求的法律规定尚不明确。这一情况与2016年苹果拒绝帮助FBI调查员解锁一名恐怖分子的iPhone相似。两起事件都突显出需要制定法规，明确为保障公众安全可以在何时以何种方式介入个人隐私。

即便这样的问题尚未解决，消费者仍会接纳语音计算。在很多场合下，语音比其他任何交流方式都方便得多也自然得多。而且可以在做其他事的同时（如开车、健身或者走在路上时）使用语音，这一点独一无二。它可以让计算的力量泽被因种种原因无法使用屏幕和键盘的人。而且，它的巨大影响不仅限于计算，还会冲击语言使用本身。计算机同声传译会让很多人觉得会不会说外语无关紧要；在一个机器会说话的世界里，小语种或许更有可能幸存下来。触摸屏的到来是人类与计算机互动之路上迈出的一大步。向语音的飞跃现在更为重要。 ■



Retailing

Push my buttons

Experiments in automated consumption

TRILLIONS of dollars of consumer spending have, historically, depended on a few steps. A shopper learns about a product, considers whether to buy it, decides to do so, goes to a shop. If he likes it, he may buy it again. Marketers have long obsessed over each step, and consultants have written treatises on how to nudge people along. E-commerce is already changing the process, but now retailing gurus are imagining a future in which shopping becomes fully automatic.

The idea is that a combination of smart gadgets and predictive data analytics could decide exactly what goods are delivered when, to which household. The most advanced version might resemble Spotify, a music-streaming service, but for stuff. This future is inching closer, thanks to initiatives from Amazon, lots of startup firms and also from big consumer companies such as Procter & Gamble (P&G).

Buying experiments so far fall into two categories. The first is exploratory. A service helps a shopper try new things, choosing products on his or her behalf. Birchbox, founded in 2010, sends beauty samples to subscribers for \$10 each month. Imitators have proliferated, offering everything from dog toys to trainers. MySubscriptionAddiction.com, which reviews these services in English-speaking countries, counts 998 new subscription boxes so far this year, up from 284 new ones in 2013. Retailers such as Walmart have followed suit with their own boxes. The scope for such services, however, may be limited. One third of those surveyed by MySubscriptionAddiction.com said they cancelled at least as many subscriptions as they added this year. Consumers, naturally, will delegate purchases to a third party only when they receive products they like. In

future, firms that comb purchase histories and search data may be able to send more reliably pleasing product assortments. For now, a consumer who becomes an unwitting owner of toeless socks, which were included recently in a box called FabFitFun, may decline further offers.

The second category of automated consumption is more functional. A service automates the purchase of an item that is bought frequently. Nine years ago Amazon introduced a “Subscribe & Save” feature, offering consumers a discount for agreeing to buy certain goods regularly, such as Pampers nappies. Dollar Shave Club, a male-grooming-products firm, sells razors to subscribers directly, and P&G now has its own, similar service. It is also testing one for laundry detergent.

Amazon is going further. Last year it began selling so-called Dash buttons, designed to be placed around the house to order everyday products—one for Campbell’s soup, for instance, and another for Whiskas cat food (pictured). Investors see this as the first step in its bid fully to automate buying of daily necessities. Already, some manufacturers have integrated Amazon into their devices; General Electric, for example, offers washing machines that shop for their own detergent.

Such services have obvious appeal for Amazon and for big consumer brands. If a shopper automates the delivery of a particular item, the theory is that he is likely to be more loyal. For some brands, the buttons are working especially well: more than half of all the many Amazon orders for Maxwell House coffee in America, for example, are made through the Dash button. Amazon says that across America, an order from a Dash button is being placed more than twice each minute.

But neither Amazon nor the big product brands should celebrate a new era of shopping just yet. Amazon does not release comprehensive data on its automated services, but Slice Intelligence, a data firm in California,

reported in March that fewer than half of those with Dash buttons had ever pressed them. One problem may be the e-commerce giant's prices, which fluctuate often. Another report, by Salmon, a digital agency inside WPP, an advertising group, found that far more British consumers would prefer a smart device that ordered the cheapest item in a category to one that summoned up the same brand each time. That suggests that automated shopping, as it expands, might make life harder for big brands, not prop them up. ■



零售业

按下我的按钮

自动消费实验

在历史上，数万亿美元的消费支出取决于几个步骤：顾客得知一种产品，考虑是否要买，决定要买，去商店。如果他喜欢这种产品，就可能再次购买。营销人员长期痴迷于这其中的每一个步骤，咨询顾问们则撰写出如何推动人们一步步前进的要诀。电子商务已经在改变这一流程，而目前，零售大师们正在设想购物完全自动化的未来。

他们的想法是，智能小工具和预测性数据分析的结合能够准确地决定要在什么时间向哪个家庭交付哪些商品。最先进的版本可能类似于音乐流媒体服务Spotify，但对象是物品。由于亚马逊、众多创业企业以及宝洁等大消费品公司的举措，这种未来正在步步靠近。

到目前为止，购买实验分为两类。第一类是探索性的，是由一种服务帮助顾客尝试新事物，代表他或她选择产品。成立于2010年的Birchbox公司以每月10美元的价格向用户寄送美妆样品。模仿者层出不穷，提供的产品从玩具狗到运动鞋，不一而足。MySubscriptionAddiction.com针对英语国家里的这类服务提供点评，据其统计，今年到目前为止共新增998个“订阅福袋”服务，而在2013年只有284个。沃尔玛等零售商也已跟风推出自己的福袋服务。然而，这种服务的范围可能很有限。接受

Mysubscriptionaddiction.com调查的人里，有三分之一表示他们今年取消的订阅服务比新使用的只多不少。只有当消费者收到他们喜欢的产品时，才会自然而然地把采购委托给第三方。今后，钻研购买记录和搜索数据的企业或许能发送出更靠谱且讨喜的产品搭配。而眼下，在茫然无知之中收到露趾袜（最近被纳入一种名为FabFitFun的福袋服务）的消费者或许还是会拒收以后的产品。

第二类自动消费则更为实用，是由一种服务来将频繁购买某产品的行为自动化。九年前，亚马逊推出了“订购省”（Subscribe & Save）这一功能，向

同意定期购买某些商品（如帮宝适纸尿裤）的消费者提供折扣。男性美容产品公司Dollar Shave Club向订购用户直销剃须刀。宝洁目前也有自己的类似服务，此外它还在为洗衣粉测试类似服务。

亚马逊正在更进一步。去年，它开始出售名为Dash的按钮，用来放置在房子各处以订购日常用品——例如，一个按钮用于金宝汤，另一个用于伟嘉猫粮（图）。投资者认为这是亚马逊实现日用品购买完全自动化努力的第一步。一些制造商已经将亚马逊服务整合到自己的设备中，例如通用电气提供的洗衣机能自行购买所用的洗衣粉。

这种服务对于亚马逊和大消费品牌有明显的吸引力。如果顾客自动化购买某一种商品，理论上说他可能会更为忠诚。对于一些品牌而言，这些按钮特别好用：例如，亚马逊在美国所有的麦斯威尔咖啡订单中，超过一半是通过Dash按钮下单的。亚马逊表示，在美国每分钟就有超过两个用Dash按钮下的订单。

然而，无论是对亚马逊还是大产品品牌而言，现在都还没到庆祝购物新时代来临的时候。亚马逊并没有公布它在自动化服务方面的全面数据，但加州的数据公司Slice Intelligence在三月份的报告中称，拥有Dash按钮的人中只有不到一半曾按动过它。一个问题可能是这一电子商务巨头的产品价格经常变动。广告集团WPP旗下的数字商务公司赛欧曼（Salmon）的另一份报告发现，更多的英国消费者喜欢能从一类产品中订购最便宜那个的智能设备，而不是每次都想起同一个品牌的设备。这表明，随着自动购物的壮大，它可能会让大品牌的日子更加难过，而不是支持它们。■



Watson and financial regulation

It knows their methods

New banking rules baffle humans; can machines do better?

JOINING “Hamilton”, a Broadway show, and concerts by Adele, a British soul diva, on the list of tickets-to-kill-for in New York is a screening in an ugly new office building that recently popped-up in the East Village, a place best known for offbeat culture. There is a ten-week-long queue to see simulations by Watson, IBM’s cognitive artificial-intelligence platform.

Initially known for stunts such as beating the world’s best chess player, Watson has been seeking a wider audience. It has found a vast potential one in the world of financial regulation. Rules have become so sprawling and mysterious that even regulators have begun asking for a map. In response, a market is springing up: for “regtech”, fintech’s nerdy new offspring.

On September 29th, IBM announced the purchase of Promontory, a 600-strong consultancy whose senior staff include former officials from the Federal Reserve, the World Bank, the Securities and Exchange Commission and other regulators. The hope is that person and machine will combine into a vast business. Promontory was founded in 2001 by Eugene Ludwig, who had headed one of America’s primary bank-supervisory agencies. It grew first because of the slathering of new rules during the previous, Bush administration and then prospered, says Mr Ludwig, as this process expanded under Barack Obama.

Promontory has recently dabbled in software, but is best known for its employees’ background and their capacity to provide expertise (its contention), contacts (its critics’) or both. Either way, it is a profoundly human business. Watson, for all its charms, is not. Automation of financial

institutions has long been a core business for IBM. It played a central role in the development of the ATM; its systems keep many banks and insurance companies around the world humming along. Aware that annual expenditure on regulation and compliance is vast—it reckons in excess of \$270 billion, of which \$20 billion is spent simply on understanding the requirements—it began work on adding this business to Watson in early 2015. Chief compliance officers and lawyers were interviewed to break down their tasks and needs.

The first area of focus was trading, which has the virtue of being both discrete and wildly complex. A pilot programme with half a dozen banks and three exchanges began in July, providing surveillance. A library of possible illicit schemes is fed into Watson, which can then evaluate trading patterns and communications ranging from overt messages to social media (voice analysis will be added in November). Scrutiny can extend to the network of people on the other end of trades in order to untangle complex relationships.

The next area is to provide clarity about rules. They are sorted by jurisdictions, institutional divisions, products and so forth, and then further broken down between rules and guidance. Watson is getting better at categorising the various regulations and matching them with the appropriate enforcement mechanisms. Its conclusions are vetted, giving it an education that should improve its effectiveness in the future.

Promontory's experts are expected to help Watson learn. A dozen rules are now being assimilated weekly. Thousands are still to go but it is hoped the process will speed up as the system evolves. Ultimately, IBM hopes speeches by influential figures, court verdicts and other such sources will be automatically uploaded into Watson's cloud-based brain. They can play a role in determining what regulations matter, and how they will be enforced.

Global financial institutions provide an obvious market for these services, but so too do small, local ones that lack the scale to justify the cost of a team of legal experts. A third group is the regulators themselves, who often privately grouse about being bewildered by their own remit and distrust other regulators with overlapping briefs.

To some extent Watson's success depends on whether the rules are consistent, make sense and are fairly applied. At the very least, it will be able to highlight anomalies. If successful, Watson could shift legal authority from individuals to laws. That, of course, may be its greatest virtue. ■



Watson和金融监管

它知道他们的招数

银行新规让人类备感困惑。机器的表现会更好吗？

最近一座丑陋的新办公楼在纽约东村（因另类文化的发展而知名）拔地而起，这里举办的一个活动和百老汇音乐剧汉密尔顿（Hamilton）、英国灵魂乐女歌手阿黛尔的演唱会一样一票难求。这就是IBM的认知人工智能平台Watson进行的模拟演示，观看这个演示需要等候10周。

Watson最初为人所知是因其击败了世界顶级的国际象棋大师和其他一些惊世之举，之后它一直在努力吸引更多的观众，并已在金融监管界找到了一个庞大的潜在观众群。尽管规定已变得庞杂而难懂，即使是监管者自身也已开始寻求指引。面对这一需求，一个全新的市场涌现出来：金融科技达人的新产物——“Regtech”（监管科技）。

9月29日，IBM宣布收购拥有600名员工的金融咨询公司Promontory，其高层员工包括美联储、世界银行、美国证券交易管理委员会和其他监管机构的前任官员。此次收购目的是把人和机器相结合，创造出一项庞大的业务。Promontory于2001年由尤金·路德维格（Eugene Ludwig，曾任美国主要银行监管机构之一的负责人）创建。路德维格说，公司最初的发展是由于前任小布什政府时期实施了大量新规，后来公司不断壮大，则是因为奥巴马执政期间新规还在继续增加。

Promontory最近开始涉足软件，但最为人知的仍是其员工的背景和他们提供专长（观点）、介绍人脉（评论员）或两者兼顾的能力。不管如何，根本来说公司的业务主要靠人。Watson尽管魅力多多，但并不依靠人。金融机构的自动化很久以来一直是IBM的核心业务。IBM在ATM的发展过程中扮演了核心作用，它的自动化系统让全球的许多银行和保险公司都提高了效率。IBM意识到每年在监管和合规方面的巨大支出（它预计达2700多亿美元，仅是理解监管要求就要花掉200亿），2015年初开始在Watson上添加此项业务功能。IBM访问了多位首席合规官和律师以更好地了解他们

的任务和需求。

IBM首个关注的领域是交易，这一领域的监管规定缺乏连贯性且极为复杂。一项与六家银行和三家交易所共同展开的试点项目于7月启动，提供合规监督服务。大量可能的违规手法被输入Watson，它可以对交易模式和各种交流内容（从公开信息到社交媒体）进行分析（11月会增加语音分析功能）。这种监察还能延伸至交易对手方的人际网络，以厘清复杂的关系。

IBM关注的另一个领域是明确监管规则。所有规则按管辖权、部门划分、产品等进行分类，然后进一步分离出规则和指引。Watson在分类各种监管规则，并在将其与对应的执行机制相匹配方面表现得越来越好。它的最终结论会受到审核，审核意见也会对它有指导作用，应该会让它在未来更有效力。IBM希望Promontory的专家能帮助Watson学习。现在每周都会有十几条规则被吸纳，待吸纳的规则还有几千条。随着系统的发展，这一进程有望加快。最终，IBM希望有影响力的人物发表的讲话、法庭判决和其他此类来源的信息将能自动上传到Watson基于云的大脑。这些信息在决定规则的重要性以及执行方式方面能发挥作用。

全球性金融机构很显然为这些服务提供了市场。但对于很多小型的地方性金融机构来说，这种服务同样有市场，因为它们业务规模有限，没必要专门聘请法律专家团队。第三类需要这种服务的群体便是监管者自身，他们经常私下抱怨被自己的工作搞晕了，也不信任工作内容近似的其他监管者。

在某种程度上来说，Watson的成功取决于监管规则是否连贯、合理以及公平地应用。但至少它能够凸显异常情况。一旦成功的话，Watson可能将法律权威从个人转到法律。当然，这也可能是它最大的优点。■



Artificial intelligence

Eyes at the border

Machines are learning to find concealed weapons in x-ray scans

EVERY day more than 8,000 containers flow through the Port of Rotterdam. But only a fraction are selected to pass through a giant x-ray machine to check for illicit contents. The machine, made by Rapiscan, an American firm, can capture images as the containers move along a track at 15kph (9.3mph). But it takes time for a human to inspect each scan for anything suspicious—and in particular for small metallic objects that might be weapons. (Imagine searching an image of a room three metres by 14 metres crammed to the ceiling with goods.) To increase this inspection rate would require a small army of people.

A group of computer scientists at University College London (UCL), led by Lewis Griffin, may soon speed up the process by employing artificial intelligence. Dr Griffin is being sponsored by Rapiscan to create software that uses machine-learning techniques to scan the x-ray images. Thomas Rogers, a member of the UCL team, estimates that it takes a human operator about ten minutes to examine each X-ray. The UCL system can do it in 3.5 seconds.

Dr Griffin's team trained its system on hundreds of thousands of container scans provided by Rapiscan. The scans were missing concealed metallic objects that might pose a threat, so the UCL team took a separate database of x-rayed weapons and hid them in the container images. A paper the group presented at the Imaging for Crime Detection and Prevention conference in Madrid in December showed that in tests, the system spotted nine out of ten hidden metallic objects. Only six in every hundred readings flagged a weapon when there was nothing. Dr Griffin says this false positive rate has been reduced to one in every 200 since the paper was written in

August. The group's software has also been trained to detect concealed cars.

The UCL team hopes to test its software shortly on real containers, some with small weapons deliberately hidden inside. Assuming that works, Dr Griffin plans to integrate the artificial-intelligence system into Rapiscan's scanning systems over the next few months. The team is also aiming to train the system to detect "anomalies"—the machine-learning equivalent of a human hunch that something is not quite right about a scan. That could, for instance, be something unusual in the way things are positioned inside the container. Given enough data, the scientists reckon computers can train themselves to identify discrepancies like this.

It is not just in ports where machine learning could speed up scanning. Weary travellers dragging themselves through the slow crawl of airport security could also benefit. Suitcases are smaller than containers, and their contents are more predictable, so humans are able to inspect their X-rays quickly and thoroughly (although regular rest breaks are still needed).

Toby Breckon of Durham University is working on automated x-ray analysis to detect small items of the sort that might be contained in passengers' cabin and hold bags. He says his group has already had an algorithm installed in commercial scanning systems. Dr Breckon thinks intelligent scanning systems will at first operate in the background at airports, for instance rechecking bags in case human inspectors have missed something. They might also be used to flag bags that could be worth a manual inspection.

In time, however, automated screening systems may go from being useful tools for human operators to outperforming them. If his team can get its hands on the large amounts of security imagery it needs to feed into its software, Dr Griffin thinks container scanning, at least, might be entirely automated. Perhaps bag-scanning at airports might go the same way. But

there will still be a need for people. Someone has to be around to check inside containers and bags with suspicious contents. ■



人工智能

边境线上的眼睛

机器正学习在X光扫描图像中找到隐藏的武器

每天，超过8000个集装箱出入鹿特丹港。但只有一小部分集装箱会被选中，通过一台巨大的X光机来检查里面是否有非法货物。这台机器由美国Rapiscan公司制造，能在集装箱以每小时15公里（9.3英里）的速度沿轨道行进时捕捉图像。但还需要人花时间来检查每张扫描图像，寻找可疑物品，尤其那些可能是武器的小件金属物品。（想象一下检视这样一间房间的图像：3米宽14米长、物品直堆到天花板。）要提高检查速度，就得需要一群人。

来自伦敦大学学院（UCL）、由刘易斯·格里芬（Lewis Griffin）带领的一批计算机科学家可能很快就会采用人工智能来加速这个过程。格里芬受Rapiscan的资助，创建使用机器学习技术来扫描X光图像的软件。UCL研究团队成员托马斯·罗杰斯（Thomas Rogers）估计操作员大约需要10分钟来检查每张X光图。而UCL的系统则只需3.5秒。

格里芬研究团队用Rapiscan提供的数十万张集装箱扫描图来训练其系统。这些扫描图上并没有可能会造成威胁的隐藏金属物体，所以UCL团队找来一个单独的武器X光图像数据库，并把武器图像藏在集装箱图像当中。12月在马德里举行的犯罪侦查与预防成像技术会议上，该团队发布的论文显示，这个系统在测试中发现了十分之九的隐藏金属物体，而误报概率仅为百分之六。格里芬表示，自8月论文成稿以来，这种误报率已经降低至二百分之一。该团队的软件还被训练来检测隐藏的汽车。

UCL团队希望很快就能在真正的集装箱上测试其软件，一些集装箱里会故意藏进小型武器以供测试。假设测试成功，格里芬计划在接下来的几个月里将人工智能系统整合到Rapiscan的扫描系统中。该团队还计划训练其系统来检测“反常现象”——类似人类直觉的机器学习能力，能感知扫描图里不对劲的地方，例如集装箱里东西的摆放位置异乎寻常。科学家们认为，

如果有足够的数据库，计算机就能自行训练来识别出这样的差异。

机器学习并不是只能在港口加快扫描。拖着疲惫身体缓慢通过机场安检的旅客也可以受益。手提箱比集装箱小，里面装的物品更可预测，因此工作人员能快速彻底地检查其X光图像（尽管中间仍需要定时休息）。

英国杜伦大学（Durham University）的托比·布雷肯（Toby Breckon）正在研究自动X光分析法来检测可能装进乘客手提和托运行李中的那种小物品。他表示，自己的研究团队已在商用扫描系统中安装了一个算法。布雷肯认为，智能扫描系统将首先在机场的后台运行，例如，用来复核行李，以防检查人员有所疏漏。它们也可用来标记那些可能值得人工检查的行李。

然而，自动筛选系统可能迟早会从操作人员的有用工具变成更胜他们的系统。格里芬认为，如果他的团队能获得大量安检图像输入到其软件中的话，至少集装箱扫描是有可能完全实现自动化的。或许机场包裹的扫描亦能如此。但仍会需要人工操作：必须有人在场检查装有可疑物品的集装箱和行李。 ■



Precision agriculture

TV dinners

Unused TV spectrum and drones could help make smart farms a reality

ON THE Dancing Crow farm in Washington, sunflowers and squashes soak up the rich autumn sunshine beside a row of solar panels. This bucolic smallholding provides organic vegetables to the farmers' markets of Seattle. But it is also home to an experiment by Microsoft, a big computing firm, that it hopes will transform agriculture further afield. For the past year, the firm's engineers have been developing a suite of technologies there to slash the cost of "precision agriculture", which aims to use sensors and clever algorithms to deliver water, fertilisers and pesticides only to crops that actually need them.

Precision agriculture is one of the technologies that could help to feed a world whose population is forecast to hit almost 10 billion by 2050. If farmers can irrigate only when necessary, and avoid excessive pesticide use, they should be able to save money and boost their output.

But existing systems work out at \$1,000 a sensor. That is too pricey for most rich-world farmers, let alone those in poor countries where productivity gains are most needed. The sensors themselves, which probe things like moisture, temperature and acidity in the soil, and which are scattered all over the farm, are fairly cheap, and can be powered with inexpensive solar panels. The cost comes in getting data from sensor to farmer. Few rural farms enjoy perfect mobile-phone coverage, and Wi-Fi networks do not have the range to cover entire fields. So most precision-agriculture systems rely on sensors that connect to custom cellular base stations, which can cost tens of thousands of dollars, or to satellites, which require pricey antennas and data plans.

In contrast, the sensors at Dancing Crow employ unoccupied slices of the UHF and VHF radio frequencies used for TV broadcasts, slotting data between channels. Many countries are experimenting with this so-called “white space” to unlock extra bandwidth for mobile phones. In cities, tiny slices of the white-space spectrum sell for millions of dollars. But in the sparsely populated countryside, says Ranjeev Chandra, a Microsoft researcher, there is unlicensed space galore.

The farmer’s house is connected to the internet in the usual way. A special white-space base station relays that signal to a shed elsewhere on the farm that sports an ordinary TV aerial. Individual sensors talk to the shed using TV transceivers with a range of more than 8km—enough for all but the biggest farms. And those transceivers are cheap: “We’ve already built sensors for less than \$100,” says Mr Candra. “Our aim is to get them to under \$15.”

Microsoft is not the only organisation hoping to make agricultural sensors practical. Researchers at the University of Applied Sciences in Mannheim, for instance, have developed a sensor network that relies on a technology called software-defined radio, which uses computers to simulate an ultra-flexible, very sensitive radio receiver. And scientists at the university of Nebraska-Lincoln are working on sensors that communicate with radio waves that propagate through the soil rather than the air, and which draw their power from the vibrations generated by farm vehicles moving about on the surface.

But although such sensor data are useful, but they cannot tell you everything. To fill in the gaps, Dancing Crow uses a drone. These are getting cheaper (a basic model costs \$1,000) but they require some skill to fly, and their small batteries mean limited flight times. So Microsoft’s team wrote an autopilot that lets a farmer outline a plot to survey, works out the most efficient route and sends the drone on its way, reducing the time taken to

cover a farm by over 25%.

The resulting imagery contains useful information on growing conditions, crop health and insect pests, but interpreting it properly is beyond most farmers. So Microsoft also developed software that runs on an ordinary laptop, and can stitch together individual pictures into a single panoramic view of the entire farm. Sensor data can be laid atop this view, and the computer can then extrapolate a handful of sensor readings into predicted values for moisture, acidity and so on at any given point.

When the nearby Snoqualmie River rises up to flood Dancing Crow farm in a couple of months, as it does most winters, Mr Chandra plans to take his technologies to India. For the very poorest farmers, even a cheap drone will be beyond their budget. He wants to see if a lower-tech solution will work just as well—simply attaching a smartphone to a \$5 helium balloon and walking it through the fields. ■



精准农业

电视晚餐

闲置的电视频谱以及无人机可能会帮助智能农场变成现实

在华盛顿州Dancing Crow农场的一排太阳能电池板旁，向日葵和南瓜正沐浴着秋天充沛的阳光。这个乡村小农场向西雅图的农贸市场供应有机蔬菜。而大型电脑公司微软正在这里进行一项实验，希望此举将更为深远地改变农业。在过去的一年里，该公司的工程师一直在开发一整套用以削减“精准农业”成本的技术。精准农业的目的是利用传感器和巧妙的算法，只向真正有需要的作物提供水、肥和喷洒农药。

到2050年，世界人口预计将接近100亿，精准农业是能够帮助养活这个世界的技术之一。如果农民可以只在必要时才灌溉作物并避免过度使用农药，他们应该就能节省支出并提高产量。

但现有系统运作所需的传感器每个要花费1000美元。这对于富裕国家的大多数农民而言都太过昂贵，更何况是穷国。况且穷国才最需要提高生产率。这些测量土壤水分、温度和酸度等指标的传感器遍布整个农场，它们本身还算便宜，而且能用廉价的太阳能电池板供电。费用产生于将数据从传感器传递给农民的过程。偏远农场很少能被移动电话网络完美覆盖，而Wi-Fi网络的覆盖范围也不能遍及整片农田。因此，大多数精准农业系统都依赖与定制基站（花费可达数十万美元）或卫星（需要昂贵的天线和数据套餐）相连接的传感器。

相比之下，Dancing Crow农场的传感器采用了电视广播所使用的超高频（UHF）和甚高频（VHF）无线电频率中的闲置频谱，利用频道间隙传递数据。许多国家正在利用这个所谓的“空白电视频段”做实验，为移动电话释放额外的带宽。在城市里，空白电视频段的很小一段频谱售价为数百万美元。但微软的研究人员兰杰夫·钱德拉（Ranjeev Chandra）认为，人口稀少的农村拥有大量的闲置频谱。

农民的房子以寻常方式接入互联网。一个专用的空白电视频段基站将网络信号中继发射到位于农场另一处的小屋，小屋上竖有普通电视天线。单个传感器通过收发范围超过八公里的电视收发器与小屋互通数据，除了那些最大的农场，这个范围对于其他农场来说已经足够了。而且这些收发器很便宜，钱德拉说：“我们现在布置一个传感器只要不到100美元。我们的目标是把成本控制在15美元以内。”

微软并不是唯一一个希望让农业传感器变得实用的组织。例如，德国曼海姆应用技术大学（University of Applied Sciences in Mannheim）的研究人员开发了一个传感器网络，依赖一种名为“软件无线电”（software-defined radio）的技术。这一技术利用计算机来模拟一种超级灵活且非常灵敏的无线电接收机。美国内布拉斯加大学林肯校区（University of Nebraska-Lincoln）的科学家们正在研究的传感器则是利用在土壤中而非空气中传播的无线电波进行通信，这些传感器所用的电力来自驶过地表的农用车辆所产生的振动。

不过，虽然这样的传感器数据很有用，但它们不能告诉你一切。为了弥补这一不足，Dancing Crow启用了一架无人机。无人机正变得越来越便宜（基本机型花费1000美元），但控制它们飞行需要一些技巧，而且它们小尺寸的电池意味着飞行时间会很有限。为此，微软的团队编写了一个自动驾驶程序，可以让农民勾勒出调查范围，算出最有效的路线，然后让无人机升空，这样能把覆盖一个农场所需的时间减少25%以上。

由此产生的图像包含了有关生长状况、作物健康和病虫害的有用信息，但是大多数农民都不能正确解读这些信息。因此，微软还开发了能在普通手提电脑上运行的软件，可以将各个单幅图像拼合成一张农场全景图。传感器数据可展示在这一全景图之上，计算机就能根据少量的传感器读数对任何地点的湿度、酸度等进行预测。

几个月后，就像大多数年份的冬天一样，附近的斯诺夸尔米河（Snoqualmie River）上升的水位将会淹没Dancing Crow农场，钱德拉计划在那时把他的技术带到印度去。对于最穷贫的农民来说，即使一架廉价

的无人机都将超出预算。他想看一看，一个较低技术含量的解决方案能否同样有效：只是将智能手机绑在一个5美元的氦气球上，并拿着它步行穿过田野。 ■



Europe's outposts

Not always in clusters

The allure of manufacturing out in the sticks

IRELAND'S Atlantic coast is sheep-rearing and pilgrim country. The drive to Tuam, a modest town of 9,550 residents, reveals mostly lush fields, low hills, stone walls and mist. Yet this unlikely spot has a hi-tech industrial side. Off Tuam's main road a bunch of warehouses contains some 400 software engineers, researchers and artificial-intelligence experts, drawn from 35 countries. Next door is a manufacturing plant employing 650 people churning out circuit boards, cameras and sensors for driverless cars.

The set-up in Tuam is operated by Valeo, a French car-parts firm with a market value of €12 billion (\$13.4 billion), which brought in €500m in sales last year from producing 100m such products globally. Tuam is "our biggest R&D centre for surround cameras, with huge production capacity", says Jacques Aschenbroich, the firm's CEO. Tuam has also become Valeo's global mother plant, overseeing its sensor factories in Hungary, Mexico and China.

What possessed the French firm to keep such operations in a spot so far from customers such as BMW, Range Rover and Google, away from big pools of labour, and a lengthy drive from Dublin? History is one answer: in 2007 Valeo bought Connaught, a successful local firm making cameras for cars, and preferred to expand there rather than move. Fergus Moyles, who runs things in Tuam (and managed the old firm), says that attracting talent is not hard. Nearby Galway University offers useful ties. Property prices are low, which appeals to foreign engineers, for example from India, who intend to save while in Ireland. Land prices help when building new facilities.

Setting up shop in a remote location like Tuam runs counter to conventional thinking about the gains from industrial clusters. But Valeo is not the only firm to see benefits from sticking operations in remote spots. Turbomeca, the helicopter-engine unit of Safran, a big French defence firm, is based in the Pyrenees on the French-Spanish border. That location, Bordes, with just 2,700 residents, makes Tuam look like a metropolis. Again, history explains the initial choice of location: Turbomeca was founded pre-war, then moved to a remote spot to avoid invading Germans. Being in the boonies means sympathetic local officials and staff who are extremely loyal.

For high-end manufacturing firms that rely on highly skilled workers, a location with an appealing climate, good housing and other compelling virtues, like schools for young families, is a big draw. Another example is Medtech, a startup that makes surgical robots for spine and brain operations. Its “Rosa” products are widely used in American and European hospitals. The firm’s founder, Bertin Nahum, started and built the firm on the outskirts of Montpellier, a picturesque town on the Mediterranean coast.

Wouldn’t Mr Nahum really be better off joining a cluster of other medical technology companies, for example in Grenoble, or around Paris? “I would much rather be here,” he says, talking warmly of support from the local mayor and of how attracting talent is no trouble at all. His robots can be flown to hospitals easily from Marseille airport. For some, the periphery appeals more than the centre. ■



欧洲的边陲

并不总是加入集群

边远地区发展制造业的诱惑

爱尔兰大西洋沿岸的乡村以养羊为主，同时也是朝圣者的向往之地。驱车前往拥有9550人口的小镇蒂厄姆（Tuam），一路上绿草茵茵，丘陵起伏，石墙纵横，薄雾弥漫。然而很多人想不到这里居然也有高科技工业的一面。在蒂厄姆主干道旁的一排排仓库里，有来自35个国家的约400名软件工程师、研究人员和人工智能专家。仓库旁边的一家制造工厂有650名员工，大量生产无人驾驶汽车的电路板、摄像头和传感器。

在蒂厄姆镇展开研发和生产的是法国汽车配件制造商法雷奥公司（Valeo），市值120亿欧元（134亿美元），去年全球配件产量1亿件，销售额达5亿欧元。法雷奥CEO雅克·阿申布瓦（Jacques Aschenbroich）说蒂厄姆镇是“我们环绕摄像头的最大研发中心，产能巨大”。蒂厄姆还成为法雷奥的全球母工厂，监督在匈牙利、墨西哥和中国的传感器工厂。

这个法国公司是着了什么魔要在这里运作？此处远离客户（比如宝马、路虎和谷歌）、远离大量劳动力供应，从都柏林开车来这里都要很久。这样的选择部分是出于历史原因：2007年，法雷奥收购了当地一家生产车载摄像头的成功企业康诺特（Connaught）后，选择在此地继续扩展，而没有迁往别处。在蒂厄姆主事（同时也管理老公司）的佛格斯·莫伊尔斯（Fergus Moyles）说在这里吸引人才并非难事。附近的戈尔韦大学（Galway University）与法雷奥有良好的合作。这里房价也低，对外国工程师很有吸引力，比如印度工程师在爱尔兰工作的时候一般会尽量存钱。低地价也有助公司建设新设施。

传统看法认为产业集群有优势，在像蒂厄姆这样偏远的地方建立运营设施有违这一看法。但看到坚持在这样的地方运营好处的公司不止法雷奥一家。透博梅卡（Turbomeca）隶属大型法国防务公司赛峰集团（Safran），生产直升机发动机，总部设在法西边界比利牛斯山中的博尔

德（Bordes）。当地人口仅为2700，相比之下蒂厄姆像个大都会。透博梅卡最初选择这里也有历史原因：透博梅卡始建于二战前，当时公司为了躲避入侵的德军而搬迁至一个偏远的地方。在乡僻之处安家意味着可以获得当地官员的支持和员工的高度忠诚。

一个地方如果有宜人的气候、良好的住房和其他令人关注的优点（比如年轻家庭看重的好学校），对于依赖高素质劳动力的高端制造公司来说便具有很大的吸引力。另一个例子是创业公司Medtech，生产脊柱和脑手术中使用的外科手术机器人。其手术定位机器人“Rosa”在欧美的医院里广泛应用。公司的创始人贝尔坦·内厄姆（Bertin Nahum）选择在地中海沿岸风景如画的蒙彼利埃（Montpellier）郊区创建了公司。

如果内厄姆当初选择加入其他医疗技术公司的产业集群，比如落户于格勒诺布尔（Grenoble，法国的创新技术中心）或巴黎附近会不会更好呢？内厄姆在热情地讲到从当地镇长那里获得的支持和吸引人才毫无困难之时说：“我更愿意在这里。”他的机器人可以方便地从马赛机场运往各地的医院。对有些人来说，外围比中心更具吸引力。■



Berlin's tech scene

The freaks are coming

As Rocket Internet fizzles, other startups take off

ROCKET INTERNET has just moved into a splendid, red building in central Berlin, around the corner from Checkpoint Charlie. The lease runs for the next 15 years, a signal of intent from a firm that brags of becoming the biggest online conglomerate outside America and China. Inside, everything is new. Alexander Kudlich, the managing director, jokes he should remove his shoes before stepping on a just-laid, thick, grey carpet in the boardroom.

The timing is awkward. Just as staff entered the building, in early September, Rocket warned about its financial performance this year. It had losses of €617m (just under \$700m) in the first six months; the full details came in earnings announced this week. Few are surprised that Rocket, which went public in 2014, had to lower the values of some of its creations. Kinnevik, an investment firm with shares in Rocket that had some of the same holdings, had already done so.

Mr Kudlich claims “we are more bullish than five years ago”. But Rocket is finding life tougher than before its IPO. Its shares are down by almost half in the past year, leaving it valued at some €3 billion.

The most creative digital types have long scorned Rocket as a factory for copycat startups. Nonetheless, it used to do three things very well. It built up e-commerce companies quickly, often within days, mimicking other (usually American) startups. It pumped its own versions full of capital and they often became market leaders, typically in emerging markets. Second, it raised that capital effectively: tapping stuffy (and mostly German) investors who twigged that they should have a digital strategy but who found tech

entrepreneurs baffling. Lastly, Rocket was skilled at recruiting brainy-but-conservative business-school graduates, who were taught to execute plans and made to toil frantically hard.

But being a company builder got much harder once startups such as Uber and Airbnb showed they could quickly internationalise themselves. One prominent investor in Berlin's technology scene says that founders should throw a parade for Oliver Samwer, Rocket's chief executive, for jumpstarting the city's tech ecosystem, but still calls the firm's copy-cat approach "an abomination". The era of Rocket-style incubation is over: "nobody does it now".

Rocket itself seems to accept as much. It plans to refocus itself as a later-stage investment firm, more like a private-equity outfit. That reflects how the wider Berlin scene is evolving. Startups are no longer content to copy others; they want to build empires that rival some of the biggest names in tech. "We need a Tesla or a Google to change the ecosystem," says another founder of tech firms, arguing that Berlin is well-placed to match traditional German engineering strengths with more creative technology types. In other words, he says, "we need more freaks."

They may be coming. Christophe Maire, a veteran of the Berlin scene, says it is flourishing, with firms scaling up in fintech, digital health, artificial intelligence, mobility, food technology, cyber-security and more. "We see formidable, original companies emerging."

Some, such as SoundCloud, a music-streaming service, are struggling to find a business model in the face of more established outfits, such as Spotify. But newer firms are rising. One is Relayr, which was founded in 2013 and has ambitions to become a platform for the "internet of things". It works with firms such as Bosch to develop sensors that set up machinery (such as lifts, kitchen appliances or elaborate espresso machines) to send

data to and receive instructions from owners.

Another is ResearchGate, a social network for scientists founded in 2008 that has completed three rounds of funding, including a \$35m investment from Bill Gates and a few other investors in 2013. It has over 10m members. Its founder, Ijad Madisch, claims to lead, with some justification, the “coolest startup in Germany” because it has succeeded in creating a place for researchers from all around the world to collaborate. They share vast amounts of data and experiments—including failed ones. Neither Relayr nor ResearchGate resemble Rocket-style copies, and many more firms should be able similarly to draw on Germany’s strength in industrial products and in scientific research.

Meanwhile, Berlin startups’ success in attracting finance is continuing (see chart). More venture-capital funds are setting up, as well as additional accelerators and “business clubs” for startups. One of them, The Factory, in a renovated brewery, is putting entrepreneurs in the same building as people from SoundCloud, but also from big old firms such as Deutsche Bank or Siemens. The hope is that Germany’s stock of financial and engineering knowledge can be brought fruitfully together with people who have bright ideas. Hardly rocket science, but it might take off. ■



柏林的科技圈

狂人来了

“火箭网络”火花渐消，其他创业公司则蓄势腾飞

“火箭网络”（Rocket Internet）最近刚搬进柏林市中心位于查理检查哨（Checkpoint Charlie）拐角处一幢非常壮观的红色建筑内。租约长达15年，正显现了这家公司的企图心——它自夸将成为美国和中国之外最大的互联网企业集团。大楼里面，什么都是新的。公司总经理亚历山大·库特里希（Alexander Kudlich）开玩笑地说，他应该先把鞋脱掉，再去踩董事会议室里那刚铺好的厚厚的灰色地毯。

这个乔迁时机颇为尴尬。9月初，员工们刚搬入这座大楼，公司便就今年的财务表现发出了预警。上半年的亏损达6.17亿欧元（将近7亿美元），9月底公布的财报给出了完整的细节。2014年上市的火箭不得不降低了自己孵化的一些公司的估值，这并没有令太多人感到惊奇。投资公司Kinnevik此前已经这么做了。这家公司持有火箭的股票，同时也持有火箭所投资的部分公司的股票。

库特里希声称，“我们现在的势头比五年前要好。”但火箭的日子要比上市前难过。过去一年里，公司股价几乎跌去了一半，导致估值缩水至30亿欧元左右。

数字领域最具创造力的那些人早就对火箭嗤之以鼻，认为它只是一家生产山寨创业公司的工厂。尽管如此，有三件事火箭在过去做得还是相当不错。它打造电商公司的速度很快，通过模仿其他（通常都是美国的）创业公司，往往几天就可完工。它会向自家的“山寨版”注入充足的资金，这些公司往往会成为市场（通常是新兴市场）的领头羊。第二，它能切实有效地筹集到上述资本：从一些古板的投资人（多数都是德国人）那里筹钱。这些投资人认识到，自己也该有个数字战略，但他们又觉得科技企业家都太让人困惑了。最后，火箭很善于招募脑筋灵光同时也很保守的商学院毕业生——他们受到的教育就是要切实执行计划，而且干活非常卖命。

但当优步和Airbnb这样的创业公司展示了自己可以多么快速地实现国际化后，做一个公司缔造者就变得困难了许多。柏林科技圈一位知名投资人说，火箭的首席执行官奥利弗·桑威尔（Oliver Samwer）使这个城市的科技生态系统得以快速重振，理应为公司创立者们大加称颂。但他仍称该公司的山寨做法“令人憎恶”。属于火箭那套孵化手法的时代已经结束了：“现在已经没人再搞那套了。”

火箭大抵也接受了这一现实。它计划重新专注于后期投资，使自己更像一个私募股权投资机构。从这种变化中也可以看出更广泛的柏林科技圈正经历着怎样的变迁。创业公司已不再满足于照抄他人，而是想打造出可与科技界一些名头最响的公司比肩的企业帝国。“要想改变生态系统，得有个特斯拉或者谷歌那样的公司才行。”另一位科技公司创始人如此说道。他认为柏林身处优势地位，可以打造出与其传统工程优势相匹配且更富创造力的科技公司。换句话说，“我们需要更多的科技狂人。”

狂人们也许就要来了。柏林科技圈资深人士克里斯托弗·迈尔（Christophe Maire）称，随着金融科技、数字医疗、人工智能、移动技术、食品技术、网络安全以及其他领域内的公司大量增加，如今柏林科技圈一片繁荣。“我们想象得到，今后将会出现强悍而又富原创性的公司。”

一些公司正直面更成熟的公司，奋力探寻自己的商业模式，就像音乐流媒体服务商SoundCloud正迎战Spotify那样。但更新的公司也在崛起，Relayr便是其中之一。这家公司成立于2013年，雄心勃勃地要成为一个“物联网”平台。它与博世等公司展开合作，研发能够整备机器（如电梯、厨房电器或复杂的意式浓缩咖啡机）来发送数据并接收用户指令的传感器。

另一家公司是成立于2008年的“研究之门”（ResearchGate）。这个科学家社交网络已完成了C轮融资，包括2013年从比尔·盖茨和其他几位投资者那里获得的3500万美元。该公司用户已超1000万，创始人伊贾德·马迪什（Ijad Madisch）称自己领导着“德国最酷的创业公司”，因为它成功地打造了一个可供全世界研究人员开展协作的平台。他的话不无道理。研究者们可以在此分享海量的数据以及实验——包括失败的那些。不论是Relayr

还是ResearchGate，都不同于火箭派的山寨公司。还有更多的公司应该也可以像它们那样，充分利用德国在工业产品及科研方面的优势。

与此同时，柏林的创业公司在吸引投资方面的成功也在延续（见图表）。越来越多的风投基金成立起来，扶植创业公司的加速器和“商业俱乐部”也有所增加。“工厂”（The Factory）便是其中之一。其“厂址”是一座翻新过的啤酒厂。它不单让创业企业家和SoundCloud的员工共处一楼，还让他们和老牌大公司德意志银行或西门子的员工也做上了邻居。它希望将德国在金融和工程领域的知识储备和那些有奇思妙想的人聚集在一起，结出累累硕果。这虽不是造火箭般的复杂项目，不过或许能一飞冲天。■



Startups

Silicon Beach

Los Angeles has become a booming hub for startups

HOLLYWOOD has produced plenty of films about underdogs rising to claim the limelight. Now Los Angeles is experiencing its own real-life Cinderella story, as the area's technology scene has been transformed from backwater to boomtown in just a few years. Hordes of venture capitalists from northern California, once long dismissive of their southern neighbour, now regularly commute in search of deals in a less heavily hunted spot than the Bay Area. In 2016 the city's startups received around \$3bn in funding, around six times more than in 2012, according to CB Insights, a research firm.

Evan Spiegel went to Stanford University in the heart of Silicon Valley, but he wanted to live and work close to the sea. So he based his new company one block from the Pacific in Venice Beach, which is better known in Los Angeles for its silicone-enhanced bodies than the silicon chips that gave the Valley its name. Mr Spiegel's firm, Snap, is best known for its ephemeral Snapchat social-media messages and is now valued at a whopping \$18bn. Other successful technology firms are thriving nearby, including Dollar Shave Club, an e-commerce firm recently sold to Unilever for \$1bn; Ring, a "smart" doorbell company, and Riot Games, maker of "League of Legends", a popular online multiplayer contest.

Los Angeles is now the third-most-prominent outpost for startups in America, after San Francisco and New York. It has several advantages, including good universities, warm weather, a relaxed culture, proximity to San Francisco and much lower costs. Michael Schneider, the boss of Service, a customer-relations startup, reckons he would need to have raised at least 40% more money if based in San Francisco, "just to pay for the

same space and people”.

Although Los Angeles has fewer experienced engineers, those that are there tend to be more loyal, not least because there are fewer firms out to poach them. Startups can convince people to move. Ophir Tanz of GumGum, an advertising startup, says he has recruited several employees looking for a more balanced life away from cities like New York and San Francisco.

Los Angeles may at last be getting the attention it deserves. “The original monetisation of the internet was created here, not Silicon Valley,” says Mark Suster, a venture capitalist with Upfront Ventures, referring to pioneers such as Applied Semantics, bought by Google. But for Los Angeles to establish itself as an enduring place for startups, it needs Snapchat to continue to thrive and go public, which could happen as soon as next year. ■



创业公司

硅滩

洛杉矶已经成为创业公司蓬勃发展的一个中心

落魄的人一跃成为众人瞩目的焦点，好莱坞已经拍了很多这样的电影。如今洛杉矶正在上演自己的现实版灰姑娘的故事——短短数年间，该地区就在科技领域从一潭死水转变成为新兴都市。从北加州蜂拥而至的风险资本家曾经对他们的南部芳邻不屑一顾，如今却经常往来于两地，在这个比起湾区来没那么被过度捕猎的地方寻觅一些生意。根据研究公司CB Insights的数据，2016年该市的创业公司获得了约30亿美元的融资，是2012年的六倍左右。

伊万·斯皮格尔（Evan Spiegel）读的是位于硅谷中心的斯坦福大学，但 he 想在靠近海边的地方生活、工作。于是他将新公司设在威尼斯海滩（Venice Beach）边，离太平洋仅一个街区。在洛杉矶，威尼斯海滩更出名的是硅胶填充的曼妙身姿，而不是赋予硅谷之名的硅片。斯皮格尔的公司Snap最知名的是“阅后即焚”的Snapchat社交媒体应用，现在估值达到惊人的180亿美元。附近还有一些成功的技术公司蒸蒸日上，包括最近被联合利华以10亿美元收购的电子商务公司Dollar Shave Club、智能门铃公司Ring，以及流行的多人在线竞技游戏《英雄联盟》（League of Legends）的开发商Riot Games。

洛杉矶现已成为继旧金山和纽约之后，美国第三大的创业公司集合地。它有几点优势：名校云集，气候温暖，文化轻松，靠近旧金山但花费低得多。客户关系创业公司Service的老板米夏埃尔·施耐德（Michael Schneider）估算，如果公司设在旧金山，他得多筹集40%的资金，“租的还是同样大的地方，请的也同样的人”。

尽管洛杉矶经验丰富的工程师要少一些，但他们往往更忠心，尤其是因为在这里想挖走他们的公司也更少。创业公司能说服人们搬家。广告创业公司GumGum的俄斐·坦茨（Ophir Tanz）说他已经招募了好几位雇员，他

们向往更平衡的生活，离开像纽约和旧金山这样的城市。

或许最终洛杉矶会获得它应有的关注。Upfront Ventures的风险资本家马克·苏斯特（Mark Suster）说，“互联网最早开始创富就是从这里开始的，不是硅谷。”他指的是像Applied Semantics这样的先驱者（后被谷歌收购）。但是洛杉矶若要让自己成为创业公司久待之处，则需要Snapchat继续发展并上市，这在明年就可能发生。■



Artificial intelligence

Google's hippocampus

Alphabet has plenty of AI expertise, so why does it need DeepMind?

DEEPMIND'S office is tucked away in a nondescript building next to London's Kings Cross train station. From the outside, it doesn't look like something that two of the world's most powerful technology companies, Facebook and Google, would have fought to acquire. Google won, buying DeepMind for £400m (\$660m) in January 2014. But why did it want to own a British artificial-intelligence (AI) company in the first place? Google was already on the cutting edge of machine learning and AI, its newly trendy cousin. What value could DeepMind provide?

That question has become a little more pressing. Before October 2015 Google's gigantic advertising revenues had cast a comfortable shade in which ambitious, zero-revenue projects like DeepMind could shelter. Then Google conjured up a corporate superstructure called Alphabet, slotting itself in as the only profitable firm. For the first time, other businesses had their combined revenues broken out from Google's on the balance-sheet, placing them under more scrutiny (see next article). But understanding DeepMind's worth is not a simple financial question. Its value is deeper than that.

DeepMind's most immediate benefit to Google and Alphabet is the advantage it gives in the strategic battle that technology companies are waging over AI (see chart). It hoovers up talent, keeping researchers away from competitors like Facebook, Microsoft and Amazon. The Kings Cross office already houses about 400 computer scientists and neuroscientists, and there is talk of expanding that to 1,000.

Another boost to the mother ship comes in the form of prestige. DeepMind

has reached the cover of *Nature*, a highly regarded academic journal, twice since it was acquired. Gigantic copies of the relevant covers adorn the walls of the office lobby. The first was for a video-game-playing AI programme the second for one that learned to play the ancient Asian board game of Go. Named AlphaGo for its parent, that software went on to make headlines around the world when it beat Lee Sedol, a South Korean champion, in March 2016 (the match is pictured here).

DeepMind's horizons stretch far beyond talent capture and public attention, however. Demis Hassabis, its CEO and one of its co-founders, describes the company as a new kind of research organisation, combining the long-term outlook of academia with “the energy and focus of a technology startup”—to say nothing of Alphabet's cash. He founded it in 2010, along with Mustafa Suleyman and Shane Legg. Mr Legg and Mr Hassabis met as neuroscience researchers at University College, London; Mr Suleyman is a childhood friend of Mr Hassabis's.

The firm's overall mission, as Mr Hassabis puts it, is to “solve intelligence”. This would allow the firm to create multifunctional, “general” artificial intelligence that can think as broadly and effectively as a human. Being bought by Google had several attractions. One was access to the technology firm's computing power. Another was Google's profitability; a weaker buyer would have been more likely to require DeepMind to make money. This way Mr Hassabis can focus on research rather than the detail of running a firm. And by keeping DeepMind in London, at a safe distance from Google's Silicon Valley base in Mountain View, he can retain more control over the operation.

Were he to succeed in creating a general-purpose AI, that would obviously be enormously valuable to Alphabet. It would in effect give the firm a digital employee that could be copied over and over again in service of multiple problems. Yet DeepMind's research agenda is not—or not yet—the

same thing as a business model. And its time frames are extremely long. Mr Hassabis says the company is following a 20-year road map. DeepMind aims to invent new kinds of AI algorithms, he adds, that are inspired by the way the human brain works. This explains the firm's large number of neuroscientists. Mr Hassabis claims that seeking inspiration from the brain sets his firm far apart from other machine-learning research units and in particular from "deep learning", the powerful branch of machine-learning that is being used by the Google Brain unit.

Even if DeepMind never achieves human-level (or indeed, superhuman) artificial intelligence, however, the learning software that it creates along the way can still benefit other Alphabet businesses. This has already happened. In July the company announced that its learning software had found a way to reduce the quantity of electricity that is needed to cool Google data centres, by two-fifths. The software learned about the task by crunching data-centre operation logs, and then optimised the process by running it over and over again in a simulation.

DeepMind is also applying its AI research to solve problems in its own right. Mr Suleyman, who leads these efforts, has expressed an ambition for DeepMind to help manage energy infrastructure, hone health-care systems and improve access to clean water, in return for revenue streams. The company has already started on health care. Its first paid work came in November in the form of a five-year deal with the Royal Free London, an NHS Foundation Trust, to process 1.7m patient records. Earlier this year it gained access to two data sets from other London hospitals: one million retina scans that it can mine and thereby identify early signs of degenerative eye conditions, and head and neck cancer imagery which, fed into its models, will allow DeepMind's AI to distinguish between healthy and cancerous tissues.

Skilful programmers and powerful computers are crucial to this applied AI business. But access to data about the real-world environment is also vital. When systems like hospitals, electricity grids and factories are targeted for improvement using AI and machine learning, data about their specific operations are needed.

Alphabet, of course, holds huge volumes of data that can be mined for these purposes. But DeepMind will have to acquire lots more in each of the fields it aims to examine. In the case of a recent project it was involved in on lip-reading, for example, it was the acquisition of an unprecedentedly large data set that made it a success. A group of researchers at the University of Oxford, headed by Andrew Zisserman, a computer-vision researcher, led the work. The BBC gave the researchers hundreds of thousands of hours of newscaster footage, in the absence of which they would not have been able to train their AI systems.

Mr Hassabis downplays the importance of data acquisition to DeepMind's future. He claims that it is enough for human engineers to build simulations of the problem to be solved; then DeepMind unleashes learning agents within them. But that is not how most machine-learning systems that are currently in operation work. AlphaGo itself first learned on a database of millions of individual moves from 160,000 human-played Go games, before iteratively training against itself and improving. But if DeepMind does need to Hoover up lots of personal information, it will have to deal with consumer concerns about corporate access to data.

If it can solve these problems, however, DeepMind will hold immense value as something entirely new for Alphabet: an algorithm factory. That would go far beyond simply being the technology giant's long-term AI research outfit and talent-holding pool. The data that DeepMind processes can remain the property of the organisations they come from (which should

help to allay concerns about privacy), but the software that learns from that data will belong to Alphabet.

DeepMind may not ever make significant revenue of its own by applying AI programmes to complex problems. But the knowledge it sends into learning software from those same sets of data may justify the bidding war that brought it into Alphabet's compass. ■



人工智能

谷歌的海马体

Alphabet已拥有大量人工智能专门技术，为何还需要DeepMind？

人工智能（以下简称AI）科技公司DeepMind的办公室藏身于伦敦国王十字火车站旁边一座不起眼的建筑物内，从外看去，完全不像是Facebook和谷歌这两大科技巨头争相收购的对象。最终，谷歌胜出，在2014年1月以4亿英镑（6.6亿美元）成功收购了DeepMind。但谷歌当初为何要收购这样一家英国AI公司呢？在机器学习及与之相近的AI技术方面，谷歌早已走在前列。DeepMind能给谷歌带来什么价值？

这个问题现在变得更迫切了些。2015年10月之前，谷歌的巨额广告收入为DeepMind这类雄心勃勃的零收入项目提供了充足的庇荫。而后谷歌构建了名为Alphabet的母公司架构，并成为公司旗下唯一盈利的公司。其他业务的综合营收首次从谷歌的资产负债表中拆分出来，因而会受到更多审视。但要了解DeepMind的价值所在并非一个简单的财务问题。其意义更为深远。

DeepMind对谷歌和Alphabet最直接的好处是使其在科技公司围绕AI展开的战略竞争中处于有利位置（见图表）。它吸纳了众多人才，令Facebook、微软、亚马逊等竞争对手对其研究人员求之而不得。公司在国王十字火车站旁的办公楼内现有约400名计算机科学家及神经科学家，据说规模将扩至1000人。

DeepMind为母公司带来的另外一个好处是声望的提升。被收购后，DeepMind已两次登上权威学术期刊《自然》的封面，相关封面的巨幅复制品就张贴在公司大堂的墙上。首次登上封面是因为一款能玩电子游戏的AI程序，第二次则是由于一款学会了下古老的亚洲棋盘游戏围棋的程序。这一以母公司名字命名的软件AlphaGo在2016年3月击败了韩国围棋冠军李世石（如图），一举登上世界各地的新闻头条。

然而，DeepMind的眼光远不止于吸引人才和公众关注。其CEO及联合创始人德米斯·哈萨比斯（Demis Hassabis）将公司描述为一种新型的研究机构：既拥有学术领域的长远眼界，也具备“科技创业公司的活力和专注”，而Alphabet的资金就更不用说了。哈萨比斯在2010年与穆斯塔法·苏莱曼（Mustafa Suleyman）和谢恩·列格（Shane Legg）一起创立了DeepMind。列格与哈萨比斯在伦敦大学学院（University College, London）从事神经科学研究时相识，苏莱曼则是哈萨比斯儿时的玩伴。

正如哈萨比斯所说，公司的整体使命是“解密智能”。这将使公司创造能像人类那样广泛高效思考的多功能“通用型”人工智能。公司接受谷歌收购有几个诱因。一是可藉此获得谷歌的计算能力。另一个则是谷歌的盈利能力：如果是由财力较弱的买家来收购，则更可能对DeepMind设下盈利要求。而谷歌没有这样的要求，哈萨比斯便可专注于研究，而非公司的运营细节。通过把DeepMind留在伦敦，与谷歌位于山景城的硅谷总部保持一段安全距离，他还可以对运营保留更大的控制权。

假如他成功实现了通用AI技术，显然将会为Alphabet带来巨大的价值，等于为之提供了一名可以被无穷复制的数字化员工，用于解决各种问题。但DeepMind的研究计划并不是——或者说尚未成为——一种商业模式，而且其未来规划极为长远。哈萨比斯表示公司正在执行一个20年期的规划。他补充道，DeepMind的目标是发明类似人脑运作方式的AI新算法。正因如此，公司聘用了大批神经科学家。哈萨比斯声称，从人脑寻求灵感使DeepMind大大有别于其他机器学习研究团队，尤其是“深度学习”这一正为“谷歌大脑”团队使用的机器学习的强大分支。

即便DeepMind从来都没研发出达到人类水平（或甚至超人类）的人工智能，但在研究过程中创建的学习软件仍可为Alphabet的其他业务带来好处，而且效果已经显现。今年七月，公司宣布其学习软件已找到方法将谷歌数据中心的制冷用电量减少五分之二。该软件先是分析数据中心的操作日志来理解任务，然后通过反复模拟运行来优化过程。

DeepMind也在应用AI研究来自主解决问题。主管这些工作的苏莱曼曾表

达过此种抱负：希望DeepMind能帮助管理能源基础设施，完善医疗保健系统，改善洁净水的供给，以此开拓公司的收入来源。DeepMind已经启动了医疗保健方面的工作。今年11月，公司获得了首个付费工作，与NHS公立医院皇家自由伦敦医院（Royal Free London）签下五年的合同，为其处理170万份病历。今年早前，DeepMind从伦敦其他医院获得了两组数据集：100万份视网膜扫描图，可从中挖掘并辨别出退行性眼病的早期征兆；头颈部癌症病例的医学影像，可输入到DeepMind的模型中，让其AI系统学习区分健康和癌变组织。

| 神经网络在延展

熟练的程序员及强大的计算机是这类应用型AI业务的关键，不过获取现实世界的的数据也至关重要。运用AI及机器学习技术改进医院、电网及工厂等系统时，获取其具体操作数据是必需的。

当然，在这些方面，Alphabet公司拥有大量数据可供挖掘，但DeepMind必须还要从其有意探究的各个领域获取更多数据。例如，最近它参与一个关于唇读的项目之所以取得成功，就是因为获得了前所未有的大数据集。由计算机视觉专家安德鲁·基泽曼（Andrew Zisserman）带领的一组牛津大学的科研人员负责了该项目。BBC向这些研究者提供了数十万小时的新闻播音员录像。没有这些数据，他们就无法训练其AI系统。

关于数据采集之于DeepMind未来的重要性，哈萨比斯轻描淡写地表示，人类工程师只要能就有待解决的问题构建模拟情境就足够了，然后DeepMind便可将学习主体置于这些模拟情境中。但目前运行的大多数机器学习系统并非如此操作。AlphaGo本身就是先在收录了16万盘人类棋局、包含数百万着棋的数据库中学习之后，才反复自我对弈训练，加以改进。不过，DeepMind如果真的需要掌握大量个人信息，就必须解决消费者对于企业获取数据的顾虑。

但如果这些问题得到解决，DeepMind将为Alphabet带来巨大的价值，成为其一个全新的部分：一家算法工厂。这样一来，DeepMind将远不止是该科技巨头的AI技术长远研究机构及人才储备库。DeepMind处理的数据

的所有权可归其来源机构（这应有助于减轻人们对隐私外泄的担忧），但通过学习这些数据而打造出的软件将属于Alphabet。

DeepMind自己运用AI程序解决复杂问题也许永远赚不了大钱，但学习软件从那些数据集中获取的知识却意义重大。科技巨头们掀起收购战，Alphabet把DeepMind纳入麾下，原因或许就在于此。■



Military supply lines

Having no truck with it

Instead of shipping parts to battlefields, why not print them there?

“AMATEURS talk strategy, but professionals talk logistics.” That military maxim’s latest consequence is the adoption by the world’s armed forces of three-dimensional (3D) printing on the front line. It will be a while before weapons robust enough for military use can be printed on demand (though civilian ones can be). But if it is a question of replacing a small but crucial component that has broken—the modern equivalent of reshoeing a horse—then making what is needed to order in this way has huge potential. Moving replacement parts through a long supply chain to a far-flung ship or base can take weeks. And, if a war is on, such convoys make tempting targets. Yet it is unrealistic to keep a full range of spares near the front line. Far better to produce what is needed, when it is needed.

Having access to a printer can even encourage innovation. For example, the *USS Harry S. Truman*, an American aircraft-carrier, took two 3D printers on her most recent tour of duty in the eastern Mediterranean and the Persian Gulf, which began in November 2015. During the eight months she was at sea her crew devised and printed such items as better funnels for oil cans (to reduce spillage), protective covers for light switches (to stop people bumping into them and inadvertently plunging, say, the flight deck into darkness) and also a cleverly shaped widget they dubbed the TruClip. This snaps onto walkie-talkies, reinforcing a connection that is otherwise prone to break in the rough-and-tumble of naval usage. According to Commander Al Palmer, one of the *Truman*’s maintenance officers, TruClips alone have saved more than \$40,000 in replacement parts. The printers themselves, by contrast, cost about \$2,000 each. On the basis of his experience using it, Commander Palmer reckons 3D printing will become an important part of

the American navy's supply chains.

| *Keep your powder dry*

At the moment, only plastic items can be printed at sea. Landlubbing printers can make things out of metal by building up layers of metallic powder that are then melted with a laser or electron beam and allowed to cool into a solid. But printers, like people, get seasick. A ship's constant yawing, pitching and rolling disturbs the powder before the beam can do its work. This is why a printer of metal ship parts operated by Canada's navy sits safely on dry land, at the Cape Scott fleet-maintenance facility in Halifax, Nova Scotia.

In time, however, metal parts may also be printed at sea. The head of engineering at the American navy's supply command, Captain Armen Kurdian, says his organisation is looking for ways to overcome the problem of instability. Mounting printers on damping platforms that hold them steady by compensating for a ship's motion could be one answer. Another might be to form the metal "ink" into wires instead of powders, for wire is more easily held in place than a layer of dust is. In this arrangement the laser or electron beams would melt the tips of the wires.

Nor are sailors the only servicemen who will benefit from 3D printing. China's army prints both basic items, such as ratchets, and more sophisticated ones, including physical relief maps of local terrain that help soldiers plan operations more effectively than a paper map or screen display could. Israel's air force prints plastic parts that are as strong as aluminium, in order to keep planes that date from the 1980s flying. And America is advising the governments of Australia, Britain and France on 3D printing, in order to speed up these allies' supply chains, says Chris Wood, a captain of marines who works at the Pentagon and is in charge of this joint enterprise.

Captain Wood will also, within the next three months, be supervising the distribution of 3D printers to American marines in Europe, the Middle East and the Pacific. In October marines at Camp Pendleton in California finished converting a shipping container into a rugged “expeditionary-manufacturing facility” movable by lorry, ship, train or aircraft. In addition to a 3D printer, this contains conventional machining equipment. Another such mobile workshop is under construction in North Carolina. And the army, too, is involved. It has already sent some 3D printers to bases in Afghanistan.

For now, like those on board ship, “forward deployed” printers of this sort make items out of plastic only. In their case the problem with printing in metal is not constant movement but grit—for this is a much more sensitive process than printing in plastic. Even that limitation will be overcome, though, according to the United States’ Army Research Laboratory (ARL). The ARL is paying two firms to develop technologies which can turn blocks of metal into printable powder within the confines of a shipping container. The purpose of this is to recycle battlefield scrap into new equipment.

At the moment this “atomisation” process works like an old-fashioned shot tower. Molten metal poured in at the top of a chamber breaks into droplets that cool and solidify on their way down. But this requires a chamber at least six metres high, which is too tall to fit upright inside a standard shipping container. One of the firms the ARL has contracted, MolyWorks Materials of Los Gatos, California, has managed to shrink the process so that it does fit inside such a container. It does so by orienting the chamber diagonally, and employing jets of inert gas to stop the droplets touching the sides before they have cooled. If printers that make use of these solidified droplets can also be made rugged enough to withstand the battlefield, then broken parts themselves will become recyclable, supply chains may no longer need to deliver even raw materials and, the logistics taken care of, more thought can be given to the little matter of strategy. ■



军需补给线 无需运输

与其运送部件到战场，何不就地打印？

“外行谈战略，内行谈后勤。”这一军事准则的最新结果是，世界各地的武装部队已开始在前线采用3D打印技术。按需打印出坚实耐用的军用武器尚需时日（民用的已不成问题）。但如果只是更换破损的关键小零件（等于以前给马匹更换蹄铁），以此方式就地制造便极具潜力。要将替换部件通过漫长的补给链运往远方的舰船或基地可能需耗时数周。而且，如果战事正酣，这样的运输队正是诱人的袭击对象。然而，要邻近前线备存各类零件又不切实际。能适时按需制造最好不过。

在前线应用打印机甚至可以鼓励创新。例如，美国的杜鲁门号航空母舰在最近前往地中海东部及波斯湾执行任务时（始于2015年11月）就随船载有两台3D打印机。在海上航行的八个月里，舰上船员设计并打印出了更好用的油罐漏斗（可减少溢油）、电灯开关保护罩（防止人们撞到开关，无意中导致整个飞行甲板陷于一片黑暗），以及一种精心设计的、被称为“杜鲁门夹子”（TruClip）的小部件，可夹在对讲机上，加固连接，避免常因艰苦颠簸的海上作业而折断。杜鲁门号上的保养官艾尔·帕尔默中校（Al Palmer）称，单是这款夹子就节省了四万多美元的零件更换费用。相比之下，每台打印机的成本仅约为2000美元。根据自己的使用体验，帕尔默认为，3D打印将成为美国海军供给链的重要组成部分。

| 处理好粉末

目前，只有塑料制品可以在海上打印。在陆上使用打印机时则能打印金属物品——先用一层层的金属粉末构建成型，再以激光或电子束将其熔化，然后冷却成固体。但打印机和人一样，也会“晕船”。船舶前后左右摇摆不止，转动不息，会干扰金属粉末成型，无法进一步热熔成型。正是由于这一缘故，加拿大海军的一台船舶金属零件打印机安居陆地，留在新斯科舍省哈利法克斯（Halifax, Nova Scotia）的斯科特角（Cape Scott）军舰维修

厂里。

但假以时日，金属部件或许也可在海上打印。美国海军后勤部的工程主管阿尔门·柯蒂恩上校（Armen Kurdian）表示其所在部门正想办法克服船身不稳的问题。一个方法是把打印机安装在阻尼隔振平台上，通过补偿船只的运动来保持稳定。另一方法可能是将金属“墨”制成线状而非粉末状，因为金属线比一层金属粉尘更易固定就位，这种情况下，激光或电子束将对准金属线的尖端进行熔融操作。

军中将受惠于3D打印技术的不止水手。在中国军队里，除了制作棘轮这类基本部件外，打印机还被用于制作显示当地地形的立体地图。与纸质或屏幕上显示的地图相比，这种地图可帮助士兵更有效地部署作战行动。以色列空军则打印出强度堪比铝材的塑料部件，用于维修和保养上世纪80年代制造的飞机。美国正为澳大利亚、英国及法国政府提供3D打印的方案，目的是帮助这些盟国加速供给链，五角大楼负责该联合项目的海军陆战队上校克里斯·伍德（Chris Wood）说道。

未来三个月内，伍德还将指挥向欧洲、中东及太平洋地区的美国海军陆战队配送3D打印机。今年十月，加州彭德尔顿营（Camp Pendleton）的海军陆战队把一个船运集装箱改造成了坚固的“远征制造车间”，可通过卡车、船只、火车或飞机运输。除了一台3D打印机，该车间还包含一些常规机械设备。在北卡罗来纳州，另一类似的移动车间也正在建造。美国陆军也有所行动，已将一些3D打印机运往驻阿富汗的美军基地。

而现在，和已经装备在舰船上的打印机类似，这些“先期部署”的打印机也只能打印塑料制品。对它们来说，打印金属部件的难题不是摇晃不稳，而是砂砾，毕竟这是远比打印塑料更为精细的过程。但据美国陆军研究实验室（ARL）表示，这一局限也将被克服。ARL已聘请两家公司开发技术，以实现在集装箱车间内将金属块变成可打印的粉末。此举目的是将战场废料回收再造新设备。

目前，这一“制粉”过程就像老式的枪弹制作塔。从容器顶端倒入的熔融金

属分散成液滴，在下落过程中冷却固化。但这意味着容器至少要六米高，从而难以竖直放置在标准集装箱内。位于加州洛斯加托斯（Los Gatos）的一家ARL外包公司MolyWorks Materials成功将该过程压缩，令容器可置放于集装箱内。这家公司采用的方法是把容器沿集装箱对角线倾斜放置，并喷入惰性气体防止液滴在冷却前接触容器侧壁。假如这类以固化金属液滴为耗材的打印机能做得更坚固、足以抵御战场环境，那么损坏的零件本身将可循环再用，以后可能连原材料也无需供给链输送。而且，处理好后勤之后，军方便可将更多心思集中在战略这件小事上。 ■



Super-slippery surfaces

The last drop

From boosting the output of power plants to pouring ketchup, new fluid-repellent surfaces will help

FOR anyone (and that is almost everyone) who has shaken and thumped a bottle of ketchup to squeeze the last dollop out of it, or flattened and then rolled up a tube of toothpaste to eject one final squirt onto their brush, help may soon be at hand. For more than a decade Kripa Varanasi and his colleagues at the Massachusetts Institute of Technology (MIT) have been creating and studying slippery surfaces for use in industrial equipment such as steam turbines and desalination plants.

More recently, they have found ways to apply their ideas to create internal coatings for containers so that their contents will flow out easily and completely, with no shaking, thumping or squeezing. And now they think they have discovered a way to adapt these super-slippery coatings to steer liquids across flat surfaces, opening up the possibility of pumping fluids around without the need for pipes.

| *The lotus position*

Dr Varanasi's work started with what are known as super-hydrophobic water-shedding surfaces, a classic natural example of which is a lotus leaf. It repels water so effectively that droplets simply tumble off. The reason is that the leaf's surface is covered with microscopic structures which contain air pockets. This reduces the surface tension that would otherwise cause a water droplet to cling on. By coating the condensing areas used in steam turbines with similar surfaces his team believes it will be possible to speed up the shedding of water droplets. That would boost efficiency and, as most of the world's electricity is still generated by coal, gas and nuclear plants that rely on steam turbines, it would also save an awful lot of money.

The same idea has since been adapted to help move other substances, such as toothpaste, paint and ketchup. These have a gooeyness that means they can get into the air pockets and take a grip. To counter that, the researchers replace the air with liquids such as oils. The resulting surfaces are, in effect, self-lubricating—so that even the stickiest substances flow across them easily. The trick, says Dr Varanasi, is to have the right combination of surface structure and lubricating fluid, so that the oiling liquid does not get swept away by what is flowing over it.

To create a completely emptyable container for a substance, be it ketchup, toothpaste, shampoo or face cream, means matching that substance to a specific surface structure and a bespoke lubrication fluid. The best way to do this, says Dr Varanasi, is to design the texture of the surface to trap a lubricant which is itself derived from the substance with which the container will be filled. That also has the benefit of not contaminating the product should some of the fluid escape. A lubricant for a food product, for instance, might be derived from a natural oil which it contains.

Dr Varanasi's team have developed a database of recipes that can be used to lubricate containers for a wide range of materials. In 2012 he and one of his students, Dave Smith, founded a company called LiquiGlide, which is working with a number of consumer-goods firms such as Elmer's, an American gluemaker, to create easy-to-pour, squeeze and shake containers for their products.

LiquiGlide has also devised a variant of the system that can be applied to the vast number of vessels and pipes in factories. This, the company claims, could reduce production losses considerably. At the moment, the tendency of things like paints to stick to piping, mixing tanks and so on means that as much as 30% of the material may be lost, especially during clean-ups in batch production, as when switching to a different colour of paint.

One feature of Dr Varanasi's liquid-impregnated surfaces is that droplets forming upon them tend to have a large area of contact. It increases the effects of the surface's temperature on a droplet. And that got Dr Varanasi and David Quéré of ESPCI, a research university in Paris, and their colleagues thinking about how to exploit one of those effects, known as thermocapillary motion. A change in temperature can alter the surface tension of a droplet, causing it to move. Usually, very large temperature differences are needed even for a droplet to move slowly. Out of curiosity they devised an experiment using a surface texture impregnated with oil. As they report in *Physical Review Fluids*, the researchers applied a temperature gradient and recorded the movement of water droplets. Even with low changes in temperature the droplets skipped along their slippery surfaces. The group have subsequently upped the speed at which they can propel water droplets to a heady ten millimetres a second. That is ten times quicker than has been reported on conventional surfaces.

Dr Varanasi and Dr Quéré have several ideas for making use of this discovery by selectively heating and cooling different areas of the surface to steer the droplets around. One is to create new types of microfluidic devices—or labs-on-a-chip, as they are known colloquially. These one-shot machines, about a centimetre across, are being increasingly used for things like analysing blood. To work, they have to be able to move reagents around inside themselves through tiny pipes and valves. This movement is hampered by surface tension, the effects of which increase as the dimensions of the pipework diminish. Dr Varanasi and Dr Quéré think that by selectively heating and cooling different areas of a liquid-impregnated surface, they could move and mix fluids without such intricate plumbing.

Steering fluids around might also help with the group's work in developing more powerful condensers. It may even solve one of the problems of space flight. Much conventional equipment depends on gravity to move liquids around inside it. That does not work in orbit. But thermocapillary motion

would.

Meanwhile, back on Earth, most people might settle for saving even a little of what every year amounts to a massive lake of wasted condiments, bathroom products, creams and just about anything else that comes in bottles, containers or tubes. If Dr Varanasi has his way the days of shake and thump are numbered. ■



超光滑表面

最后一滴

从提升发电厂的发电量到挤番茄酱，新的疏液表面都能帮得上忙

把番茄酱瓶子摇来摇去、狠狠拍一拍，只为挤出最后一滴；把牙膏管压平再卷起来，把最后一截牙膏挤在牙刷上。对于任何有过这类经历的人（几乎是每个人）来说，也许很快就有帮手了。十多年来，麻省理工学院的克里帕·瓦拉纳西（Kripa Varanasi）和他的同事们一直在创造和研究光滑表面，用于蒸汽轮机和脱盐工厂等工业设备。

近来，他们已经找到办法实践自己的创意，给容器添加上内涂层。无需摇晃、敲打或是挤压，容器内的东西就能轻易地完全倒出。如今他们认为已有办法让这些超光滑涂层引导液体流过水平表面，这意味着可能无需管道便能循环输送液体。

| 模拟荷叶

瓦拉纳西的工作始于对“超疏水表面”的研究。这种表面在自然界中有一个典型的例子，就是荷叶。它非常拒水，叶面上的水滴会完全滚落。原因是荷叶表面覆盖着包含气穴的微观结构。这降低了表面张力，否则水滴应当能附着其上。瓦拉纳西的团队在蒸汽轮机的冷凝区涂上类似的表层，他们相信这样或许会加快水滴的滴落。这可以提高效率，而且由于世界上大部分电力仍由依赖蒸汽轮机的煤电厂、燃气电厂和核电厂产生，这样也能节省一大笔钱。

同样的想法改良后被用来帮助移动其他物质，如牙膏、油漆和番茄酱。这些物质有黏性，因而会陷入气穴中并产生附着力。为了对付这种情况，研究人员用油之类的液体替代空气。这样一来，表面其实是自润滑的，因此即便是最黏稠的物质也能轻易流出。瓦拉纳西指出，诀窍是正确选择表面结构和与之相匹配的润滑液，好让油性液体不被流经其上的物质冲刷掉。

为了造出能完全倒空的容器，无论里面装的是番茄酱、牙膏，还是洗发水

或面霜，都意味着要为这一物质找到相匹配的特定表面结构和定制的润滑液。瓦拉纳西说，最佳方法是设计出能够留住润滑液的表面质地，而润滑液本身就来自容器中填充的物质。这样还有另一个好处：即便有一些润滑液流失也不会污染产品。例如食品的润滑液可能源自食品中含有的天然油。

瓦拉纳西的团队已经建立了一个数据库，为盛放各类材料的容器罗列相对应的润滑配方。2012年他和学生戴夫·史密斯（Dave Smith）成立了一家名为LiquiGlide的公司。该公司与包括美国粘合剂生产商Elmer's在内的几家消费品公司合作，为它们的产品设计容易倒出、挤压和摇晃的容器。

LiquiGlide还设计出这一系统的不同版本，可用于工厂里大量的器皿和管道。公司称这可以大大降低生产损耗。涂料之类的东西容易黏在管道、混合槽等之中，这可能造成多达30%的材料损失，尤其是在转为批量生产另一种颜色的涂料时所进行的清理工序中。

瓦拉纳西的液体浸渍表面的特点之一是其上形成的液滴往往有很大的接触面积，因而加大了表面温度对液滴的影响。这让瓦拉纳西和巴黎一家研究型大学巴黎高等物理化工学院（ESPCI）的大卫·盖赫（David Quéré）及其同事不禁思索该如何利用其中一种被称作“热毛细运动”的效应。温度的变化能改变液滴的表面张力，从而让它移动。通常情况下，即便是让一滴液体缓慢移动也需要非常大的温差。出于好奇他们设计了一个实验，用的是浸渍了油的表面质地。根据他们在《流体物理评论》（Physical Review Fluids）中的报告，研究人员对温度变化做了梯度调整，并且记录下水滴的运动。即使温度变化很小，水滴也弹跳着掠过光滑的表面。之后，研究团队成功加快了水滴移动的速度，达到令人激动的每秒十毫米。这是常规表面上录得速度的十倍。

通过选择性地加热或冷却表面不同区域引导水滴移动，瓦拉纳西和盖赫对于怎么利用这一发现已经有了好几个想法。其中之一是发明新型的微流控器件（即人们俗称的芯片实验室）。这些一次性的机器宽约一厘米，正越来越多地运用于验血等方面。要运作起来，它们得让试剂能够通过微小的

管道和阀门在其内部移动。这种运动受到表面张力的阻碍，且管道系统的尺寸越小，这一阻碍的影响就越大。瓦拉纳西和盖赫认为，通过选择性加热或冷却液体浸渍表面的不同区域，他们无需使用这么复杂的管道系统即可移动并混合液体。

引导液体移动或许也有助于团队研发更强大的冷凝器。这甚至可能解决宇宙飞行中的一个问题。许多传统设备依靠重力让液体在其中移动。这在天体轨道中不起作用，但热毛细运动可以。

另一方面，在地球上，大部分人也许满足于节省哪怕一点点浪费掉的调味品、卫浴用品、面霜，以及瓶子、罐子或管子里装的几乎任何东西——每年积少成多，总量就非常可观。如果瓦拉纳西能成功，摇摇拍拍的日子就屈指可数了。■



Wireless communication

In a whole new light

Lighting fixtures that also transmit data are starting to appear

FLICKERING lamps are normally a headache-inducing nuisance. But if the flickering happens millions of times a second—far faster than the eye can see or the brain respond to—then it might be harnessed to do something useful, like transmitting data. That, at least, is the idea behind a technology dubbed Li-Fi by its creators.

Li-Fi works with light-emitting diodes (LEDs), an increasingly popular way of illuminating homes and offices, and applies the same principle as that used by naval signal lamps. In other words, it encodes messages in flashes of light. It can be used to create a local-area network, or LAN, in a way similar to the LANs made possible by standard, microwave-based Wi-Fi.

Such LANs would, Li-Fi's supporters believe, have two advantages over standard Wi-Fi. One is that light does not penetrate walls. A Li-Fi LAN in a windowless room is thus more secure than one using Wi-Fi, whose microwave signals pass easily through most building materials and can thus be listened to by outsiders. The other advantage is that light does not interfere with radio or radar signals in the way that microwaves sometimes do. Li-Fi can therefore be installed in hospitals, nuclear plants and other sites where Wi-Fi might create dangerous interference with electronic kit.

One business about to benefit from this selectivity is commercial aviation. Though aircraft avionics have been hardened over the years, to reduce the risk of interference from radio and microwave signals, using Li-Fi would make absolutely certain. It would mean that LANs could be set up in the cabin, distributing entertainment to passengers and permitting those with Li-Fi-equipped phones and computers to contact the outside world.

This arrangement would also save on weight, as passenger-entertainment systems would no longer have to be fed by cables. To this end Airbus, a big European aircraft-maker, let Velmenni, an Indian firm, spend six months earlier this year installing and testing a Li-Fi network in a mocked-up passenger cabin of one of its planes. Velmenni hopes to use passengers' reading lights to broadcast the signal. Luciom, a French firm, is even further advanced. In January 2017 it will begin installing Li-Fi on passenger jets built either by Airbus or by its American rival, Boeing (a non-disclosure agreement forbids it from saying which one).

In the longer run, though, it is buildings that Li-Fi's manufacturers have their eyes on. PureLiFi, a British firm that sells components to lighting manufacturers, plans to use the same cable to carry power and data to the LEDs themselves. That should make the system simple to install. PureLiFi is also designing LEDs that radiate data even when dimmed, so that a film can be streamed into a room and shown with the lights down.

Installing a Li-Fi LAN, then, should not be too difficult. But for the technology to succeed, computers, phones and other signal-receiving devices will also have to be modified, so that they can pick up and reply to optical transmissions. To give that capability to existing kit engineers at Luciom have made a dongle that plugs into a standard USB port. This dongle contains both an ordinary LED (though it is one that emits infra-red flashes, which are invisible to the human eye) to send data to the LAN, and the opposite of an LED—a photodiode that converts light into electricity rather than the other way around—to receive data.

PureLiFi, looking further ahead to a time when Li-Fi has become routine, is miniaturising such components with the intention of embedding them into devices at the point of manufacture. Nor is it alone in this desire. Zero.1, based in Dubai, says it has managed to tweak the cameras in the latest smartphones to run Li-Fi. Perhaps more pertinently, the intentions of

Apple, the world's most valuable listed company, were revealed earlier this year when it emerged that the term "LiFiCapability" is buried in the code of the iOS 9.1 operating system used by one of its most successful products, the iPhone.

Li-Fi may spread outdoors, too. Sunlight spoils its signals during the daytime, but in the hours of darkness Li-Fi-enabled streetlamps should work perfectly well. Gabe Klein, an entrepreneur who was once the boss of Chicago's transport department, says the city has begun testing the idea of adding Li-Fi to the LED-based street lighting now being installed there. One potential beneficiary of this idea, if it succeeds and spreads, is Trópico, a Brazilian streetlamp-maker. According to Daniel Auad, Trópico's owner, the Li-Fi-enabled streetlamps the firm is now working on should sell for about \$325 a piece—a premium of only \$75 over the non-enabled variety.

The technology may even be co-opted as a navigation tool in places, such as many buildings, that signals from the satellite-based global-positioning system cannot reliably penetrate. In this case the flickering LEDs act not as message-carriers but as beacons, permitting suitably equipped devices to locate themselves. Luciom has already installed such beacons in the ceiling lights of Orly airport, near Paris, and in a hypermarket in Lille. In Orly, the beacons (which are currently under test and used only by employees) will eventually show passengers to, for instance, the correct baggage carousel for their flight. In the hypermarket they direct shoppers with a Luciom dongle on their smartphones to the locations of desired items.

Li-Fi, then, seems to be developing as a useful addition to the list of ways electronic devices can communicate. That it will actually replace conventional Wi-Fi seems unlikely. But by extending the amount of spectrum available for communications it may, as it were, lighten the load. ■



无线通讯

灯里觅网

可以传输数据的照明器材登台亮相了

闪烁的灯光通常是个让人头疼的烦心事，但如果闪烁的频率为每秒数百万次——眼睛和大脑远不能辨识或反应——那么也许可以利用这种闪烁做点有用的事情，比如传输数据。至少这是一种技术背后的理念，其发明者称之为Li-Fi。

Li-Fi利用的是发光二极管（LED，家居办公越来越常用的照明方式），原理和海军信号灯一样。换言之，Li-Fi利用闪光将信息编码，可用于创建局域网，和以标准微波为基础的Wi-Fi异曲同工。

Li-Fi的支持者认为，这种局域网较之标准Wi-Fi有两大优势。一是光线不会穿透墙壁。在无窗的房间里使用Li-Fi局域网要比用Wi-Fi更加安全，这是由于Wi-Fi的微波信号可以轻易穿透大部分建筑材料，因此也就可以为外人监听。另一个优势是光线不会干扰无线电或雷达信号，微波有时则会。因此可以在医院、核电站和其他Wi-Fi有可能对电子设备产生危险干扰的环境中部署Li-Fi网络。

将从这一信号选择性中受益的一个行业是商用航空业。尽管机载航空电子设备多年来已经得到加强，以降低受无线和微波信号干扰的风险，而使用Li-Fi则会保证万无一失。这将意味着可以在机舱部署局域网，为乘客提供娱乐节目，还可允许使用Li-Fi网络的手机和电脑的乘客与外界联系。

使用Li-Fi局域网还可以减轻机身重量，因为旅客娱乐系统不再需要依靠电缆传输内容。鉴于此，今年早些时候欧洲飞机制造商空客公司委托印度公司Velmenni花费六个月的时间在一架空客飞机的模拟客舱中安装并测试了Li-Fi网络。Velmenni希望利用旅客的阅读灯来传输信号。法国公司Luciom则更进一步，将于2017年1月开始在空客或其美国竞争对手波音公司（保密协议禁止其公开到底是哪一家公司）所生产的客机上部署Li-Fi网

络。

不过更长远来说，Li-Fi制造商们真正看中的是楼宇。英国公司PureLiFi向照明设备制造商出售元件，计划使用同一根电缆同时向LED输送电力和数据，这会让系统安装变得简单。PureLiFi还在设计即使在灯光调暗时也能传播数据的LED，这样在灯光调暗时也可以使一部电影通过网络播放。

这样说来，部署Li-Fi局域网应该不太难。但这项技术要想成功，电脑、电话和其他信号接收设备也都将需要调整，以接收和回应光信号传输。为了让现有电子设备具备这种能力，Luciom的工程师研发出了一个可以插入标准USB接口的适配器。这个适配器既包含一个向局域网发送数据的普通LED（不过它发出的是人眼看不到的红外线），还有一个与LED工作原理相反的用于接收数据的光电二极管（它将光能转化为电能而不是像LED那样将电能转化为光能）。

PureLiFi考虑到未来Li-Fi将变为常用网络，现正在缩小元件尺寸，以便在未来大规模生产时可嵌入到相关设备中。有此打算的不止这一家公司。迪拜的Zero.1公司表示它已成功改进了最新款智能手机的相机，使之可以运行Li-Fi。与此关系最密切的可能是世界上市值最高的上市公司——苹果公司的打算。年初得知，苹果公司将“Li-Fi功能”（LiFiCapability）一词加入了iPhone（苹果最成功的产品之一）所用的iOS 9.1操作系统代码中，其意图不言自明。

Li-Fi网络也可扩展至户外。白天日光会破坏Li-Fi的信号，但在夜间，装有Li-Fi的路灯应该完全不会受到干扰。曾任芝加哥交通部门主管的加布·克莱因（Gabe Klein）现在是位企业家，他说芝加哥市已开始在市內正在安装的LED路灯上尝试加装Li-Fi。如果这种做法能够成功且得到推广，巴西的街灯制造商Trópico将会是潜在受益者。Trópico公司的老板丹尼尔·阿瓦德（Daniel Auad）说，公司如今正在生产的Li-Fi路灯单价应该可以卖到325美元左右，比非Li-Fi路灯仅高出75美元。

这项技术甚至可能在一些地方和其他技术并用作为导航工具，比如在很多

建筑物中，基于卫星的全球定位系统发出的信号很难穿透建筑材料。在这种情况下闪烁的LED灯的作用不是信息载体，而是信号灯，允许具有相应设置的设备进行定位。Luciom已经在巴黎附近的奥利机场（Orly airport）和里尔一家大型超市的顶灯中安装了这种信号灯。在奥利机场，信号灯（目前尚在测试阶段，仅限员工使用）最终将能为旅客提供指引，比如说旅客所乘航班行李传送带的具体位置。在里尔的超市里，通过顾客智能手机上安装的Luciom适配器，信号灯可以引导他们前往所要购买物品的位置。

这样看来，Li-Fi似乎在已有电子设备通讯方式的基础上又添加了一种有用的方式。最终取代常规的Wi-Fi网络似乎不太可能，但通过扩展可用于通讯的光谱数量，它或许能减轻网络的负载。■