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Change agents

Bill Gates famously noted: "We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten."

This mismatch between our short- and long-term expectations has huge implications for technological progress and innovation, not least for investors; invest too soon and you are likely to fail as the world may not be ready for your visionary idea, invest too late and you risk missing the boat.

Being a good investor requires the imagination and foresight to peek into the future, while grounding such intuition in cold, hard and practical reason. With *A/Q*, we always try to delicately balance these two competing modes of thinking. As any investor will tell you, achieving it is not easy.

This edition starts with a column on the darker side of Big Tech, delving into some of the conundrums and inconsistencies thrown up by the marriage of ESG and technological progress. We follow this with two features on how governments are upping the regulatory ante to curb tech's growing influence in the West and in Asia.

Quantum Leap is an example of us trying to peer around the corner and see what game-changing technology lies ahead. But we do so with a heavy dose of realism, looking at the real-world impact of quantum computing today. As technology platforms proliferate, we also examine the business case and impact for brands looking to cut out the middlemen and go direct to consumers (so-called D2C).

Notwithstanding the need for significant behavioural change, if there is one area where technological breakthroughs are desperately needed it is in tackling the threat of climate change. In *Wild Solutions*, we offer a visual guide to the most promising nature-based and man-made solutions.

The Anti-Social Network looks at hate speech and asks whether social media companies face a day of reckoning. And finally, *Levelling Up* takes readers through the accelerating digitisation of manufacturing and construction.

As always, we welcome your feedback so please send any comments to me at the email address below.

I hope you enjoy the issue.

Rob Davies,
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Aviva Investors

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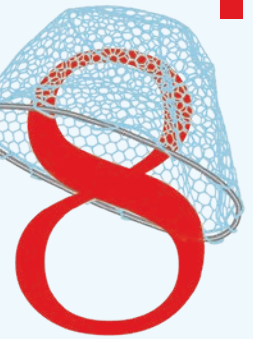




REGULATION

THE REGULATORY CHALLENGE TO BIG TECH

In a two-part feature, we explore how Western regulators and their Chinese counterparts are trying to rein in the tech giants – with mixed results.



OPINION

INVESTORS SHOULD CONFRONT THE DARK SIDE OF TECH

Investors need to challenge unethical and unsustainable practices in the tech industry, argue Louise Piffaut and Charles Devereux.



CLIMATE CHANGE

IN SEARCH OF WILD SOLUTIONS

We flag different pathways to address warming gases in the atmosphere: five nature-based, and five technical.



COMPUTING

QUANTUM LEAP

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SOCIAL MEDIA

THE ANTI-SOCIAL NETWORK

Facebook, Twitter and other platforms are drawing criticism for their failure to tackle hate content. How can investors make a difference?



DATA AND D2C

IN BRANDS WE TRUST

The tech-driven trend toward direct-to-consumer (D2C) is transforming consumer brands, their intermediaries and their marketing.



DIGITALISATION

LEVELLING UP

Construction and manufacturing firms are making digital upgrades, boosting productivity and creating opportunities.



INVESTORS SHOULD CONFRONT THE DARK SIDE OF TECH

Technology firms are often favoured by ESG funds because of their ostensibly clean, asset-light business models. But investors need to look deeper and challenge unethical and unsustainable practices across the industry, argue Louise Piffaut and Charles Devereux.

Communications technology was a lifeline for many people during the darkest months of the coronavirus pandemic. Video calls and messaging platforms kept families connected and businesses were able to continue operating as workers decamped from office suites to kitchen tables.

Thanks to soaring demand for their products, technology giants such as Alphabet, Facebook and Microsoft have seen their market valuations soar over the past 12 months. And this has boosted many environmental, social and governance (ESG) funds, which tend to have large exposures to the technology sector. A recent study found information technology was the sector with the largest allocation among the 20 biggest ESG funds tracked by MSCI.¹

On one level, the tech bias among ESG investors is understandable, and not simply because the industry offered societal benefits during the pandemic. Technology offers vital access to information and education for many communities, especially in poorer countries. Unlike manufacturing or energy companies, most tech firms do not have an obvious environmental footprint, and consequently sidestep the exclusionary barriers used by some ESG investors.

But fund managers should always be wary of focusing on business models while disregarding the impact of business practices – and the business practices of many tech firms warrant closer scrutiny.

Data's carbon footprint

Start with environmental impact. Perhaps surprisingly, given the intangible nature of the digital world, tech companies are either directly or indirectly responsible for significant carbon emissions.

It is true digital solutions are often cleaner than the alternatives: for example, by speaking over a video call rather than meeting physically, we avoid transport-related emissions. Nevertheless, every online activity – from sending an email to streaming a Netflix series or Spotify track – uses a small amount of energy. Repeated and multiplied on a global scale, these emissions add up.

An academic study published in 2018 estimated the relative contribution of the information and communication technology (ICT) industry to global greenhouse gas emissions could hit 14 per cent by 2040, or around half the relative emissions of transport, as of 2016. Electricity used to power smartphones accounts for a large proportion of the projected increase.²

These striking findings illustrate a salient fact: data is not environmentally costless. Sprawling, temperature-controlled data centres are required to process and manage the vast amounts of information produced by an ever more densely interconnected world. Obtaining accurate figures on the energy usage of data centres is difficult, but some recent estimates suggest they accounted for one per cent of global electricity consumption, as of 2019, equivalent to 18 million US households. Demand for data processing is only set to grow further in the era of cloud computing and the Internet of Things.³

Tech firms such as Alphabet and Microsoft have made efforts to source renewable energy to power their data centres in recent years; both firms have also announced new innovations such as storing these facilities

underwater to keep them cool, saving on power.⁴ While these are welcome initiatives, many data centres still run on electricity from non-renewable sources. As of 2019, renewable energy accounted for only 12 per cent of the power used by some of Amazon's largest US data centres, and its cloud services operations were expanding without any corresponding increase in the use of renewables.⁵ Tech firms ultimately have a responsibility to find cleaner, more efficient ways of running their businesses.⁶

Tax and the social fabric

Tax is another major issue that should be on tech investors' radar. Many multinational companies are adept at what's known as base erosion and profit shifting (BEPS), exploiting mismatches in international law to ensure their liability falls in lower-tax jurisdictions, and tech firms are among the worst offenders. The Organisation for Economic Cooperation and Development estimates governments lose out on \$100-240 billion every year due to BEPS, money that could be spent on education, healthcare, infrastructure, or solutions to the climate crisis.⁷

The basis of ESG investing should be to reward companies that contribute to the creation of shared value. By depriving nations of tax revenues that should be available to fund vital services, BEPS schemes violate this principle; in that sense, tax is a social issue. Tech platforms may seem detached from the real world, but tax avoidance has a profound impact on the communities their employees, customers and stakeholders inhabit.

G7 policymakers are thrashing out the details on a coordinated plan that aims to close the relevant loopholes and force large companies to pay tax in countries where they take large profits, whether or not they have a physical presence there.



Louise Piffaut and Charles Devereux are ESG analysts at Aviva Investors.

The Biden administration is also pushing for a global minimum corporate tax rate of at least 15 per cent.⁸ Such moves are to be welcomed, provided the resulting revenues are fairly distributed between high and low-income countries. Additional tax revenues could be used to invest in programmes that strengthen the social and economic fabric, improving our collective resilience for when the next global crisis hits.

Governance and inclusion

A third key concern relates to the 'g' in ESG. Many firms have dual-class share structures, which effectively allow the founders of these companies to retain significant control; for example, Facebook's Mark Zuckerberg and Alphabet founders Larry Page and Sergey Brin have majority voting powers.

The strong market performance of Big Tech over the past decade has gone some way to mitigating investor discontent – but pressure to reform these companies' governance structures is starting to build. In 2020, more than 30 per cent of Alphabet shareholders voted in favour of a resolution to abolish the dual-class shares, on the

basis such structures tend to entrench the positions of senior executives and insulate them from external pressure and scrutiny.

Technology firms are gaining more power in society, and rapidly introducing innovations that generate thorny ethical questions. Think of the data privacy issues raised by artificial intelligence and facial recognition algorithms, the debate around the responsibility for moderating hate content and the role of fake news in influencing democratic outcomes, or the worrying lack of safeguards to keep children safe online.⁹ In this context, good governance, including independent boards to properly hold executives accountable, becomes vital.

Governance is related to another key issue: diversity and inclusion. The executives that wield the power in these organisations tend to be overwhelmingly white and male, and, despite improvements in transparency on gender and ethnicity reporting in recent years, progress remains slow. Google's latest diversity report shows that, as of 2020, only 3.7 per cent of its US employees, and 2.6 per cent of its leaders, identified as black; of the leaders in its global workforce, only 26.7 per cent were women.¹⁰

“*The executives that wield the power in tech organisations tend to be overwhelmingly white and male*”

Each of these issues warrants further study among investors. We cite them here not because we have all the answers, nor because we think investors should shun the industry altogether. The point is that investors need to be clear-eyed when assessing the ESG implications of Big Tech and, where possible, engage with these firms to improve their practices. After all, progress was never achieved by turning a blind eye to difficult problems ●

1 Rumi Mahmood, 'Some of these ESG funds are not like the others', MSCI Research, April 19, 2021.

2 'Assessing ICT global emissions footprint: Trends to 2040 and recommendations', Journal of Cleaner Production, March 10, 2018. Volume 177, Pages 448-463.

3 George Kamiya, 'Tracking report: Data centres and data transmission networks', IEA analysis, June 2020.

4 John Roach, 'Microsoft finds underwater data-centers are reliable, practical and use energy sustainably', Microsoft, September 14, 2020.

5 Daniel Oberhaus, 'Amazon, Google, Microsoft: Here's who has the greenest cloud', Wired, October 12, 2019.

6 See the recommendations of the Science Based Targets initiative for network and data centre operators: 'Guidance for ICT companies setting science based targets: Mobile networks operators, fixed networks operators and data centres operators', Science Based Targets initiative (SBTi), April 2020.

7 'What is BEPS?', OECD.

8 'US Treasury says G7 expected to endorse U.S. global minimum tax proposal', Reuters, June 3, 2021.

9 Of 100 major technology companies assessed by the World Benchmarking Alliance's Digital Inclusion Benchmark in 2020, only 16 demonstrated a high-level commitment to child online protection. See 'Measuring the world's 100 most influential tech companies', World Benchmarking Alliance, 2020.

10 'Google diversity annual report 2020', Google, 2020.



THE TAMING OF THE FEW

Regulatory authorities around the world are targeting the big US tech giants. However, while investors need to keep a watchful eye on developments, Big Tech's stranglehold and influence on numerous economic sectors will be hard to loosen.

Alfred Chandler, a leading US business historian, once described the post-civil war US economy as “ten years of competition and 90 years of oligopoly”. His observation feels as true as ever, with Big Tech representing the latest incarnation of his prophecy.

One of the latest antitrust accusations is a charge that certain companies are undermining democracy by facilitating the exponential growth of fake news and extremist content and failing to tackle the malign actions of hostile states. The lengthening list of complaints also includes claims social media addiction is a growing problem, data privacy is being undermined, and Big Tech companies are failing to pay their fair share of tax.

The success of Apple, Amazon, Alphabet (parent company of Google), and Facebook has led to an exponential increase in their market worth, in turn delivering stunning returns for investors. As of June 29, their collective worth was \$6.66 trillion – 13 per cent more than the largest 100 British, 30 German and 40 French companies combined.¹

Unfortunately for shareholders, the rapid increase in share prices has drawn the attention of regulators around the world and led to potentially the most damaging complaint of all: that these companies have become too powerful and are behaving in an anti-competitive way.

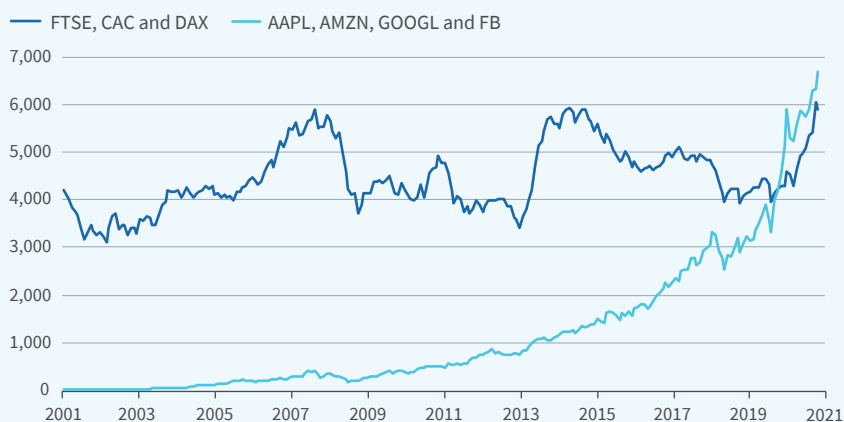
By exploiting their scale and network effects, firms are accused of crushing would-be competitors and suppliers in markets such as e-commerce, app stores, social media, internet search and cloud services.

The European Union, long considered the world's most aggressive regulator of Big Tech, released long-awaited drafts of its Digital Services Act (DSA) and Digital Markets Act (DMA) at the end of last year. One of the key aims of the legislation is to ensure ‘gatekeepers’ will not be allowed to use “unfair practices towards the business users and customers that depend on them to gain an undue advantage”. The EU has also filed antitrust charges against Amazon.

From scrappy start-ups to monopolies

Suddenly, having for years avoided clashes with Washington, tech companies have begun to attract the unwanted attention of authorities there, too. In October 2020, US lawmakers said Amazon, Apple, Facebook and Alphabet had turned from “scrappy” start-ups into “the kinds of monopolies we last saw in the era of oil barons and railroad tycoons”. In a scathing 449-page report presented by the House Judiciary Committee's Democratic leadership, companies were said to have abused their dominant positions, setting and often dictating prices and rules for commerce, search, advertising, social networking and publishing.²

Figure 1: Big Tech stocks soar (combined market values \$ billion)



Source: Eikon Datastream, Aviva Investors' calculations, as of June 2021.



THE TAMING OF THE FEW *continued*

The list of charges includes allegations that Apple harms app developers by taking a big cut of their revenue and pre-installing its own apps on its devices to encourage phone owners to use them rather than potential rivals such as Spotify; that Google favours its own products in search results over those of third-party search engines such as TripAdvisor; and that Amazon uses business data to gain an unfair advantage over merchants operating on its platform.

Facebook also faces accusations its \$1 billion purchase of the photo-sharing app Instagram in 2012, and \$19 billion acquisition of the global messaging service WhatsApp two years later, were driven by a desire to take out potentially harmful competitors.

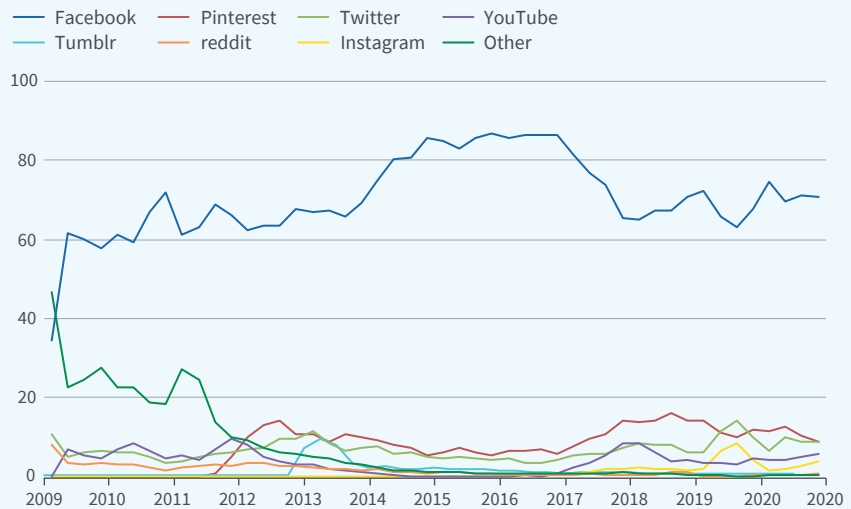
In what appears to be an incriminating series of emails sent in 2012, six weeks before Facebook acquired Instagram, chief executive Mark Zuckerberg wrote that one of his motivations for the purchase was to “neutralize” a potential competitor.³

Other countries have jumped on the bandwagon. Among a slew of complaints, Australia’s competition regulator has accused Google of misleading consumers to get permission for use of their personal data for targeted advertising; Britain’s watchdog has opened an investigation into Apple over its terms and conditions for app developers; China is preparing to launch an antitrust probe into allegations Google has leveraged the dominance of its Android operating system to stifle competition; and Canada and India are investigating whether Amazon’s practices hurt local companies and consumers.

Some commentators, such as David Teece, a global business professor at UC Berkeley’s Haas School of Business, see little need for regulators to get involved. He argues that so long as the opportunity to compete is kept wide open, market forces will take care of dominance as smaller companies are more entrepreneurial and nimbler.⁴

Others are less convinced. Annabelle Gawer, Professor in the Digital Economy

Figure 2: Facebook’s dominance of social media



Source: statcounter, shows % market share of browser usage based on page views.

at the University of Surrey, while expressing her respect for Teece’s work, says Big Tech companies need to be viewed through a different lens to traditional ones since they operate in a fundamentally different way.

She argues platform companies such as Amazon, Facebook, Google and Apple have created network effects by building technologies that have acted as a magnet, towards which many third-party businesses and innovators, such as developers of apps and web services, gravitate.

“The opportunity for new entrants to compete is not wide open, because these companies have been able to erect high barriers to entry via exclusivity arrangements, denial of interoperability, self-preferencing, or the deliberate obstruction of users switching from one platform to the other,” says Gawer, an advisor to both EU and UK lawmakers.

While Chinese companies could theoretically pose a threat at some point, this seems some way off. For the time being, the main competitive threat is from each other. As each firm’s tentacles get ever longer, they are starting to encroach on each other’s turf.

For example, privacy updates on Apple’s operating system will allow users of its iPhones to prevent apps from collecting their data. This has led to a dispute with Facebook, which relies on collecting user data to power effective advertising. Zuckerberg has complained the changes were driven by concerns over competition rather than privacy. However, even if one firm seriously damages another, the problem will most likely be exacerbated, not lessened, by increasing the concentration of power.

Big Tech, big problem

According to Atlantic Equities technology analyst James Cordwell, there is now a widespread feeling Big Tech is a big problem. He points to two of US President Joe Biden’s more high-profile appointments as evidence of what could be a decisive and seismic shift in attitudes within Washington. In March, Biden hired Timothy Wu to the National Economic Council as special assistant to the president for technology and competition policy, a newly created position. Later that month, he nominated Lina Khan to become a commissioner at the Federal Trade



Current laws are unsuitable for addressing the challenges posed by Big Tech's dominance



Commission. Wu and Khan, both antitrust lawyers, are prominent critics of the way Big Tech companies abuse their market power.

“Given what is going on in Washington, and indeed Europe and elsewhere, there’s a high probability changes are coming. The challenge is defining their precise form and timing,” Cordwell says.

While turning up the heat on companies is one thing, taking action to limit their power meaningfully is another entirely. First, authorities need to decide whether to use antitrust legislation to try to foster more competition or instead accept dominant online platforms as natural monopolies or oligopolies. The latter would involve regulating them as such and limiting how much money they can make. Whichever method they choose, taming Big Tech will not be easy.

Cordwell believes the US, given its aversion to big government, would rather go down the former route, which would explain Biden’s appointments of Wu and Khan.

Outdated legislation

If this is true, legislation that better reflects the modern economy will be needed as current laws are unsuitable for addressing some of the challenges posed by Big Tech’s dominance.

As a law student at Yale University, Khan wrote a paper in 2017 entitled “Amazon’s Antitrust Paradox”, which captured significant attention. In it, she argued that gauging real competition in the twenty-first-century marketplace – especially in the case of online platforms – requires analysis of the underlying structure and dynamics of markets.⁵

In recent years, competition authorities in the US, and to a lesser extent the EU, have primarily constructed cases against companies where they deem there to have been a loss of consumer welfare. But judging Big Tech companies by this yardstick is problematic.

In her paper, Khan said Amazon engaged in predatory pricing behaviour to drive

competitors such as Quidsi, at the time one of the world’s fastest growing e-commerce companies, out of business. Having achieved that goal, it then put prices up. While predatory pricing technically remains illegal, proving it is not easy. US courts require evidence the alleged predator would be able to raise prices and recoup its losses.

“In any case, the trouble with traditional competition approaches is these tech companies’ competitive advantages go beyond pricing power or market share,” explains Aviva Investors’ senior ESG analyst Louise Piffaut.

She says much of the explanation for their success is that, partly through acquisitions, these companies have been able to create business ecosystems that have allowed them to bundle services together, thereby locking in their customers.

In a landmark antitrust case of 2001, the US government successfully argued that Microsoft had illegally maintained its monopoly position in the personal computer market primarily through the legal and technical restrictions it put on rival PC manufacturers and users to uninstall Internet Explorer and use other programs such as Netscape and Java.

Although cases could arguably be constructed against Apple, Alphabet, Amazon and Facebook on similar grounds, Piffaut believes they would not be easy to win.

Further complicating the picture, while the likes of Google and Facebook may at first glance appear to be handing out their services for free, the reality is less simple. As Piffaut points out, companies are reaping ever-bigger rewards by harvesting their customers’ data and monetising it with advertisers.

Tristan Harris, one of the stars of the 2020 Netflix docudrama *The Social Dilemma* and former Google design ethicist, put it presciently: “If you’re not paying for the product, then you are the product.”

Some are calling for regulators to try to inject more competition by making it easier for

consumers to take their data to rival companies. However, while data portability may sound like a good idea, there are doubts it would work in practice. After all, it would require extensive coordination by users of a platform. Equally, start-ups require access to large amounts of data at once, not piecemeal access to individual customers.

“People say data is the new oil and there is something good in that analogy because oil out of the ground is not much use; it’s how it’s refined that is important. Similarly, your data is next to useless to most people. It’s how Facebook or Google use data that makes it valuable. I don’t think data portability necessarily solves anything,” Cordwell argues.

Conflicts of interest

Furthermore, there is an inherent tension between antitrust and data privacy laws. For example, were regulators to look to reduce the power of Facebook by making it easier for a customer to take their data elsewhere, that could potentially invade the privacy of their network of friends.

“One of the unhelpful things around this debate is the issue is really one of antitrust and power, yet a lot of the conversation focuses on privacy. In some ways, those two are kind of pulling in opposite directions in terms of the remedies you would be putting in place,” says Cordwell.

Even though some US politicians think dominant tech firms can help them stay ahead of China, the need to modernise antitrust laws to rein in Big Tech is one of the few areas where there appears to be bipartisan support. Few think the process will be quick, however.

In any case, it is unclear how much an updated rulebook will help given the difficulty regulators have in defining the markets in which companies operate.

“The fundamental problem is that while antitrust works very well when you have a clearly defined market and can measure market power in terms of price differential, the kind of competitive abuses Big Tech is

THE TAMING OF THE FEW *continued*

being accused of are of a totally different nature, because price (on one side of the platform) for users is often set at zero,” Gawer says.

The fact these businesses are complex, hard to understand, and evolving rapidly, will make it doubly difficult to draft effective legislation that stands the test of time.

Global divergence

Although global regulators would ideally agree on a common roadmap, this looks unlikely. For example, Europe appears to want to regulate Big Tech companies as if they were public utilities. This is not surprising when one considers it has been employing antitrust legislation against big US tech firms for the past decade without much success.

“Europe mobilised antitrust ten years before the US, was not happy with the result, and said we have to take another tack,” says Gawer.

Following a probe that lasted seven years, Brussels in 2017 hit Google with a €2.4 billion fine for abusing its near monopoly in online search to “give illegal advantage” to its own shopping service. A year later it fined the firm €4.34 billion for abusing its power in imposing conditions on mobile phone manufacturers and operators. A third antitrust lawsuit resulted in a €1.49 billion fine in 2019 for online advertising abuse. Yet Gawer says the fines had little observable effect on the behaviour of the firm, which is appealing the latest two penalties.⁶

Thierry Breton, EU commissioner for the internal market, recently said: “There is a feeling in Brussels that online platforms have become ‘too big to care.’”⁷

With its DMA and DSA legislation, Europe is set to become something of a global test bed for data regulation and the growing power of tech companies. The former seeks to place new restraints on platforms. It will set out rules, so it is clear which activities are illegal without regulators having to launch lengthy antitrust investigations to

prove damage to consumers. It will also seek the power to launch market investigations in different sectors of the economy where new gatekeeper platforms could potentially emerge. As for the DSA, it will introduce new obligations on platforms to disclose to regulators how their algorithms work, how decisions to remove content are taken, and the way advertisers target users.

In a report to the European Parliament, of which she was the main author, Gawer said while the DSA and DMA draft legislation were sensible starting places, efforts to apply a single, one-size-fits-all code of conduct across the big platforms were misguided.⁸

Whether the legislation can help curb the power of Big Tech, as and when it comes into force, is questionable. According to Carmelo Cennamo, professor of strategy and entrepreneurship at Copenhagen Business School, and D. Daniel Sokol, professor of law at the University of Florida, the new rules may do little to promote competition and innovation, and could even stifle them.

“The EU is a cautionary tale of the unintended consequences of applying broad regulatory fixes to a rapidly evolving landscape,” they wrote in an article for the *Harvard Business Review*.⁹

Data protection

In 2018, Europe introduced what many consider to be the strictest and most far-reaching data protection and privacy laws ever passed. The General Data Protection Regulation imposes tight data protection requirements and heavy penalties for non-compliance for any business around the world that collects or processes EU resident data. Other jurisdictions around the world are taking cues from it to develop their own frameworks.

While that is forcing major changes in the way companies handle data, there are doubts the legislation will hinder the biggest companies. Indeed, one of its

“

Europe appears to want to regulate Big Tech companies as if they were public utilities

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adverse consequences could be that it strengthens their position.

“GDPR really impacts your ability to follow people about and cross-pollinate data between platforms. In doing so, it has created a higher barrier to entry for smaller platforms,” says Piffaut.

Giles Parkinson, global equities portfolio manager at Aviva Investors, agrees. “I see it benefitting the bigger platforms over smaller publishers. You’ve made a mental permission for them to use your data as you’re giving them your most intimate secrets anyway,” he argues.

Break up

Breton believes some Big Tech companies might need to be split up if they continually violate the spirit of the rules.¹⁰ Any efforts by Europe to break up a big US tech company could provoke a backlash in Washington were they to be seen as an effort to advantage European companies, or likely to increase the relative power of a Chinese rival.

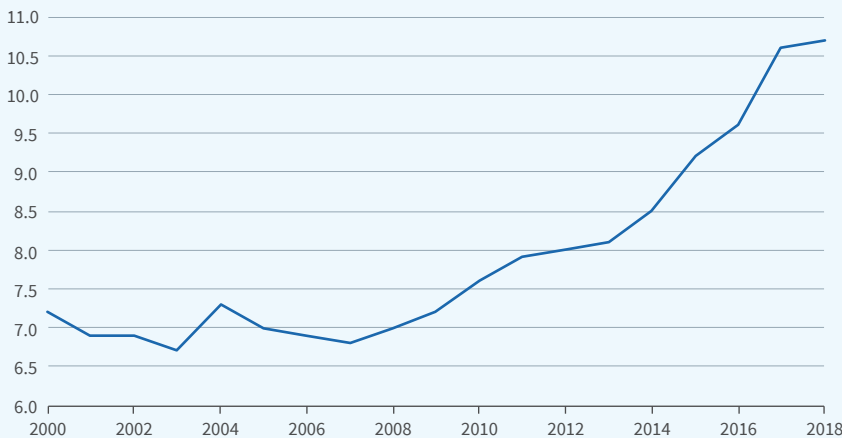
Then again, the threat of breaking companies up is coming from the other side of the Atlantic too. In December 2020, the Federal Trade Commission (FTC), the US competition watchdog, along with the attorneys general of 46 states, the District of Columbia, and Guam, sued Facebook, alleging it is “illegally maintaining its personal social networking monopoly through a years-long course of anticompetitive conduct”. It says it may force it to divest assets, including Instagram and WhatsApp.¹¹

However, Cordwell is sceptical that will happen. “It’s quite hard to argue Facebook has a monopoly. The FTC is trying to do it by defining the market in quite narrow terms but whether that can legally be argued I think is a real sticking point,” he says.

Notwithstanding Breton’s remarks, Gawer believes it is highly unlikely Europe will try to break up Facebook, or any of the other Big Tech companies. “I see the



Figure 3: Rising US youth suicides



Note: Deaths per 100,000 population persons aged 10-24. Source: U.S. Department of Health and Human Services, as of September 11, 2020.

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Tax authorities are also
turning up the heat on
Big Tech
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rhetoric of breaking up companies as a bit of theatre designed to catch their attention, but I don't envisage a complete bust up,” she says.

That said, whereas in the past these firms have all too easily been allowed to cement their dominant position by acquiring potential rivals, that will be extremely difficult, if not impossible, in future.

“These companies have gotten away with a variety of acquisitions they won't be able to get away with any longer,” Gawer says.

At Khan's confirmation hearing before the US Senate in April, Democrat Senator Amy Klobuchar, who is pushing forward legislation that would effectively bar the biggest firms from using mergers to get any larger, said: “For too long mergers have gone unchallenged.”¹² Khan herself called for greater vigilance, adding “in hindsight there's a growing sense that some of those merger reviews were a missed opportunity.”¹³

But does this matter? As these companies now boast such dominant market positions, the inability to take out smaller would-be rivals is unlikely to be particularly troubling for now.

A taxing problem

Competition authorities are not the only ones turning up the heat on Big Tech; tax authorities are too. For years, most of the US tech giants have been paying very low levels of taxation around the world, despite eye-watering market valuations and growth rates.

According to a 2019 report from UK not-for-profit company Fair Tax Foundation Limited, between 2010 and 2019, Google, Amazon, Apple, Facebook, Microsoft and Netflix combined had avoided paying \$100 billion in taxes they had provisioned for.¹⁴

With government finances having taken a battering from COVID-19, many countries will be looking for new sources of tax to dig themselves out of their fiscal hole. Already under fire, the fact these firms have been some of the biggest winners from the pandemic will make them an even more tempting target.

“These tech companies have made quite a few political enemies by playing quite fast and loose with the rules,” says Cordwell.

When Facebook recently announced it was paying £15.8 million tax in the UK, where its

sales total £1.3 billion, politicians and others were quick to vent their fury. “Absolutely outrageous that Facebook's UK tax bill is 0.62 per cent of their revenue here,” tweeted Margaret Hodge, Labour MP and former chairman of the public accounts committee.¹⁵

The low rates of tax paid by these tech giants partially reflects the kind of creative tax practices employed by virtually all multinational companies. Legions of tax accountants and lawyers are employed to exploit various loopholes and stay one step ahead of the relevant tax authorities.

But it is also the by-product of an outdated international tax system that pre-dates the globalisation and digital eras. The nature of their businesses makes it almost impossible to identify where economic activity took place, enabling profits to be shifted to popular tax havens such as Bermuda, Ireland, Luxembourg and the Netherlands.

Global agreement in sight

To try to address these issues, finance ministers from the Group of Seven rich nations on June 5 agreed what was described by *The Economist* as the biggest overhaul of corporate taxation in

THE TAMING OF THE FEW *continued*

a century. They hope it will form the basis of a worldwide deal.

Under the first of the agreement's two pillars, global firms with at least a ten per cent profit margin would see 20 per cent of any profit above that 10 per cent margin reallocated and then subjected to tax in the countries in which they operate. The aim is to stymie tech firms' ability to shift profits to low-tax jurisdictions.

The biggest overhaul of corporate taxation in a century

Under the second pillar, ministers agreed to back a global minimum corporate tax rate of at least 15 per cent. The aim here is to end what US Treasury Secretary Janet Yellen has described as a "30-year race to the bottom" on corporation tax rates, as countries competed to lure multinationals.¹⁶

While the accord has been widely welcomed, much still needs to be ironed out – including the metrics that will determine how and to which multinational companies the tax will be applied.

A G20 meeting scheduled for Venice in July will see whether the G7 accord gets broad support from the world's biggest developing countries, although even if it does it is far from clear national legislatures such as the US Congress will approve the proposals.

In any case, it seems unlikely to significantly dent firms' profitability. According to the OECD, 40 per cent of multinationals' overseas profits are shifted to havens, which it estimates costs exchequers up to \$240 billion a year. *The Economist* says while the combined reforms might raise \$50-80 billion, that is meagre beside multinationals' \$6 trillion of global annual profits.

Perhaps tellingly, Amazon, Facebook and Google were among those to welcome the June 5 announcement.

A malign influence

Some of the big US technology companies such as Facebook and Alphabet, as well as Twitter, are facing calls for greater regulatory oversight for another reason: mounting concern over data privacy and the malign influence of the internet in general, and social media in particular.

In March 2018, news broke that British political consultancy Cambridge Analytica had acquired personal data on 87 million Facebook users without their permission. The data was said to have been used to try to sway the outcome of the 2016 US presidential election.

Meanwhile, recent years have seen a proliferation of 'fake news' and conspiracy theories. In helping spread this kind of disinformation, social media companies are said to be playing a big part in the worsening societal discord seen across the West, thereby threatening to undermine democratic processes.

Perhaps most worrying of all, rates of self-harm and suicide are soaring. US suicide rates among ten to 24-year olds, having previously shown no discernible trend, soared more than 50 per cent in the decade to 2018.¹⁷

Meanwhile, incidents of self-harm among girls aged ten to 14 climbed even faster, increasing 18.8 per cent a year between 2009 and 2015.¹⁸ Social media and internet companies are widely blamed for doing too little to take down abusive content.

Both Zuckerberg and Twitter chief Jack Dorsey have themselves called for more regulation of harmful online content, arguing it is not for companies like theirs to decide what counts as legitimate free speech. However, that seems unlikely to placate regulators.

A hypothetical antitrust dragon?

With authorities threatening the biggest shake-up in competition, tax and data

policy in a generation, one might have expected investors to be concerned. Instead, the near vertical rally in share prices shows little sign of abating. As of June 23, Alphabet and Facebook shares had delivered stunning year-to-date gains of 39 and 25 per cent respectively with Amazon stock up 8 per cent and Apple up 0.75 per cent.¹⁹

However, some observers caution against reading too much into what share prices currently imply in terms of the threat of regulatory intervention.

"The speed at which dollars are shifting from offline to online is accelerating. At the same time, these firms are being helped by the shift to streaming, which means traditional media advertising is in flames. The market is asking itself: Do I really want to imagine some hypothetical antitrust dragon in five years' time and miss out on this opportunity? Not really," Parkinson says.

Moreover, as Cordwell argues, while there may be complacency, it would be wrong to take recent share price gains to mean the market is entirely unconcerned about the threat of regulatory intervention.

"There's a belief these things are long and complex, nothing is going to happen in the next year, and the market tends to look no further ahead than that. But when I look at 2022 forecast earnings for Facebook, it's on the same valuation as the overall market. Given the growth it's delivering, that looks too cheap, suggesting the shares are being impacted to some degree," he says.

As for Alphabet, it is far from clear regulatory intervention would be a bad thing for its share price anyway.

"There's a widespread feeling Google is worth more on a sum-of-the-parts basis than as an integrated business. Because it was so content with Google Search being so hyper profitable, it hasn't monetised businesses like YouTube nearly as well as it should have," Parkinson says.

Cordwell, who largely agrees, says Amazon is the one company where the market could be underestimating the threat of action. “These appointees to the Biden administration could well change the way people think about antitrust. It could start to come onto the agenda in a way that isn’t currently envisaged,” he says.

Imperfect competition

Many believe the complexity of their businesses has allowed Big Tech companies to exploit wiggle room, undermine the spirit of the rulebooks and run rings around regulators, famously illustrated by a memorable altercation when Zuckerberg appeared before Congress in 2018. Asked by 84-year-old Senator Orrin Hatch how Facebook sustained a business model

“in which users don’t pay for your service”, Zuckerberg responded: “Senator, we run ads”, before breaking into a smirk.²⁰

“When I was there, I always felt like fundamentally it was a force for good. I don’t know if I feel that way anymore,” Alex Roetter, formerly Twitter’s senior vice president of engineering, told *The Social Dilemma* viewers.

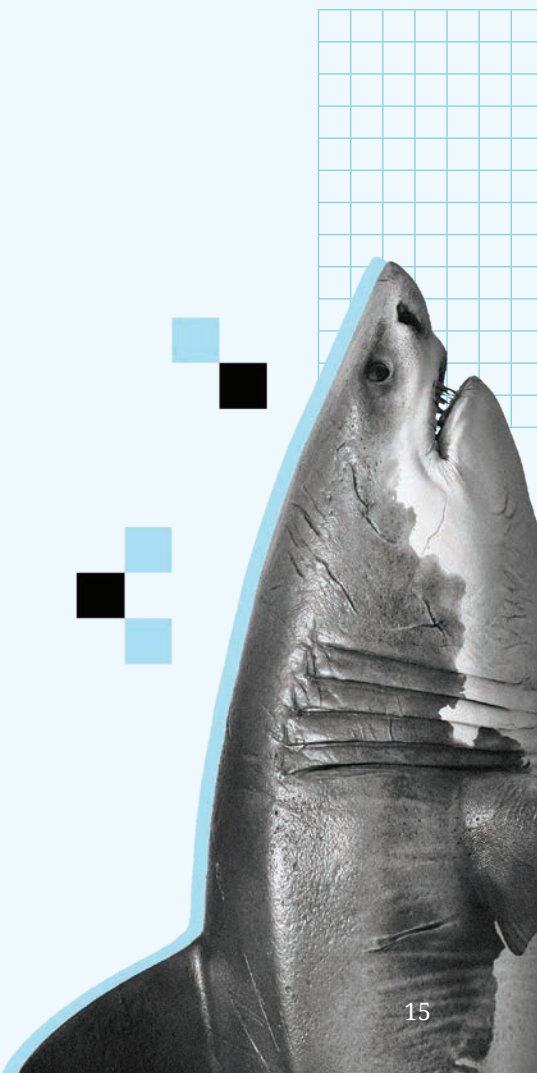
Perfect competition is a myth only found in economic textbooks. However, few dispute the need for at least some level of competition in healthy economies. This implies the days of Big Tech getting such an easy ride – as Zuckerberg did in 2018 – look to be over. But just how much their influence and dominance can be reined in remains to be seen ●

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Perfect competition is a myth only found in economic textbooks

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CHINA'S BIG TECH CRACKDOWN



Like Washington and Brussels, Beijing is worried about the growing power of large technology companies. But China's regulators are taking swifter, more radical action than their peers in the West.

When Jack Ma launched his e-commerce company in 1999, he decided to call it Alibaba, after the famous character from the *One Thousand and One Nights*. In the story, Ali Baba opens the door to a cave of treasures using a magic phrase: "Open sesame." Ma pledged his company, like its namesake, would "open a doorway to fortune".¹

Over the following two decades, Ma delivered on his promise: Alibaba became the dominant Chinese e-commerce firm and expanded into other areas, including artificial intelligence, cloud software and even filmmaking. An affiliate firm, Ant Group, controls Alipay, a leading mobile payments platform.

Ma himself became a globally recognised personality, criss-crossing the world in a private jet to ink joint ventures, buy real estate and glad-hand with foreign leaders. But in October 2020 he finally overreached, making a speech in which he likened state-run banks to pawnshops and branded financial regulators "an old people's club".²

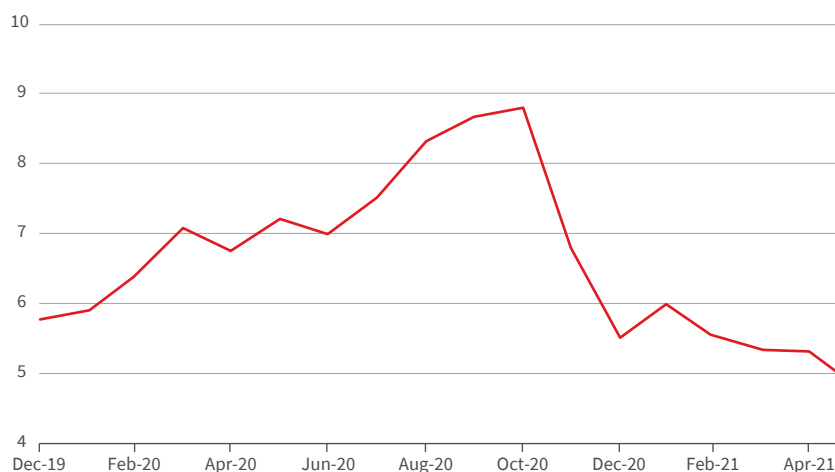
The response was swift. The following week, the Shanghai Stock Exchange cancelled Ant Group's \$37 billion initial public offering (IPO) – which would have been the world's biggest – citing "changes in the financial regulatory environment".³ In December, the State Administration for Market Regulation (SAMR), an antitrust body, started investigating Alibaba over alleged monopolistic practices.

Ma disappeared from public view, prompting rumours he had been detained by the authorities. After a three-month absence, he posted an online video on January 20: striking a humble note, he said he and his colleagues would devote themselves to "education and public welfare".⁴

Fall of the house that Jack built

Jack Ma's downfall is emblematic of a wider shift in Beijing's attitude towards China's tech giants and the tycoons who run them. Over recent months, a raft of new financial, antitrust and data-protection laws have been introduced, leaving tech bosses

Figure 1: Alibaba weighting in MCSI EM Index (per cent)



Source: Bloomberg, as of May 20, 2021.

CHINA'S BIG TECH CRACKDOWN

continued

scrambling to comply. The sudden clampdown has sent shivers through the country's equity markets and beyond. Alibaba's share of the wider MSCI EM Index has plunged since the crackdown began (see Figure 1).

On April 10, 2021, regulators fined Alibaba a record \$2.8 billion for abusing its dominant market position and called on other tech giants to conduct "comprehensive self-inspections" to ensure they are adhering to competition law.⁵ It was not an idle warning: the following week, the regulator opened a new antitrust investigation into takeaway delivery platform Meituan.⁶

For many years, Beijing took a hands-off approach to the technology sector, willing to countenance the rapid growth of national champions that provided convenient services to the population at home and commanded respect on the world stage. But now the government has changed tack, and for reasons that differ from those driving recent regulatory moves in the West.

"Regulation of technology companies is tightening everywhere – it's a global trend. In practice, though, Chinese tech firms were already under much more state influence than their counterparts in the US or Europe. What we are seeing is more of a shift in emphasis from the authorities," says Alistair Way, head of equities at Aviva Investors.

"Beijing is trying to balance the interests of China's national tech champions with its own policy objectives. The factors behind this regulatory tightening are threefold: The first is political, about affirming who's in charge; the second is economic, and has to do with stabilising the financial system; the third is the antitrust element, motivated by concerns over competitiveness."

The battle for power

Start with the politics. The clampdown on tech giants can be seen to reflect the all-powerful central government under President Xi Jinping, who has cemented

control over the Communist Party and the state since constitutional term limits on his office were abolished in 2018.

Xi has long been uncomfortable with the power wielded by billionaire entrepreneurs such as Ma. At the G20 Summit in Hangzhou in 2016, visiting dignitaries divided their time between conferences with Xi and audiences with Ma at Alibaba's headquarters, reportedly angering the president, who felt upstaged.⁷

Tech firms' sway over media platforms is a particular bone of contention. Pro-Ant editorials on Alibaba-owned business websites have been taken down in recent months, while Alibaba has also been criticised for censoring gossip about its executives on social media. As the state-run *People's Daily* put it in a recent article on the subject: "It's astonishing how powerful [Alibaba] is in forming public opinion."⁸

The regulatory blitz on Ma's businesses could be the first step in what *The Economist* calls a "de-tycoonification" of the tech sector.⁹ March saw the surprise resignation of Colin Huang, founder and CEO of fast-growing e-commerce firm Pinduoduo, ostensibly to pursue new interests – reports suggest he was wary of leading the company at a time of greater scrutiny from regulators – while other moguls, such as Tencent founder and CEO Pony Ma, have sought to prove their loyalty to the government by calling publicly for tougher regulation on their own businesses.¹⁰

"Big Tech has considerable power over media, data, and communication," says Kendra Schaefer, head of tech policy at Beijing-based consultancy Trivium China. "China has never had to contend with huge domestic players that are not state owned. While China does not want to kneecap its tech champions' ability to compete on the international stage, it doesn't want to allow them unlimited power domestically."

As well as reining in the bosses, the government has sought institutional means to keep the large companies under control,

reshaping the relationship between state and private enterprise at a deeper level. Companies have been asked to launch "Party Committees" to weigh in on corporate decisions and ensure they are aligned with government policy.

Financial stability

While Jack Ma's speech might have been the immediate catalyst for some of these policy changes, they also represent the latest development in the long-running battle between regulators and tech firms seeking to make inroads in finance.

The process started with online payments. Innovative apps such as Alipay and Tencent's WeChat turned China into the world leader, with millions of people using smartphones to pay bills not just online, but also in brick-and-mortar shops and restaurants. E-payments had a penetration rate of 32.5 per cent in China as of 2019, compared with eight per cent in the US.¹¹

Over time, the big tech firms sought to build on their digital expertise to explore more lucrative financial business lines. Ant Group created a wildly popular money-market fund, Yu'E Bao ("leftover treasure"), which allowed the 700 million monthly users of Alipay to invest spare cash left over in their accounts. The government imposed some restrictions on the fund in 2016, citing liquidity risk, but allowed it to continue.

The key selling point for investors in the lead-up to the ill-fated IPO was Ant's consumer lending business. Alipay provides users with two lending products: Huabei, an app-based credit card, and Jiebei, a kind of unsecured loan. Thanks to these offerings, Ant's lending to consumers ballooned to over 1.5 trillion RMB (\$250 billion) as of June 2020, according to Reuters data. This made it the country's largest lender, surpassing traditional retail banks that faced stricter capital requirements.¹² Now regulators have moved to level the playing field.

"Although the timing was dramatic, the intervention to thwart Ant Group's IPO



shouldn't have come as a surprise. It looked as though Ant was trying to aggressively push through its IPO on a wave of publicity from investment banks and hysteria among retail investors, before regulators could properly assess the implications for financial stability," says Way.

In April 2021, the government announced it was investigating how Ant obtained such swift approval for the IPO. Ant will also be forced to restructure: the company's lending business will now be regulated more like a traditional bank, and it will have to operate its payments platform separately.¹³

Meanwhile, the government has been making progress in the development of an official, central bank-administered digital currency as an alternative to the Alipay and WeChat Pay apps, which would give policymakers more real-time data on economic activity.¹⁴

Trust-busting

In their public statements, China's regulators have argued these measures are not simply about financial stability, but also about bringing tech companies into line with the country's modernised competition and data protection laws. As in the West, the government is concerned these firms are using the information they collect on users to manipulate online behaviour and outmuscle smaller competitors.

"Tech companies, especially those online platform giants, came on the radar of Chinese antitrust authorities for enforcement as early as 2019," says Scott Yu, Beijing-based partner at the law firm Zhong Lun and a specialist on the legal frameworks surrounding corporate competition.

"The Interim Measures on Prohibition of Abuse of Market Dominance, promulgated in June 2019, dedicated one article specifically on how to determine if an internet sector operator has market dominance. In the recently issued Platform Economy Antitrust Guidance, one can find rules and provisions very similar to the dominant theories currently discussed and used in the US and

EU, such as spoke-and-hub harm theory."

Spoke-and-hub refers to a practice whereby a dominant player restricts competition by using its market clout to coordinate the activities of other companies. Yu says the regulator is also looking into "choose one of two" cases, where tech giants force merchants using their platforms to favour their own services over those owned by rivals, as well as algorithms that offer different prices to users based on their shopping history. In addition, mergers and acquisitions will come under closer scrutiny.

The SAMR investigation into Alibaba found it guilty of using its "market position, platform rules and data, and platform position" to reward merchants that used its shopping sites exclusively, and to punish those that did not. Meituan also stands accused of forcing exclusivity on partner firms and implementing algorithmic price discrimination.¹⁵

Chinese-style antitrust

In a separate case, platforms backed by Alibaba, Meituan and Pinduoduo have been fined for running so-called "group-buying schemes" that became popular during the pandemic, whereby communities would club together to purchase heavily discounted groceries via the major e-commerce platforms. The schemes sparked concerns over employment, because smaller food retailers were being squeezed out.

This points to a difference between China's regulatory approach and that of Western counterparts. Although the group-buying schemes were good for consumers, who benefited from lower prices, this did not stop SAMR putting in measures to control them. By contrast, US and European regulators are typically constrained by the need to prove companies' activities have hurt consumers before they bring antitrust action.

Angela Huyue Zhang is director of the Center for Chinese Law at the University of Hong Kong and author of the recent book *Chinese Antitrust Exceptionalism: How the rise of*

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China's regulators are bringing tech companies into line with competition and data protection laws
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CHINA'S BIG TECH
CRACKDOWN*continued**China challenges global regulation.*

As she writes: “[Chinese] antitrust law grants the central government strong sanctioning powers, allowing it to impose anything from astronomical monetary fines to severe structural remedies. The Chinese antitrust regulator also possesses vast administrative discretion while being subject to little judicial oversight. Furthermore, Chinese antitrust law enforcement is spearheaded by a central ministry that follows the central government’s directives.”¹⁶

This suggests China’s antitrust regulator can be wielded by the central government as a powerful strategic tool, even as it ostensibly targets some of the same practices as its peers in Washington and Brussels.

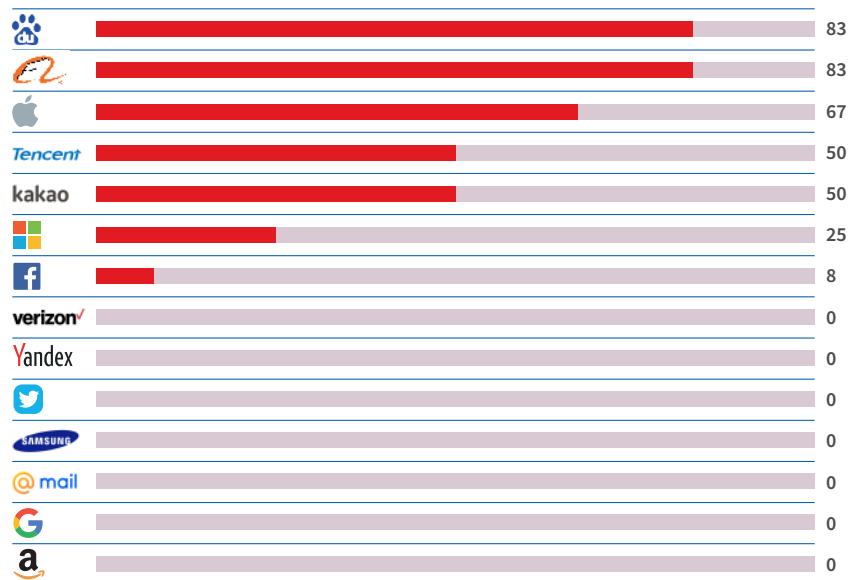
Zhang points to a stridently worded editorial in the *People’s Daily*, which frames the regulatory crackdown on Big Tech as a way to encourage these companies to redirect their efforts away from boosting retail profit margins towards loftier ambitions, such as technological innovations that might give China the edge in its ongoing rivalry with the US.

Control of data

A similar tension between the rule of law and the government’s strategic objectives is evident in China’s recent moves to update its data protection regime, which should curb technology firms’ ability to hoard user information. The government has introduced a Cybersecurity Law, a Data Security Law and a draft Personal Information Protection Law since 2017.

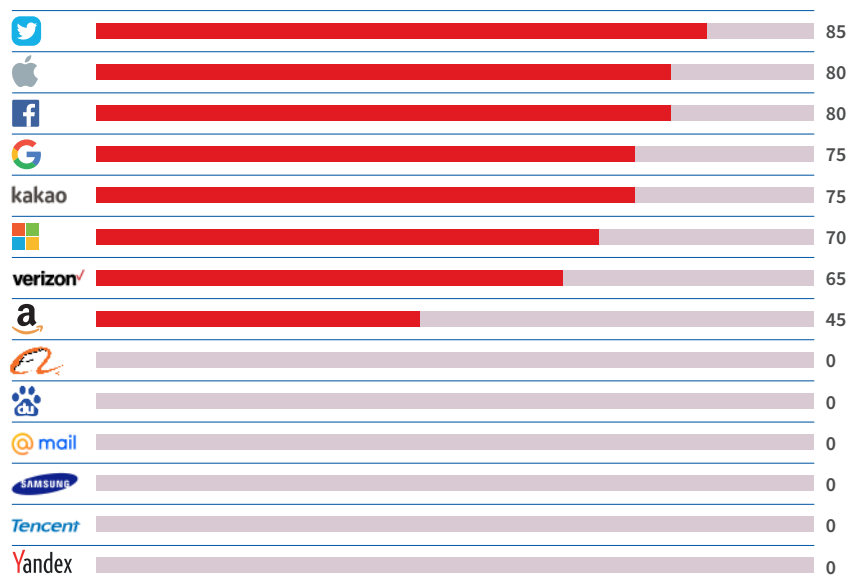
“These laws are all generally aimed at achieving the same goal: creating an ‘orderly’ digital economy in order to drive the next phase of growth. China has stated ambitions – most recently in its 14th Five Year Plan – to create a standardised data market, where the laws and norms around the buying, selling, and trading of data are clear, and so that data can circulate throughout society and the economy,” says Schaefer.

Figure 2: Does the company publicly disclose information about its processes for responding to data breaches? (per cent)



Note: Percentages show company’s score against the relevant indicator on RDR’s index. Source: ‘Chinese tech giants can change: But the state is still their number one stakeholder’, 2020 Ranking Digital Rights Corporate Accountability Index, 2020.

Figure 3: Does the company regularly publish data about government demands for user information? (per cent)



Note: Percentages show company’s score against the relevant indicator on RDR’s index. Source: ‘Chinese tech giants can change: But the state is still their number one stakeholder’, 2020 Ranking Digital Rights Corporate Accountability Index, 2020.

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China's tech giants publish almost no information about government requests to access user data

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In part, these laws look to be aimed at modernising China's approach to data classification to bring it in line with recent regulatory developments in the West, such as Europe's General Data Protection Regulation (GDPR), a project designed to put users back in charge of their personal information.

Non-profit organisation Ranking Digital Rights finds that China's 2017 Cybersecurity Law has been particularly effective at improving tech companies' record on reporting data breaches to users. In fact, Alibaba, Baidu and Tencent are now more transparent than the likes of Amazon, Google and Microsoft in this respect (see Figure 2).¹⁷ The report also finds that investor engagement with Chinese companies on environmental, social and governance (ESG) criteria can be effective in encouraging these firms to improve their standards.

“Chinese companies have improved significantly in that, when there is a breach, they are getting much better at informing the user as well as the authorities. That is not something that you see as standard practice across the world by any means,” says Louise Piffaut, senior ESG analyst at Aviva Investors. “Nevertheless, governance experts are still concerned by the government's access to data in China.”

The government's stance on this issue is complex. On the one hand it has brought in laws to protect consumers, perhaps wary of a social backlash if big companies continue to indiscriminately Hoover up personal data. It has even sought to educate citizens on their rights: in March 2021 state television broadcast a “Consumer Day” programme, featuring an investigative report into the use of facial-recognition cameras in high street shops that obtain data without consent.¹⁸

On the other hand, Beijing is trying to preserve its own access to private data. Unlike Western firms, China's tech giants publish almost no information about government requests to access user data (see Figure 3).¹⁹ Media reports suggest the People's Bank of China, the central bank, is pressuring Ant Group to hand over the

reams of information it has on consumers, with a view to creating a data bank that enables state-owned financial institutions to better assess consumers' creditworthiness.

On a grander scale, the government is in talks with the largest tech companies to create a joint venture designed to oversee vast pools of user data across all their business lines, from social media and online gaming to banking and e-commerce.²⁰ Few details of the plan are available at this point, but if taken forward it is likely to provide the government with even more power to oversee and control citizens' lives in a country where mass surveillance is already a fact of life.

“We have spoken to the tech companies about this project,” says Way. “While this joint venture may create a more formal process for government access to data – at the moment the state requests information on an ad hoc basis, which the companies have no choice but to hand over – this would give the government the opportunity to know what is going on everywhere.”

The plan is particularly concerning in light of events in Xinjiang. According to a 2019 report from Human Rights Watch, the government

is already leveraging tech companies' cloud services and AI tools in a brutal regime of surveillance, incarceration and “re-education” of ethnic Uighurs and other Muslim people in the province.²¹

Market impact

Unlike in the US, where the announcement of antitrust investigations into Google and Facebook barely dented share prices, Beijing's regulatory tightening has had a pronounced market impact. Alibaba's shares fell sharply in the wake of the cancelled Ant IPO and the start of the antitrust investigation in late 2020. During this period, some of Alibaba's rivals rose in value, reflecting a view that Alibaba was an isolated case and its rivals would be able to grab market share from it.

Given the nature of the e-commerce sector in China, this is somewhat understandable. Alibaba was already facing tough competition on numerous fronts before the antitrust probe was announced: JD.com has a superior logistics operation and better-quality goods; Pinduoduo was catching consumers' interest with its distinctive, entertaining platform; and

Figure 4: Hang Seng Tech Index



Source: Hang Seng Indices, as of April 21, 2021.

CHINA'S BIG TECH
CRACKDOWN*continued*

Meituan was using its strong local distribution operation to snatch customers from Alibaba's food-delivery subsidiary.

But the widening of the regulatory crackdown has impacted these other firms, as reflected in the sharp decline in the Hang Seng Tech Index of Hong Kong-listed stocks, on which many of mainland China's largest internet and e-commerce firms are represented (see Figure 4 and Figure 5).

Way says other factors were partly responsible for this decline, including a wider rotation of portfolios out of "growth" towards "value" stocks. Baidu's shares also took a hit due to the forced liquidation of positions held by Archegos Capital, a family office, in late March. But the shift in regulation is undoubtedly "the biggest driver of stock prices at the moment".

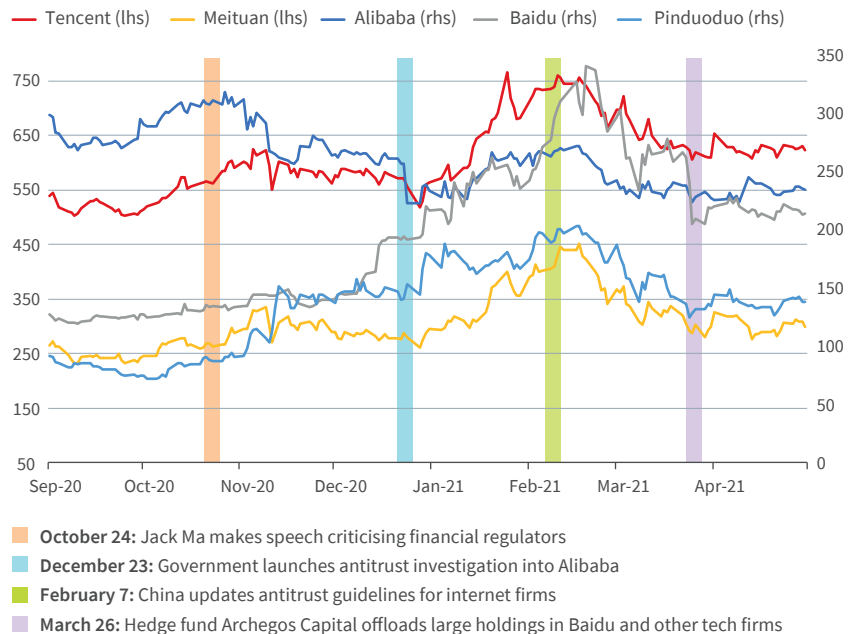
Alibaba's shares recovered slightly after the antitrust investigation concluded in April. Despite the massive fine levelled by SAMR – which amounts to around four per cent of the company's 2019 revenue, below the maximum ten per cent penalty permissible under Chinese law – investors appear to be heartened by the sense it draws a line under the affair and removes the more serious threat of a company break-up.

Meanwhile, Meituan's share price has fallen in relative terms, as SAMR begins its antitrust probe. As for the next company in the firing line, reports suggest Tencent's music-streaming spin-off Tencent Music will be forced to give up exclusive music rights and sell off its two main apps to satisfy the competition regulator. As of April 30, the subsidiary's shares on the New York Stock Exchange had fallen almost 50 per cent since their peak on March 19.²²

Levelling the playing field?

The crackdown on Big Tech may bring some market benefits. For one thing, the meteoric rise of the Chinese tech giants had distorted wider emerging market indices and brought possible concentration risk. At its peak in October 27, 2020, shortly before the response to Jack Ma's fateful speech, Alibaba

Figure 5: Relative equity market performance of China's major tech firms



Source: Aviva Investors and Bloomberg, as of April 30, 2021.

accounted for almost nine per cent of the index; as of May 20, 2021, its index weighting was just below five per cent, according to Bloomberg data.

This suggests one consequence of the antitrust action would be to bring about a more balanced, diversified and competitive economy that would probably benefit markets in the long run. Other Chinese companies whose business models are better suited to the government's strategic objectives could find opportunities in this new environment.

"There are some smaller companies whose business models look more aligned with the government's current objectives of promoting employment and balanced growth. One is called Dada Nexus, a firm that works like eBay for local supermarkets: its platform allows smaller retailers to connect with customers online to sell their stock," says Way.

"The government wants traditional food retailers to survive – they have cold-chain

facilities, good inventories, fresh-food distribution routes – and a company that helps these firms gain a digital presence is more likely to stay on the right side of regulators than one that aggressively seeks to put them out of business," he adds.

Other firms that have been hit by the regulatory tightening could emerge in a stronger position in the long run, and investors will need to carefully monitor how each company is responding to the new rules.

Take e-commerce firm Vipshop, which runs a site specialising in discounted retail. The company was hit by a SAMR fine of around \$500,000 in February for anticompetitive practices.²³ But since then it has started seeing some high-end brands list their products on its platform for the first time, because the exclusivity agreements that previously restricted them to using the major shopping sites are no longer allowed. This indicates a tougher antitrust regime could work in its favour.

Reading the regulatory runes

The crackdown on Ant Group, meanwhile, could permanently reshape China's fintech sector and insulate traditional lenders from disruption. By forcing Ant to separate its payments and consumer loans businesses – and potentially making it share its data – the government has provided banks with a competitive moat.

“China's traditional financial institutions should be beneficiaries of the new regulation, especially the retail-business focused banks,” says Xiaoyu Liu, global equities fund manager at Aviva Investors. “Ant Group and many other online lenders were focusing on retail lending. Now the government has put them on the same playing field as the banks, because they will need to put down capital for lending and to share the credit cost.”

Chinese financial institutions were already in a robust position, thanks to the economy's strong rebound from the coronavirus slump

– GDP grew 18.3 per cent year-on-year over the first quarter, according to official figures. From an investment perspective, Chinese banks tend to offer higher dividend yields and lower price-to-earnings ratios than their counterparts in other emerging markets.

As for Ant itself, it is setting up a new unit to handle consumer lending. But it seems unlikely the company will be able to return to the market with an IPO at anywhere near the \$37 billion originally proposed. The sharp reversal in Ant's fortunes contains lessons for investors in China, who must always be aware of how companies' business models fit within the government's strategic vision for the future of the country.

“Ant's story serves as a reminder of something investors in China should have known already: you always need to be aware of subtle shifts in the tone of statements emanating from official bodies. No company – not even a tech goliath – is big enough to defy the state,” says Way ●

“*The crackdown on Ant Group could permanently reshape China's fintech sector*”

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QUANTUM LEAP

COMPUTING REVOLUTION BRINGS SECURITY RISKS AND INVESTMENT OPPORTUNITIES

Quantum computers have the potential to shake up finance, cybersecurity and other sectors. But investors hoping to profit from the new technology must be patient – and separate reality from hype.

In 2017, Chinese scientist Juan Yin and her team conducted a unique experiment. Using quantum technology, they linked two photons on a satellite called Micius, then dispatched them to different locations on Earth, thousands of miles apart.

Even across this vast distance, the two photons maintained their connection: when one was observed, the other immediately changed its properties, as if the particles were magically communicating. In scientific parlance, they were *entangled*.¹

Welcome to the weird world of quantum mechanics, where up is down, here is there and the usual laws of physics no longer apply. In the early 20th century, Albert Einstein dismissed entanglement as “spooky action at a distance”, but it is now being observed in laboratories across the world.² Quantum theory appears to explain the inner workings of the universe, however counterintuitive it may seem in the context of our everyday lives. Spooky indeed.

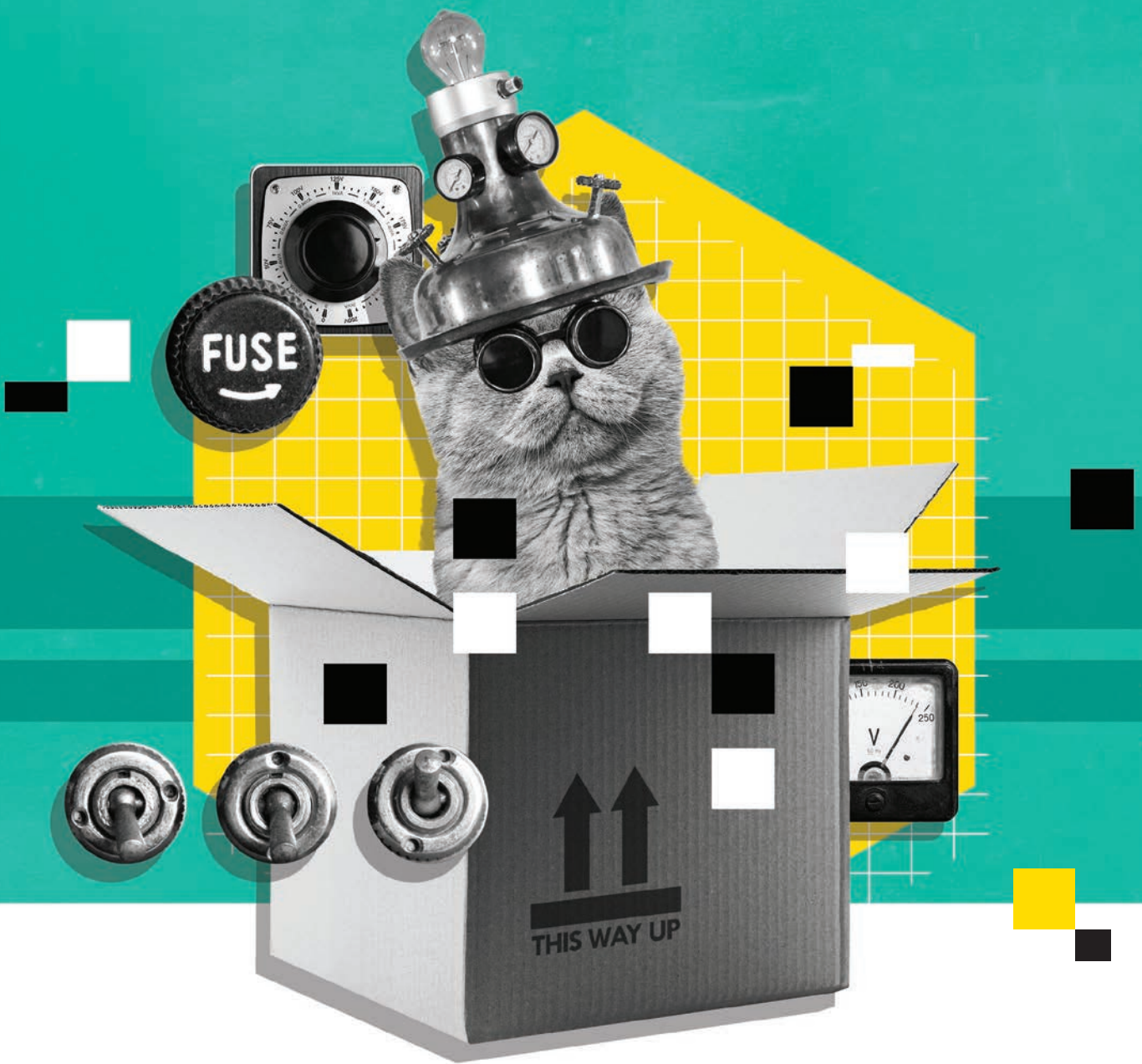
Entering the quantum era

Before they fully grasped the implications of quantum physics, scientists used its principles to design technologies such as lasers and semiconductors, ushering in the information age. Today, the bizarre characteristics of the quantum realm are being harnessed more directly, opening new possibilities.

Governments and technology companies are racing to develop quantum computers made up of strings of entangled quantum bits, or qubits, that promise to increase computing speeds exponentially. These machines could theoretically revolutionise any sector that relies on rapid processing power, including finance, while posing a serious threat to existing cybersecurity systems. Quantum algorithms have the potential to model chemical processes with unprecedented accuracy, yielding new discoveries in pharmaceuticals and biotech.

A great deal of uncertainty surrounds the efficacy of the technology, and big technical challenges must be addressed before it becomes a practical tool. But experts argue that if these obstacles are overcome, quantum methods could be used to improve medical treatments, optimise energy and financial networks, and even tackle global problems such as climate change.

“There is enormous potential for quantum simulation – and quantum computing, once we have it – to enable us to better understand the details of the world around us, to make better drugs, to improve society,” says Lene Oddershede, professor of physics at the Niels Bohr Institute, University of Copenhagen, and senior vice president at the Novo Nordisk Foundation.



PART 1: SCHRÖDINGER'S CAT

To understand how quantum computing works, you need to get your head around one of the spookiest aspects of quantum physics: the notion that reality behaves differently depending on whether it is being observed.

Austrian physicist Erwin Schrödinger illustrated this concept with a famous thought experiment. Imagine a cat is kept in a box where a quantum phenomenon has a 50:50 chance of occurring, thereby triggering the release of poison. The point is not simply that we don't know whether the cat is alive or dead until we open the box; according to the rules of quantum mechanics, the cat is both alive and dead at the same time, until it resolves into one of the two possibilities once it is observed.

"One of the fundamental statements of quantum mechanics is that you do not know the state of a system before you have made a measurement," Oddershede explains. "Until the box is opened, the cat is in a *superposition* of two distinct states, dead and alive. You cannot know the state before you do the measurement, and when you do the measurement, *you* have determined whether the cat is dead or alive."

Thankfully, no real cats have been harmed in quantum experiments – but the superposition

effect has been recorded at a micro scale in laboratories, where light particles behave differently if they are being measured.

Scientists and philosophers struggle to explain how this effect tallies with the laws of classical physics. According to one view, everything in the universe has a hidden shadow, an unobservable layer of reality where the numbers add up. Other experts have suggested we are living in many parallel universes simultaneously (when I look in the box and see a dead cat, there

QUANTUM LEAP *continued*

is another “me” in a different universe who sees the cat contentedly purring).³

What we do know is that we can use superposition to build a new type of computer. Traditional computers are made up of long chains of bits, which can be described in a binary way: 1 or 0. By contrast, quantum bits can be in various superpositions of 1 and 0 states, only resolving definitively into one or the other once a measurement is taken. This means quantum computers can work through huge numbers of potential solutions to a problem simultaneously.

What’s more, qubits can be entangled in pairs, like the photons in the satellite experiment in China. In effect, their quantum states are linked: a qubit and its entangled partner will always take the same form when observed. Thanks to the combined power of superposition and entanglement, a quantum computer could reach processing speeds only a planet-sized classical computer could match.

This is all the more significant given classical computers are not improving as rapidly as they once were. Moore’s Law – the theory that the number of transistors on a computer chip doubles every two years – is breaking down as it becomes ever more difficult (and expensive) for technology firms to cram nanometre-long transistors onto microchips.

Quantum competition

We are some way from seeing quantum computers in our offices or homes, however. One issue is *decoherence* – qubits can be knocked out of superposition by miniature vibrations or tiny shifts in temperature, making quantum computers extremely challenging to build.

“Quantum information is very delicate, and a quantum computer needs to be kept very well isolated from the environment,” says Adrian Kent, professor of quantum physics at the University of Cambridge. “The individual quantum circuits need to be kept isolated from each other so that they don’t interfere. And a programmable quantum computer needs to allow you to control

quantum interactions quite precisely, so that you can create the right circuit for the given program.”

US and Chinese technology companies with the resources to assemble and maintain these temperamental machines are leading the way, along with some large universities. The likes of Alibaba, Google and IBM have developed working quantum computers, although the most advanced only have around 50-100 qubits, some way short of the 1000-plus qubit machines that would be of any use in the real world (see Figure 2).

Most of the larger tech companies are aiming to build what are known as “universal” quantum computers based on quantum logic gates, which should eventually be able to handle a range of different applications, along with a stack of software to run on them. Others, including Canadian firm D-Wave, are building more specialised machines known as annealers, designed specifically for optimisation problems, which involve finding the most efficient solution from a range of options.

In a competitive field, all these firms are vying to achieve what’s known as

quantum supremacy: proof their quantum computer can complete a task that would be impossible for a classical one. In 2019, Google proclaimed it had achieved quantum supremacy on an obscure calculation with its 53-qubit machine (IBM fired back, arguing Google had not benchmarked its test against the best modern supercomputers, which could complete the same task more accurately given a little more time).⁶ In December 2020, a team of Chinese academics published a paper demonstrating their computer had achieved supremacy in a narrow, photon-based experiment – an impressive feat, albeit one with no obvious practical applications.⁷

“People have probably seen headlines about Google, and more recently Chinese researchers, achieving so-called quantum supremacy. Those are really impressive technical achievements, but it’s important to understand what they mean,” says Kent.

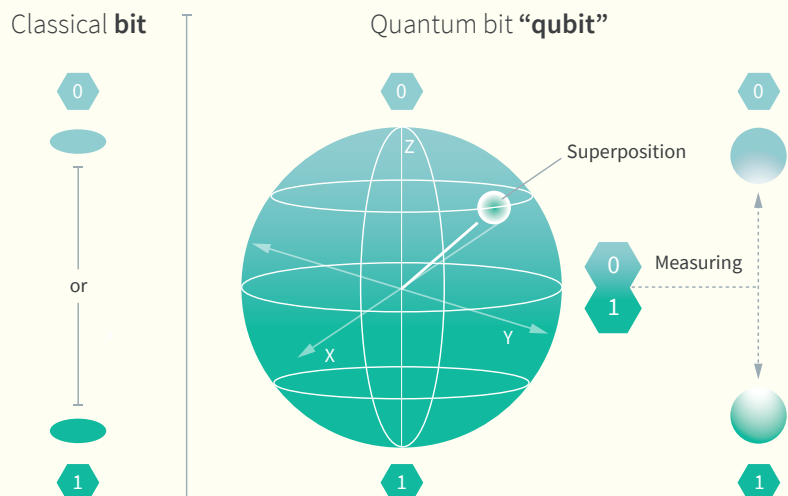
“These groups built relatively small quantum devices, using different technologies, which can do *something* that would be effectively impossible to simulate on any standard computer. There’s a little

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Quantum computers can work through huge numbers of potential solutions to a problem simultaneously

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Figure 1: The quantum bit⁴



Source: Volkswagen, November 5, 2019.



room for debate even about those claims but, taking them at face value, it doesn't mean you can run any program, or even necessarily a single useful program, on the quantum computer."

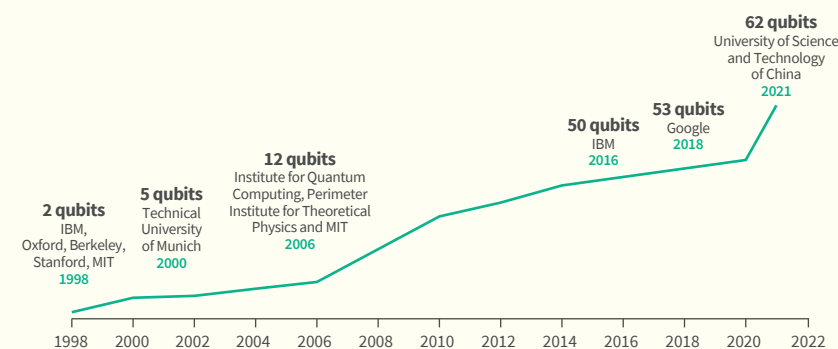
The fierce nature of the race has led to media hype, and there has been the occasional climbdown by the companies involved. In early 2021, Microsoft was forced to retract a paper claiming it had discovered a way to build quantum computers using a new group of particles less prone to decoherence, admitting it had made

mistakes in its research.⁸ D-Wave has been criticised for exaggerating the amount of quantum mechanics actually involved in its annealing devices and testing them against inferior classical computers.⁹

Despite these controversies, tech companies are targeting rapid improvements. Google recently demonstrated its quantum computer can be used to simulate chemical reactions,¹⁰ while IBM says it will build a 1000-qubit machine by 2023; both companies believe a million-qubit machine is feasible by the end of the decade.¹¹

Whether or not this timeline is realistic, the technical difficulties involved in operating full-scale quantum computers mean they will probably be used for specific problems classical computers tend to struggle with. These include modelling large systems and performing complex mathematical calculations, such as the factorisation of prime numbers. However, even limited to these areas, a quantum breakthrough could have significant implications for a wide variety of sectors ●

Figure 2: Quantum progress: quantum computers over time⁵



Source: Science, May 6, 2021.

“Google and IBM believe a million-qubit machine is feasible by the end of the decade”

PART 2: QUANTUM FINANCE

Finance is a good candidate for quantum improvements. Markets are just the kind of complex, unpredictable systems quantum computers should be able to model more accurately than their classical equivalents. And companies are not waiting for the advent of full-scale quantum computers to investigate quantum solutions.

Large financial institutions are teaming up with tech firms to try out quantum algorithms using intermediate, error-prone (or “noisy”) quantum machines, made

available using software accessible over the cloud. Willis Towers Watson is working with Microsoft on new quantum-powered risk management protocols, while JPMorgan has partnerships with both IBM and Honeywell to take advantage of two different quantum technologies (the former uses superconducting loops in its computers, while the latter has a different kind of architecture based on trapped ions).

Using these methods as a stepping stone, experts have determined quantum tools could be used for a variety of financial tasks. Quantum computers should speed up the machine-learning algorithms used by hedge funds, for example, and lay the ground for

quicker, more efficient trading strategies. Spain's Caixa Bank says it has proved a hybrid classical-quantum computing model – which combines quantum computing and conventional computing in different phases of the calculation process – can be used to precisely segment customers based on their risk profiles.¹²

Quantum risk management

Other firms are investigating quantum solutions to speed up Monte Carlo simulations, the complex calculations used to price derivatives options and measure risk. Research shows quantum-powered methods can speed up option pricing from

QUANTUM LEAP *continued*



an overnight process to an instantaneous one and allow organisations to stress test and immediately adjust portfolios based on a real-time picture of their risk exposures.

“Many financial institutions are investigating quantum algorithms for quantifying and pricing risk in financial markets,” says Matthias Rosenkranz, scientific project manager at start-up Cambridge Quantum Computing. “The main workhorse is a quantum algorithm called Amplitude Estimation, which improves Monte Carlo simulations. This algorithm promises to estimate risk or instrument prices using fewer samples compared to a standard Monte Carlo simulation. This can translate to faster execution of Monte Carlo-based pricing engines or higher accuracy for a given time budget.”

Goldman Sachs and IBM, which have a quantum computing partnership, recently published the results of a study that showed a quantum computer with 7,500 qubits could price derivatives faster and more accurately than classical computers (see Figure 3).¹³

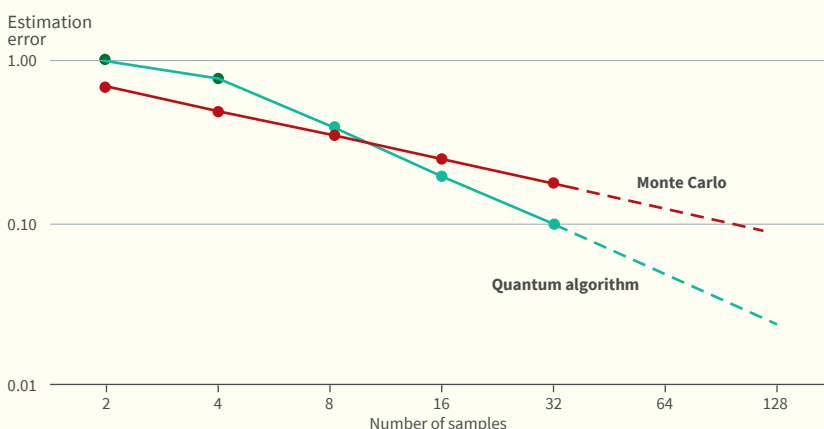
Other companies are investigating the use of quantum algorithms in asset management to optimise portfolios and boost returns. Using historical trading data, Spanish start-up Multiverse Computing and Spanish bank BBVA used a quantum annealer to determine the optimum portfolio composition out of $10^{1,300}$ possibilities, more than the number of atoms in the known universe. (Simply put, annealing works by using quantum properties to find the lowest energy state of a system, thereby flagging up the simplest way of organising or navigating it.) The simulated portfolio delivered returns of between 20 and 80 per cent over a four-year period, depending on the amount of volatility investors were willing to accept, compared with a return of 19 per cent on the part of BBVA's human traders and their classical computer models.¹⁴

The key question is when quantum methods will deliver real-world results in finance beyond such simulations. Rosenkranz says it is difficult to estimate with any degree of certainty.

“It has been suggested that certain applications such as quantum-assisted portfolio optimisation may provide an advantage within five years. However, such estimates hinge on overcoming two main challenges. First, quantum computing

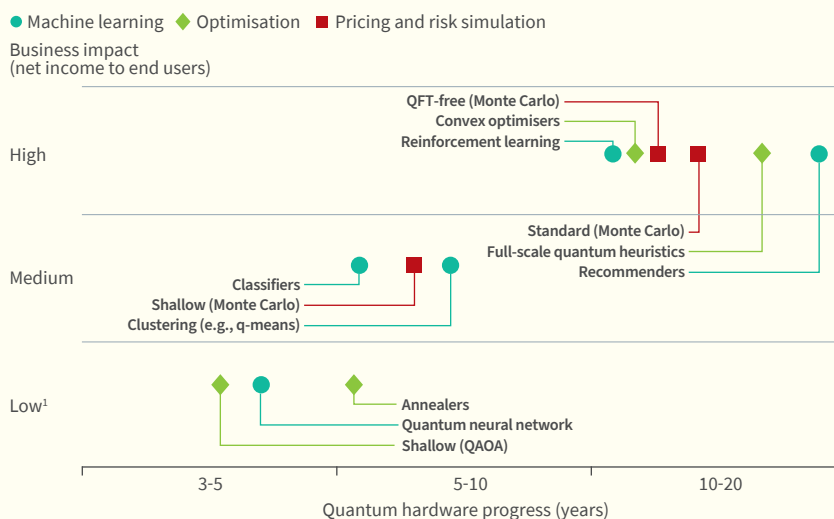
hardware needs to reduce the levels of noise we find in today's devices. Second, we need to develop better software and algorithms that can leverage today's devices to accelerate the quantum advantage,” he says.

Figure 3: Quantum-driven risk calculation offers improvements over traditional Monte Carlo methods



Note: While the existing small, error-prone quantum computers do not outperform classical computers when gauging portfolio risk, quantum computers with more qubits could perform the same calculations quicker and more accurately than the most sophisticated classical algorithms. Source: IBM, 2019.

Figure 4: Estimated timeline for quantum applications in finance



Note: Quantum advantage over classical computing is uncertain in many areas listed. Business impact assumes that quantum advantage is realised in each area and is not risk-adjusted. QFT = quantum Fourier transform. QAOA = quantum approximate optimisation algorithm. Source: QC Ware, BCG, November 2020.

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Some large investment banks are hiring quantum physics graduates to build expertise
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A recent study from Boston Consulting Group estimates Monte Carlo-based modelling applications will be widely available within five to ten years, with powerful quantum algorithms being used for portfolio optimisation within the next decade (see Figure 4).¹⁵ Other estimates suggest the practical uses of quantum methods in finance will arrive sooner

– Zapata, a US quantum start-up, believes quantum-powered credit scoring will be available within 18 months.¹⁶

Some large investment banks are hiring quantum physics graduates to build expertise internally, but for the most part financial institutions prefer to work with specialists who have direct access to the hardware. IBM's Quantum Network is

popular in finance, counting Goldman, Wells Fargo and Barclays among its customers. This may be because of its accessibility and user-friendly software tools: IBM allows companies to build virtual quantum circuits and test them out on real quantum computers using a simulator ●

PART 3. QUANTUM CYBERSECURITY

There is another, more pressing reason why financial institutions are investigating quantum computing: security. Modern cryptographic protocols rely on factorising large numbers back into their constituent prime numbers, a calculation too difficult for even superfast classical computers to perform. Using a process known as Shor's algorithm, quantum computers could theoretically crack these codes and punch holes in cybersecurity defences.

Metaculus, a forecasting platform that aggregates expert predictions of future events, has a running estimate on the date when Shor's algorithm will be used to factor one of the large RSA numbers used in current cryptography.¹⁷ As of May 2021, the median prediction for the date was 2048 – a long way away, but soon enough that companies and governments should start worrying about the safety of their data, according to experts in the field.

“A lot depends on how highly you value privacy, how long you need to maintain it, and how big a disaster it would be if your cryptosystem were hacked. Bear in mind that if we take the median estimate as representing a 50 per cent chance, then shorter timescales still have a significant chance,” says Kent at Cambridge University.

“Some government secrets are meant to be kept secure for 50 years or longer, and a one per cent chance they could be broken sooner might be unacceptable. People responsible for keeping those secure should be, and I'm sure are, very, very concerned about the possibility adversaries will store the encrypted data now and be able to decrypt it later when they have a large quantum computer. They probably shouldn't be using any cryptosystem that relies on factorisation for its security,” Kent adds.

Breaking bitcoin

A related problem is that quantum computers pose a threat to the blockchain technology underpinning cryptocurrencies such as bitcoin. They could rapidly crack the one-way mathematical functions used to generate the digital signatures that authenticate users and validate the digital ledger of previous transactions.

In addition, quantum computers could accelerate bitcoin mining, the process used to add new blocks to the chain using random numerical searches. Because of the limitations of classical computers, mining is a laborious and energy-intensive process that naturally slows down the rate new blocks are added to the global ledger; this ensures the new additions can be properly recorded and checked. But a quantum computer could complete these searches in an instant, monopolising the mining process and potentially subverting the system for nefarious ends.

“Within ten years, quantum computers will be able to calculate the one-way functions, including blockchains, that are used to secure the internet and financial transactions. Widely deployed one-way encryption will instantly become obsolete,” according to a *Nature* paper by a team of researchers led by Alexander Lvovsky, professor of physics at the University of Oxford.¹⁸

“Quantum computers will find solutions quickly, potentially enabling the few users who have them to censor transactions and to monopolize the addition of blocks to the bitcoin ledger... These parties could sabotage transactions, prevent their own from being recorded or double-spend,” Lvovsky and his colleagues added.

The quantum sword, the quantum shield

Given the threat to state secrets and financial stability, it is no wonder governments are investing heavily in quantum computing technology, with a special focus on quantum cybersecurity. In a speech in April 2021, the head of the UK intelligence service, GCHQ, warned the government needed to spend more on improving its quantum capabilities to keep pace with China.¹⁹

China has invested more than \$1 billion in a quantum research institute in Hebei province and is leading the way on patents for commercial quantum applications. ►

QUANTUM LEAP

continued



The US, meanwhile, has ploughed \$1.2 billion into quantum technology as part of the National Quantum Initiative Act, passed by Congress in 2018.²⁰

One line of state-sponsored research centres on “post-quantum” cryptography, the attempt to design cryptosystems that use processes other than factorisation and will therefore be resistant to quantum hackers. The US National Institute of Standards and Technology (NIST) is currently running an international contest to find the most effective post-quantum encryption system and is expected to decide on new standards in 2022. (Some companies already offer off-the-shelf quantum-based cybersecurity products, based on quantum algorithms generated on small, noisy quantum devices. However, governments recommend large organisations wait until new standards are agreed, to avoid having to invest twice in new security upgrades.)²¹

As for bitcoin, Lvovsky and colleagues argue

the currency could be secured using quantum communication, which harnesses the mysterious properties of quantum physics to flag network breaches. Because of the principle that an observation changes the state of a quantum object, eavesdroppers on a quantum communications system can be immediately detected.

Quantum communications do not require full-scale quantum computers to work and the technology is already available, although there are limitations on distance when using fibre-optic cables. China’s Micius satellite could represent a solution – scientists have used it to relay quantum keys, setting up a quantum-encrypted video call between Beijing and Vienna.²²

Quantum technology is even being used to explore the possibility of entirely new kinds of currencies, whose security is guaranteed by quantum physics. Kent is working on a theoretical framework known as “S-money”, which is both secure and potentially much

faster and more flexible than existing financial technology.

“It’s specifically designed for settings where time is critical, and so you want a recipient to be able to verify the money without having to send signals around the network to cross-check. A key realisation here was that the very concept of what money is or does needs to be extended to make it as useful as possible in settings like this, the global financial network being an example,” he says.

S-money consists of secure virtual tokens that materialise at given points in a network in response to real-time data flows, as opposed to existing physical or digital currencies that need to travel on definite paths through space. In fact, S-money could conceivably be used for commerce on a galactic scale with no time lags – although, like so much else in quantum tech, interstellar trade is a theoretical prospect at this point ●

PART 4. INVESTMENT IMPLICATIONS

This is not to say there are no implications for investors in the here and now. According to recent analysis from Berenberg, quantum computing is unlikely to move the dial on revenues for the large, diversified tech companies building the most advanced machines. Nevertheless, governments and private organisations will need to start securing their systems against quantum computers long before they become widely available, creating a fast-growing quantum cybersecurity industry in the interim.

Quantum proofing

Berenberg forecasts quantum cybersecurity will be worth \$32.5 billion by 2028 (compared with \$5 billion for quantum

computing proper).²³ This is not simply a matter of upgrading IT infrastructure: as the Internet of Things spreads and our physical world becomes more connected, manufacturers will have to future-proof their products against the quantum threat.

Take autonomous and internet-connected vehicles: Berenberg observes “auto models being designed today could still be operating on the roads well beyond the expected timeline for the development of a quantum computer powerful enough to present a threat to current encryption methods”.²⁴

Investors will also need to ensure the companies they hold in their portfolios are resilient against the quantum cyber threat. Today, a data breach occurs once every 39 seconds in the US, affecting nearly one in three Americans, with the mean cost of each data breach to businesses around \$3.9 million.²⁵ When user data is compromised, companies can be subject to regulatory fines

and class-action lawsuits worth hundreds of millions. The financial costs of security breaches are only likely to escalate in a world where all cryptographic protocols are vulnerable to quantum attack.

As for the beneficiaries of the quantum cyber trend, much will depend on the outcome of NIST’s competition over the next 18 months. The winning post-quantum method will probably become the global standard, opening up government and private contracts for quantum cybersecurity companies to run the relevant algorithms. Based on its shortlist, NIST looks to be favouring so-called lattice systems, which generate public and private keys based on coordinates in mathematical grids, although an alternative method based on error-correcting codes, developed by London-based quantum cryptography firm Post Quantum, is among those being tested in the final stages of the competition.²⁶

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Another route into the industry is to invest on the ‘picks and shovels’ side

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Many quantum cybersecurity companies, Post Quantum included, are small start-ups. But there are some listed exceptions, including Canada’s 01 Communique, which recently agreed a deal with PwC to secure its China-based operations with quantum-powered cryptography.²⁷

Data management, drug discovery and systems optimisation

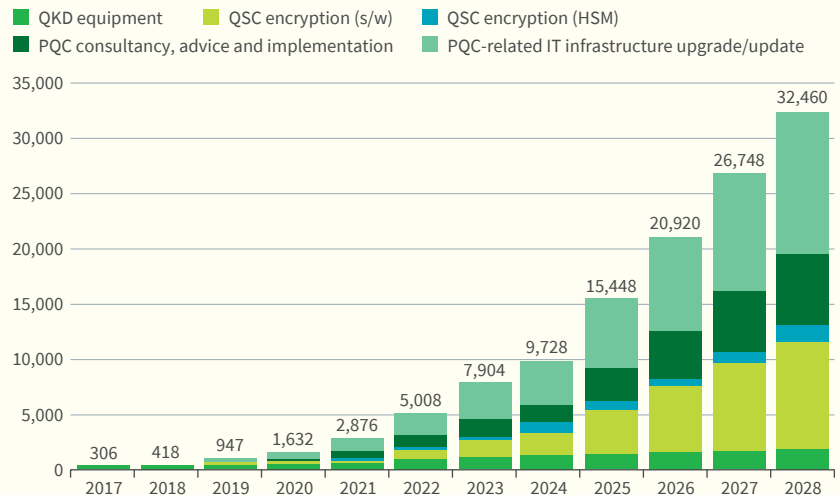
Another investment route into the industry is to invest on the “picks and shovels” side. The manufacturers of dilution refrigerators, photonic systems, vacuum technology and other high-tech gizmos are likely to see increased demand over the next decade as larger, more sophisticated quantum computers are constructed. Honeywell, Oxford Instruments and Keysight Technologies are among the companies that specialise in quantum computer components.

Over the longer term, the advent of quantum computing should increase the value of large datasets by speeding up the machine-learning algorithms that analyse and make sense of them. This would benefit companies already adept at managing data, along with firms supplying them with hardware.

“Quantum computing is yet another set of tools which makes data more useful – both existing historical datasets and data-gathering infrastructure. If you know you will get better, more precise, faster answers from looking at your data, you will value the historic data more. This benefits data-rich companies with strong existing datasets,” says Giles Parkinson, global equities portfolio manager at Aviva Investors.

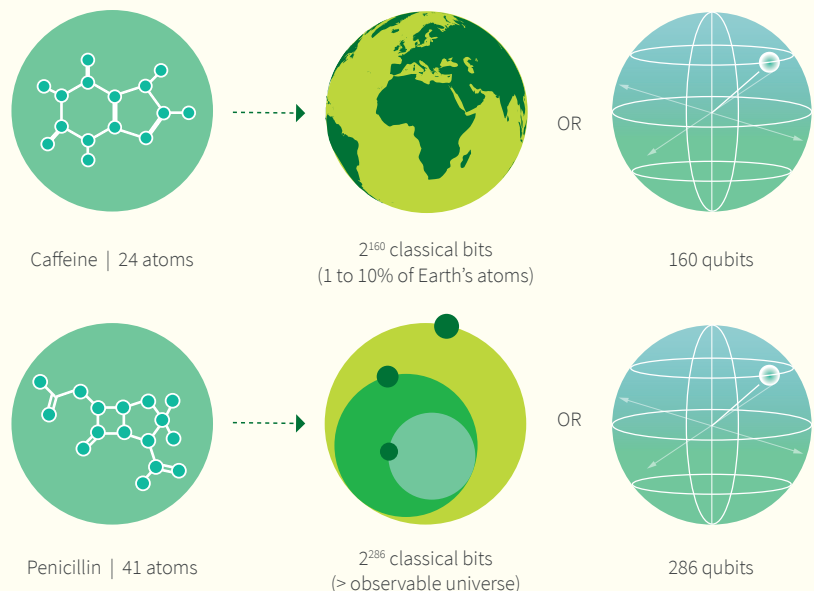
“There will also be more investment in gathering new data, benefiting manufacturers of sensors, memory and connectivity chips that provide the nuts and bolts of data collection and transmission to the point where it’s analysed for answers. This is already the

Figure 5: Estimated growth of post-quantum cybersecurity market (\$ millions)



Source: Berenberg, 2018. QKD = Quantum key distribution, QSC = quantum-safe cryptography, PQC = post-quantum cryptography, HSM = hardware security module.

Figure 6: Modelling molecules: To model a complex molecule, a classical computer would need more bits than there are atoms in the known universe



Note: To accurately simulate a molecule and model its chemical reactions, you would need a traditional computer of impossible size - for complex molecules, such a machine would require more bits than there are atoms in the known universe. A quantum computer with a relatively small number of qubits could perform the same calculation with ease. Source: Cambridge Quantum Computing.



QUANTUM LEAP

continued

case – quantum computing just extends this ‘data utility’ megatrend further into the future,” Parkinson adds.

Quantum methods should also find applications in the pharmaceuticals industry, promising to cut costs and improve the effectiveness of new treatments. Because quantum mechanics align with the deep workings of nature, quantum systems are much better equipped than classical ones to simulate its effects, aiding drug discovery. Quantum computers with a relatively modest number of qubits could replicate molecules such as penicillin and simulate their interactions; to do the same thing, a classical computer would need more bits than there are atoms in the known universe (see Figure 6).

“Quantum mechanics is at the heart of the complexity of the problem of drug discovery, because the underlying biomechanical processes take place on the molecular scale, which is where quantum interactions rule,” says Professor Oddershede at Novo Nordisk.

“Because of the quantum nature of these building blocks, there is an advantage to using quantum simulation in drug exploration. Quantum simulators can be used because they are quantum in nature and can mimic the system being investigated. When we have a full-blown quantum computer, just the computational power it will provide is going to revolutionise drug discovery,” she adds.

In the meantime, US biotech multinational Biogen has partnered with Canada-based quantum computing specialist IQbit to develop a molecule comparison tool, using the small, noisy quantum devices already available. It says this gives it a competitive advantage in the early stages of drug discovery, by improving accuracy and cutting costs in what is a notoriously error-prone and expensive process.²⁸ Biogen is not the only company experimenting with quantum: almost one third of all life sciences companies globally have started evaluating quantum methods for drug discovery, according to McKinsey.²⁹

“We’re already benefiting from scientific breakthroughs that enable better analysis, diagnostics, modelling and design of both the mechanics of diseases and possible cures,” says Matt Kirby, global equities portfolio manager at Aviva Investors. “Cryogenic electron microscopy, more affordable gene sequencing, gene and cell therapies are all part of this change. In-silico, or computer-aided, drug discovery and modelling of drug interactions with the human body is another one of these progress vectors. It looks like quantum computing will aid that further.”

The whole ecosystem of tools and service providers in this area – including contract manufacturers of novel biological drugs, suppliers of diagnostic and analytical tools, and clinical research organisations – are likely to benefit from an acceleration in the productivity of R&D in pharmaceuticals and biotech.

Quantum tools are also being used to model electrochemical materials, such as those found in batteries. Carmaker Volkswagen has developed algorithms capable of simulating some of the key molecules used in battery production on the existing quantum computers offered by Google and D-Wave, raising the possibility of better-performing batteries (and higher-performance electric vehicles) once a whole battery can be modelled on a more sophisticated piece of hardware.

Such are the myriad possibilities of quantum computing, first movers are beginning to find applications across very different parts of their businesses. As well as its battery experiments, VW is working with D-Wave’s quantum annealing technology on a traffic optimisation project. By crunching data from vehicles in Beijing, the two companies were able to cut journey times between the airport and the city centre.³⁰ VW used this proof-of-concept experiment to develop an app that is being used in a real-world pilot project to improve traffic congestion in Lisbon, providing data to bus drivers they can use to amend their journeys in real time.

Similar methods are now being used to improve supply chain logistics and streamline production inside factories. Japanese manufacturer Denso is applying a hybrid classical-quantum process to reduce gridlock on its factory floors, for example.³¹

Energy efficiency and climate change

Perhaps more significant are the potential uses of quantum optimisation and chemical modelling in the renewable energy sector, which could eventually make quantum computers a vital tool in the battle against climate change. In July 2020, Microsoft said it was using quantum algorithms to devise new carbon fixation methods, with a view to creating technology to remove CO₂ from the atmosphere.³²

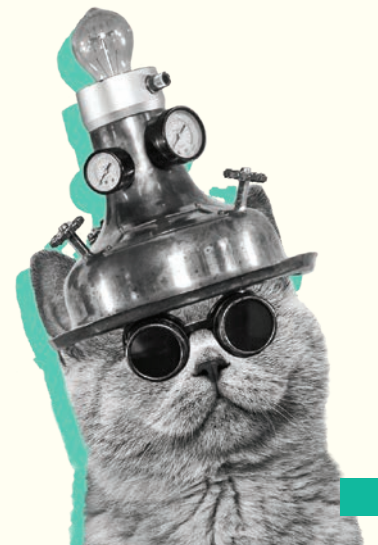
Oddershede believes governments should be looking at quantum solutions to improve the efficiency of national energy grids – the kind of large, data-spewing systems quantum computers will be able to manage more efficiently than today’s supercomputers, which have gargantuan carbon footprints (the world’s current largest supercomputer guzzles 17.8 megawatts of power, enough to supply electricity to 13,500 American households).³³ Microsoft has made steps forward in this area, too: the company is working with the Dubai Water and Electricity Authority to implement quantum algorithms to optimise the energy mix based on the city’s real-time consumption needs.³⁴

“The energy sector generates enormous amounts of data. Imagine the energy grid of Europe; calculating where energy is needed, and how to get energy to that place, requires processing enormous amounts of data. Once we have a quantum computer, that process is going to be revolutionised,” says Oddershede. “Solely for security reasons, every country should have large efforts on the quantum computation front, but also for the benefits related to climate change and renewable energy.”

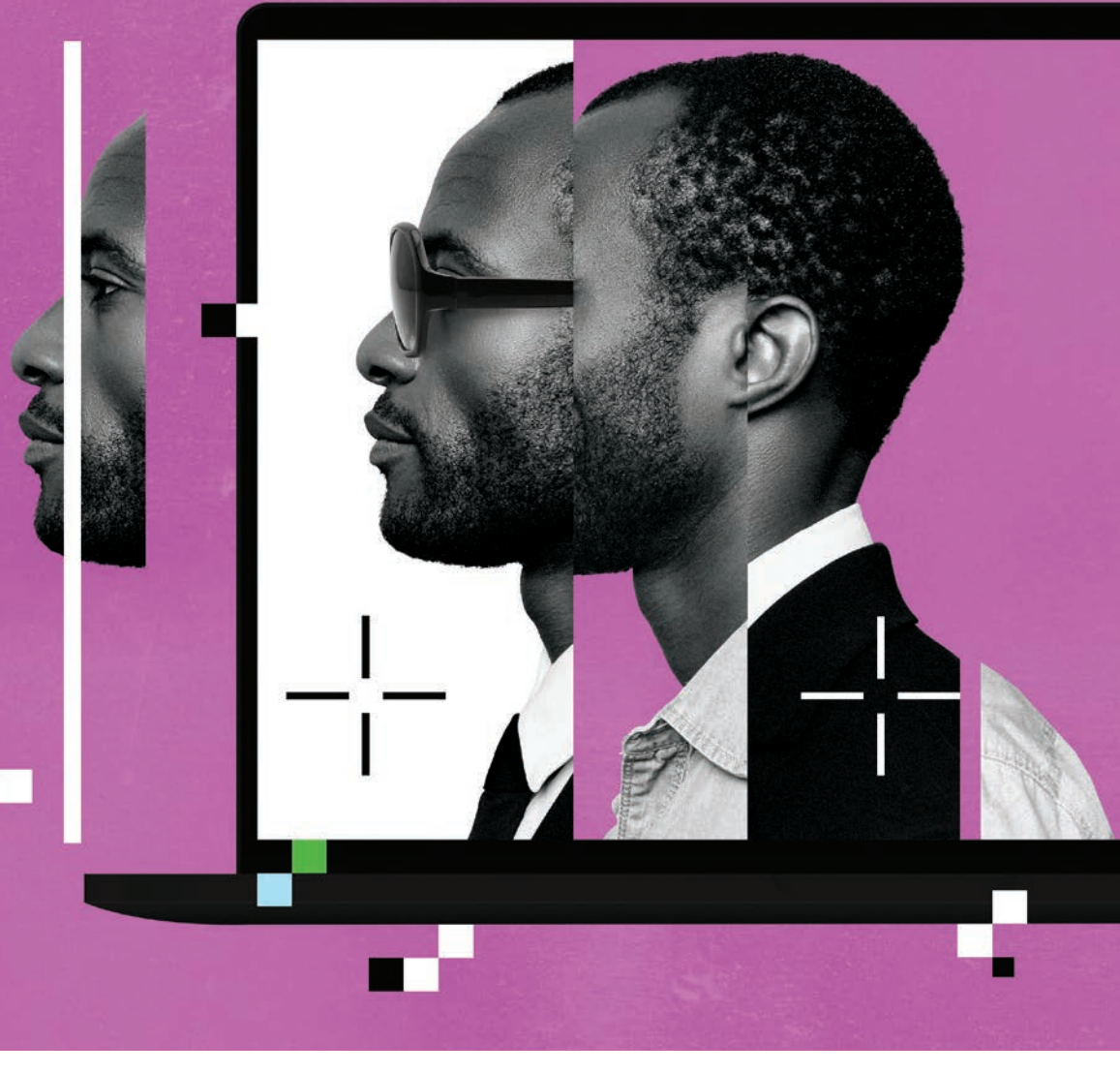
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Governments and companies
across sectors are looking to
become early adopters
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Given the range of its possible applications, it is no wonder governments and companies across a swathe of sectors are looking to become early adopters of quantum technology, despite the question marks over its efficacy in the present. Timescales are relative – while a quantum-powered smartphone or desktop PC may be a remote prospect, those in charge of cybersecurity for large organisations will need to start thinking about quantum-proofing their systems sooner rather than later.

In this respect, quantum computing is no different from any other disruptive technological advance. Think of the hype surrounding the internet in the mid-1990s, which prompted scepticism as to its true value over the longer term. As Microsoft founder Bill Gates sagely warned in his book *The Road Ahead* (1996): “We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don’t let yourself be lulled into inaction”³⁵

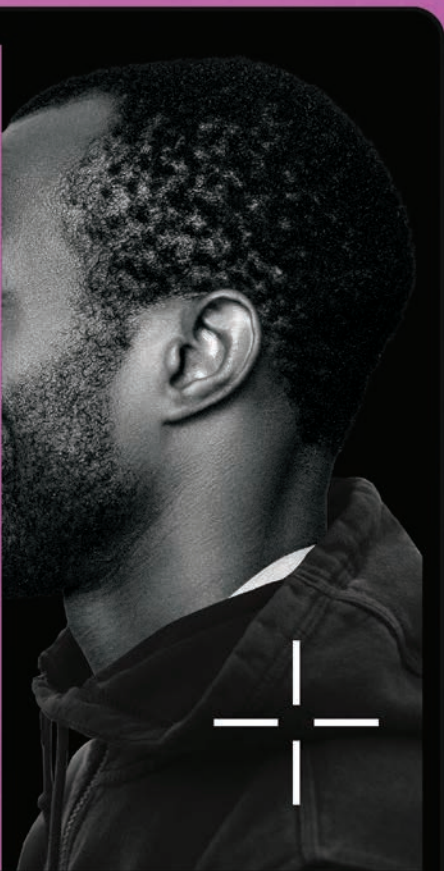


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IN BRANDS WE TRUST

DIRECT-TO-CONSUMER,
DATA AND THE
BEHAVIOURAL ECONOMY



The tech-driven trend towards direct-to-consumer is transforming brands, their intermediaries and their marketing. Intimate relationships with customers and new shopping experiences are alluring, but companies must tread a fine line between hyper-personalisation and intrusion.

Once upon a time, advertising solved a problem and, in the process, brands were created.

After the Second World War, the problem was finding a way to pay for mass entertainment and information in an era when the only option was broadcasting. The solution opened the age of commercials and soap operas, so named because the radio shows were sponsored by soap manufacturers. It led to the rise of global brands, the advertising industry and an entire ecosystem built up around them.

Today, the initial problem no longer exists. “While companies still spend large budgets advertising, where they advertise is another matter,” says Giles Parkinson, global equities portfolio manager at Aviva Investors. “Much of the spend has shifted from TV, radio and print publications to social media and search engine advertising. In a world where ads are no longer the only

way to pay for entertainment and information, how can advertising redefine itself to stay relevant? And what are the implications for companies trying to build a brand?”

Part of the answer can be found in the increasing collection and use of data, the rise of platforms and online marketplaces, and the surge in direct-to-consumer (D2C) interactions, from established brands moving online, but even more so from newcomers that expertly navigate the online universe.

Research by consultancy McKinsey and survey group Nielsen has found that, in recent years, the leading brands have only captured 25 per cent of value growth, against 30 per cent for private-label products and 45 per cent for small and medium-sized brands.¹

The decades-long relationship between

mass consumption and mass production is breaking down, creating a more direct relationship between producers and consumers, and potentially squeezing out middlemen like supermarkets.

“The boundaries between entertainment, communication and shopping will blur,” according to a recent article by *The Economist*. It noted a surge in creativity, from established brands like Nike selling trainers on its website to e-commerce firms like Shopify doubling its sales between 2019 and 2020. “[Shopify] hosts the first-ever sale by a first-time retailer every 28 seconds.”²

D2C looks set to expand even further with far-reaching implications, not just for advertising, but also traditional offline brands, middlemen, and of course consumers. Companies that can establish and maintain trust should win out.

IN BRANDS
WE TRUST
continued

PART 1. A NEW BUSINESS MODEL

“Direct-to-consumer – buying something on ‘brand.com’ – is a subset of buying online more generally, whether that is on tesco.com, Amazon, or Walmart,” explains Parkinson.

Some platforms like Facebook Shops offer a solution halfway between full D2C and selling through another company’s website, being hosted on the platform but offering brand personalisation to a level not possible on marketplaces where products are presented as a simple line item. Such solutions can therefore be considered D2C, to a certain extent.

“For companies with a strong consumer brand and the potential to establish customer relationships, D2C can be a very profitable disintermediation route,” says Ed Kevis, equities portfolio manager at Aviva Investors. “For example, digital D2C has been key to Nike’s strategy in recent years. It is the company’s fastest-growing channel, Nike invests a lot in it in all the markets where it operates, and it is margin-positive, since it disintermediates distributors and third-party retailers. Nike can curate its offer towards higher-margin, more profitable products.”

For new entrants without an established brand, the central question is how to build the funnel of brand and product discovery that will eventually lead to consumer sales and loyalty. “One of the keys to success is having a narrow focus,” says Scott Freundlich, senior credit research analyst at Aviva Investors. “Although Netflix, which is the powerhouse of video streaming, is not necessarily focused in terms of age group or genre, it is very focused on being D2C with a simple business model.”

Netflix shows that, across categories, investors hoping to identify the future winners of D2C need to focus on two sets of factors: tech capabilities on the one hand, and the ability to build and retain a strong customer community on the other.

End-to-end experiences

“What is important is having an agile, scalable tech stack, digital brand-building capabilities, and a well-invested, back-end infrastructure to facilitate fulfilment, from warehousing to logistics,” says Charlotte Meyrick, UK equities fund manager at Aviva Investors.

Building an audience quickly and the ability to create content that will go viral are particularly important for brand and product launches. But so is delivering a faultless client experience across the lifecycle of the customer relationship, from the first click to doorstep delivery.

According to research commissioned by McKinsey in August 2020, while free delivery and returns and fast delivery remain important, the pandemic and its ensuing lockdowns also drove up the significance of informative descriptions and clear images for customer satisfaction in the experience at a time when products couldn’t be seen in stores.³

Meanwhile, to build trust, brands increasingly need to communicate and demonstrate a sense of social purpose on issues such as community, health and the environment as part of their overall value proposition. A survey by consultancy Accenture found that purpose is at least as important as customer experience for eight in ten global consumers.⁴

Omni-channel challenges

Achieving this is fraught with challenges. The most successful brands have created demanding customer expectations, from cheap or free deliveries to purpose-led positionings, hyper-personalised relationships and frequently renewed products and services. From a logistics and technology standpoint, it makes it challenging to progress from the first few customers to a quick expansion, and even more so to maintain a viable offering over the long term.⁵

Laurence Buchanan, a partner at EY, recently wrote that foregoing distribution intermediaries means companies “must deal with an omni-channel strategy, be able to forecast demand, create bespoke supply-chain and delivery processes, as well as handling payments, return management and customer communication”. This is further complicated by differences across countries in terms of privacy laws, consumer attitudes and the cost of doing business.⁶

Another key challenge lies in companies’ ability to embrace an entirely new form of marketing. Consumers are no longer passive recipients of awareness-raising advertising campaigns. Instead, they are active participants in a two-way relationship spanning offline and online advertising, social media, influencers, product co-creation and, most crucially of all, data collection and analysis to deliver personalised products and communications.⁷

Legacy issues

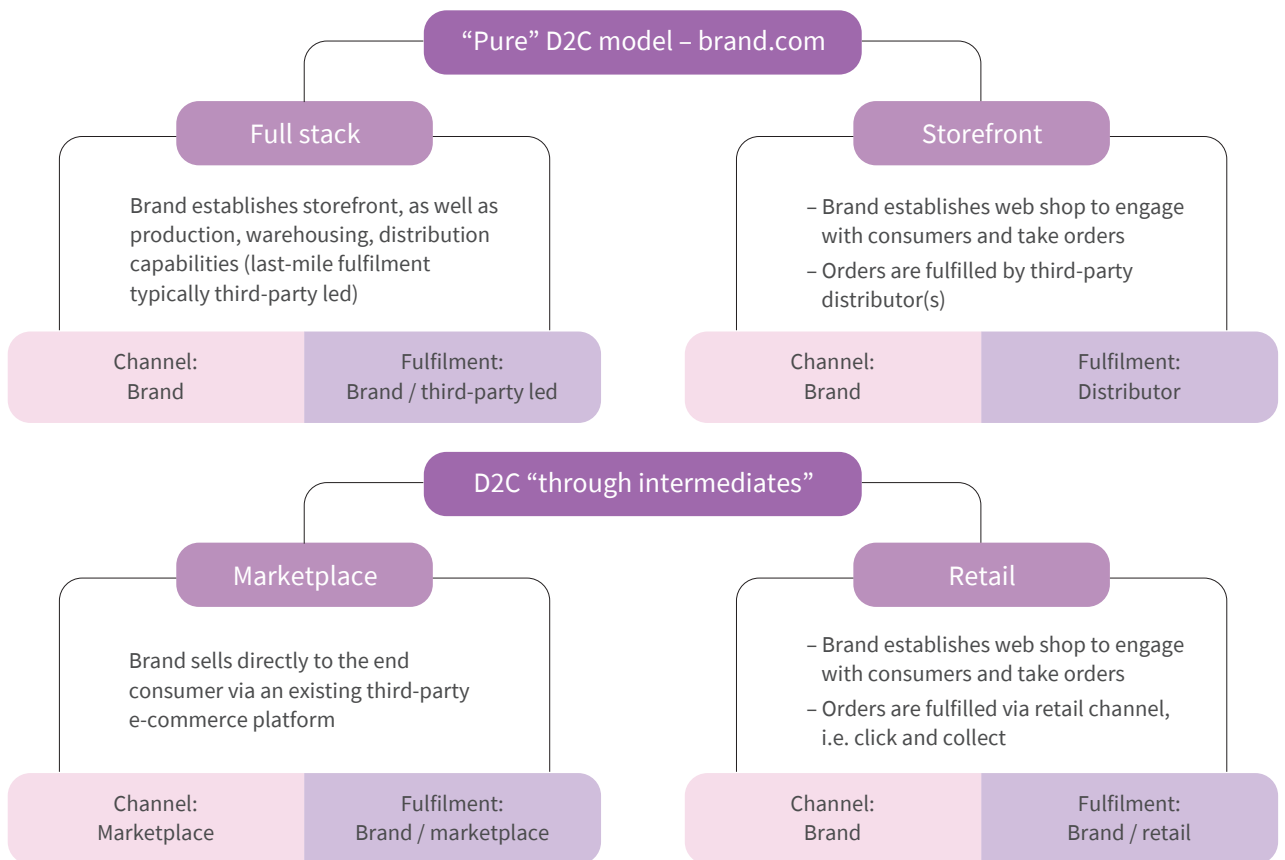
Whether traditional brands can build these capabilities and successfully switch to D2C remains to be seen.

“D2C can open new markets where brands benefit from increased sales,” says behavioural scientist Ben Voyer, research chair of Turning Points, Cartier – ESCP – HEC Paris and full professor in the department of entrepreneurship. “The issue is more to do with D2C-only brands without a retail presence. Those will have to fight for market share in ever more crowded markets. Social media is driving curiosity, and this encourages customers to be less loyal and keep on trying new brands.”

Start-up success stories and growth figures seem to show established brands falling behind the trend. One area is particularly delicate for them to navigate: positioning their brand purpose in an authentic manner.

“D2C brands, especially those born and bred online, have a unique opportunity to

Figure 1: Four possible online direct-to-consumer models⁸



Source: 'How to accelerate online direct to consumer strategies beyond COVID-19'; EY, June 15, 2020.

create a brand narrative from the beginning they can actually stick with in an authentic and transparent manner," says Prianka Srinivasan, EYQ insights director at EY. "When legacy brands try to change their personas and cater to people's prevailing sentiments from a marketing perspective, it starts to feel manipulative. In people's minds, if the companies weren't doing this two years ago, the only reason they are doing it now is to make a bigger buck. That is a challenge for a lot of legacy brands."

Many are nonetheless demonstrating an ability to create a persona in line with their core positioning, and successfully using

specialist outsourced partners or in-house direct marketing channels to improve awareness, acquisition, engagement, satisfaction and profitability.⁹

Parkinson explains that companies' own perception of the importance of D2C is a key driver for successful transitions.

"One of the reasons cosmetics has gone so heavily D2C is because of the expensive department-store sales model," he says. "The likes of Macy's and John Lewis were capturing so much margin that it has been wildly profitable for the big brands to shift to D2C channels. Some market commentators estimate that, for every one per cent of

L'Oréal's global sales that moves D2C, it could add two per cent to profits."¹⁰

Another key factor is product category. Parkinson illustrates this by contrasting the example of canned soft drinks with cosmetics. "When we want some Coke, we just put it in our Ocado or Tesco online basket. We tend not to look for it on the company's website; it's just the nature of the product," he says.

This raises several questions on what will happen to intermediaries, how online sales will split between brands and middlemen, and who will win the battle for "the new oil" that is customer data¹¹ ●

IN BRANDS
WE TRUST
continued

PART 2. DATA AND THE MIDDLEMAN

“There is the term ‘attention economy’. What we are all fighting for now is people’s attention,” says Greg Davies, head of behavioural finance at Oxford Risk, a company specialising in behavioural software to help people make better financial decisions.

This has created several new breeds of middlemen, the first of which is social media advertising, from Facebook to YouTube or TikTok influencers.¹²

“These people are very much the middlemen in terms of brand awareness and marketing, but the ultimate end is they’re pointed towards your own website, whereas in the past they would have been pointed towards a Tesco store or another retailer,” says Parkinson. “These digital properties are intrinsic to the nature of D2C, and the success of a brand’s website hinges on the effectiveness of their social media and online marketing, particularly if they are a start-up.”

However, social media can also become the store. “The issue is that every social media platform has the potential to become a D2C platform,” says Voyer. “Think of TikTok; just add a ‘buy now’ button next to your favourite social media influencer and this allows them to enter the market. This has become known as ‘social shopping.’”

The second type of middleman focuses on providing marketplaces where consumers can find all available options in one place. Amazon is the epitome of the generic marketplace, while travel sites from Expedia to Booking.com and Airbnb are specialised.

“The economics of that are interesting,” says Davies. “If these firms are matching hotel rooms to people, they apparently take 20 to 25 per cent of the revenue. If you book five days in a hotel through one of

them, one entire night of your stay is going directly to a company who doesn’t even own the hotel but has done the matching.”

The third type of emerging middleman is more of a solutions provider working behind the scenes to deliver various components that make up a D2C offering.

“Some consumer brands are playing catch-up and don’t know how to develop a D2C offering quickly at scale,” says Meyrick. “That’s where Shopify or Magento come in with their front-end self-service D2C solutions.

“A company called The Hut Group goes further still and has a full end-to-end enterprise D2C solution, providing convenience and often a more cost-effective solution than sourcing individual components from a number of different vendors,” she adds.

The fragmentation of shopping

Another danger to traditional retailers, which also applies to online marketplaces like Amazon, is the ease of shopping across multiple sites compared with brick-and-mortar stores. Shopping is fragmenting, after several decades of consolidation of the weekly shop – which went from stopping at the butcher’s, fishmonger’s and greengrocer’s in turn to buying everything in a single supermarket, enabling the spectacular success of large retailers.

“Clicking five times on different ‘buy now’ buttons in different places on the web is less of a hassle than doing five separate shopping trips, even if they’re linked in a single drive,” says Parkinson. “The opportunity to fragment customers’ buying behaviour is there, and D2C ventures will want to exploit that.”

In a recent letter to shareholders, Amazon CEO Jeff Bezos underlined the fact most Amazon shoppers completed their

purchases in under 15 minutes.¹³ “It’s not a complete coincidence because he may see the reduction of the fragmentation barrier as a threat,” notes Parkinson.

On the other hand, traditional retailers with a relevant, differentiated client proposition can still prosper as brands shift to D2C. Meyrick gives the example of JD Sports, historically a store-led retailer and wholesale partner for leading sports brands.

“Nike and Adidas are successfully shifting to D2C and shrinking their number of wholesale partners as a result,” she says. “However, they have continued to give more business to wholesalers that complement their offering like JD Sports, who help them reach a different customer demographic.”

Uncovering new markets

What this also reveals is companies can explore other avenues to market than the very largest platforms and marketplaces.

“There are other channels and other means to get customers, and D2C brands need to start exploring all the available options, especially given the fact some D2C brands are global,” says Srinivasan. “China, India, Southeast Asia, Singapore, Australia and even the UAE all have completely different platforms. D2C brands, especially ones born and bred online, need to take advantage.

“They can also create their own online presence and never go to any of the platforms,” she adds. “Though some of the advertising might have to, the real focus is on SEO optimisation, brand alliances with traditional big retail, innovative avenues to get their online brand in the market. It’s good to diversify the risk.”

As firms become more experienced, digital commerce is becoming intertwined with regular commerce. Legacy firms are catching up with their digitally native peers and mixing and matching various blends of in-house and outsourced solutions.



Split down the middleman?

Eventually, there may be a split between commodity products sold on retail sites and marketplaces on the one hand, and higher-value, purpose-driven brands thriving in a D2C model on the other.

In this emerging ecosystem, behemoths Facebook and Amazon are each making strides to capture separate strands.

Amazon is growing its advertising business at pace. “As both advertising and commerce become digital, companies’ ability to close the loop between their advertising spend and the sales generated goes up structurally,” says Parkinson. “If I have a shopfront on Amazon and I advertise on Amazon, I have a complete picture of where I spend dollars and how many of those people ended up buying my products on Amazon.”

In a mirror initiative, Facebook launched Facebook Shops in May 2020, as an alternative to products being a simple line item on a marketplace.¹⁴

“Facebook is trying to rapidly grow its e-commerce business because of its dominance in advertising, and its ability to close the loop for a different demographic of customers with a different need,” says Parkinson. “Facebook Shops offer the ability to customise the branding compared to a line item on Amazon, while keeping it all within a platform where there is no GDPR to prevent companies from connecting the dots between the dollars they spend and their revenue.”

Data versus access

With pure D2C, however, brands will retain more control over their customer data. Depending on their strategy, they may choose between relinquishing some of that control, to benefit from the unparalleled visibility a large platform can give their brand, and offering a pure D2C channel to oversee and optimise the end-to-end customer experience, albeit to a smaller audience. Strategies may evolve over time, as fledgling companies build their

customer base on marketplaces and bring them in-house as they grow.¹⁵

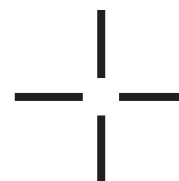
One advantage of controlling as many touchpoints as possible along the customer journey is that it enables brands to collect behavioural data along the way and use it to enhance the client experience – providing personalised information in the most relevant places, giving insight across departments from sales to client support, and developing a single customer view to provide a seamless experience.¹⁶

It also allows companies to understand what their customers need. However, it is crucial for companies to provide accurate information as well – not just collect it. European research conducted by data solutions provider Yext in August 2020 found nearly half of customers (47 per cent) said brands struggle to display the correct information online. At the same time, 70 per cent said being offered accurate answers by a brand evokes trust, and 56 per cent added they would buy from a brand they trust. Not using data effectively can hinder relationships and jeopardise the entire brand.¹⁷

“Customers, especially in Europe, are wary of the information they give away when signing up to platforms,” says Voyer. “They make a trade-off that the sharing will lead to benefits (discounts, personal recommendations, etc. . .), the issue being that the bar keeps being pushed up. Consumers want more and more because the baseline of benefits keeps improving and is offered everywhere.”

On the other hand, some brands are at risk of pushing data usage too far. In particular, the use of cookies to share information across sites, or even between different media, can make companies feel manipulative. It is a fine line between personalisation and intrusion, and companies must find the right balance ● ►

“*With pure D2C, brands will retain more control over their customer data*”



IN BRANDS
WE TRUST
continued

PART 3. A QUESTION OF TRUST

“The phasing out of Apple’s Identifier for Advertisers – IDFA – and of third-party cookies, reducing firms’ ability to target consumers, is the backlash from intrusive practices,” says Parkinson. “That backlash is happening, and the industry, which is completely reliant on cross-platform advertising, is furiously trying to build a new ‘Unified ID’. This aims to replace cookies with a more purpose-built method allowing explicit user consent of tracking against more relevant advertising.”

While this may complicate the building of accurate models and predictions of consumer behaviour, Davies says regulation will mostly change data collection and usage in a good way for customers.

“If we approach things in a way where people are engaged, and willingly sharing their information to get better service, this isn’t something regulation should stop,” he says. “If I know you are profiling me, but you are doing so to help me, and I share by answering questions, I am part of the process. It’s not something you are doing to me but with me.”

Personalise and engage

According to EY’s *Megatrends 2020* report, “consumers are hungry for innovative approaches using behavioural capabilities to empower and engage with them rather than exploit and alienate them. Companies able to fill this void could see tremendous market potential”.¹⁸

Behavioural science is increasingly used by marketers to respond to or influence consumers’ beliefs, creating or reinforcing behaviours to build trust, loyalty and, ultimately, sales.¹⁹

“D2C companies are doing a lot of things behavioural economists would consider effective strategies: creating a differentiated brand on social media; being very active on social media; and creating a sense of intimacy and authenticity,” says Gautam Jaggi, director of EYQ at EY.

“A lot often tap into emotional triggers as well,” he adds. “You will see D2C companies tapping into frustration with the high prices of traditional brands and offering a lower-priced alternative or using social norms and a sense of purpose, with some brands making social or environmental commitments for every product sold.”

Jaggi also lists companies specialising in products consumers might be embarrassed to buy in-store or those that require a lot of information gathering, where a good D2C site will support consumers in their research, or even share video tutorials on product use. “All those things create a more intimate relationship and tap into emotional needs, and that creates a strong bond,” he says.

Many D2C companies also offer their customers more choice, not necessarily in terms of the product range but through personalisation, sometimes down to the price people are willing to pay. “That’s one way of building trust because it provides transparency and makes the customer a partner in the process,” says Srinivasan.

Personalisation can be as simple as predicting when consumers will run out of their favourite products and offering them a deal or sending them a reminder to renew, or as complex as asking customers to participate in new product development, explains Voyer. “For brands who do not have an established online community, engaging in co-creativity for new products is a good way to build trust and respect,” he says.

Additionally, aligning messages and product innovation with consumer mindsets can be a strong way to build loyalty. Lipton’s Immune Support Tea,

rolled out after COVID-19 increased consumers’ health and wellness concerns, and haircare brand Olaplex’s donations to support local hairdressers during lockdown are good examples.²⁰

Though the concept of behavioural science may sound ominous, its use in marketing mostly equates to effective practices.

“There is not a marketing department in the world that does not use behavioural economics, whether they are aware of it or not,” says Jaggi. “Marketing and behavioural science evolved in separate universes for a long time but independently came to similar conclusions. From the way things are priced to how they are shelved and advertised, all of marketing uses behavioural economics. You can call it manipulation, or you can just say that’s what works.

“However, that’s not to say the perception of manipulation isn’t real and isn’t something to be worried about,” he adds.

Manipulation or participation?

While Jaggi and Srinivasan don’t always agree with the term ‘manipulation’, behavioural strategies can create a perception of manipulation and spur a backlash.

“What makes certain companies more successful is authenticity and transparency; that requires showing up in the market in a consistent manner,” says Srinivasan. “If you can do that, it won’t be perceived as manipulative. At the end of the day, these are tools, and they are not good or bad in and of themselves. How you use those tools is what dictates the outcome.”

Jaggi explains the greatest danger is when companies are not aware they are using behavioural science techniques. “Behavioural economics can lead to very dark outcomes if we’re not using it consciously,” he says. “Social media is



the latest example, but there has been behavioural manipulation for years; getting people to smoke cigarettes, eat unhealthy foods, or rack up credit card debt. All of those are dark outcomes and rightfully led to a backlash.

“All companies, including D2C brands, should be thinking about how to use this purposefully, to empower people to do the things they really want to do, as opposed to just getting them to buy more,” he adds.

As an example, Davies says that to build a system that will help people make better financial decisions, it is necessary to first have a clear idea of what ‘better’ means. In personal finance, that includes understanding people’s financial circumstances, but also their behaviours (do they spend more than they earn or save every month?) and perceived financial wellbeing (how anxious are they about their financial situation?). Only by granularly profiling each customer on all three aspects can a system offer them the best options to help them build financial resilience.

To avoid manipulation, Davies says engagement is important. “People must be involved in the construction and evolution of their own financial system. That means not telling them what to do, but giving them a menu of good things they could do and letting them choose,” he says.

Demonstrating trustworthiness is also crucial, which requires companies to prove they will act to the benefit of their customers, even when it is to their own detriment. “Often, investing is about encouraging people to do less, rather than more,” says Davies. “A company willing to encourage that, even if it brings in less revenue, will credibly demonstrate its trustworthiness.”

Would I lie to you?

Regardless of such efforts, companies could still find themselves at the mercy of malicious fakes capable of harming their brands deeply.

“A shallow fake is taking a real video or audio and editing it to portray something different. A deep fake is a complete forgery,” explains Srinivasan. “If you think about the number of Tom Cruise videos that have been all over social media recently, those are completely fake. But if you look at the Nancy Pelosi video that was done, that’s a shallow fake. It was really her; she really said those things, but the video was manipulated to make her look bad.”

According to the Yext survey, 92 per cent of consumers believe misinformation is a problem, and two thirds think this will only grow. This is an issue for companies, as nearly half the respondents blame brands themselves for misinformation, no matter where they find it.²¹ Fakes can have a potentially devastating impact.

“These have the same effect as counterfeit products for luxury brands: they can tarnish a brand image, and put people off buying the product. D2C brands need to be especially careful to educate customers on what genuine products are and look like,” says Voyer.

Such fakes can affect a company’s share price. Equally, malicious actors can harm the brand by posting negative product reviews by the hundreds. Any of these can erode customer trust and loyalty.²²

“In March 2021, the FBI issued a ‘private industry notification’, telling companies malicious actors will almost certainly leverage synthetic content for cyberattacks in the next 12 to 18 months. This is how serious the situation has become,” says Srinivasan.

Occasionally, deep fakes are deliberately used for marketing purposes – some brands having recently revived Marilyn Monroe and Audrey Hepburn in their advertising, for instance. However, more concerningly, a major smartphone maker now includes software enabling anyone to create a deep fake.²³

Jaggi says another cause for concern is that our cognitive abilities are declining just as we need to become more sophisticated in discerning fakes and fraud. “We are in a world where conspiracy theories are running

“Companies still find themselves at the mercy of malicious fakes”





IN BRANDS WE TRUST

continued

amok and a growing percentage of people believe the earth is flat,” he says. “Despite having instant access to information prior generations could never have dreamed of, we are becoming less able to use those sophisticated tools.”

Hackers also keep evolving, meaning companies must monitor all the online content related to their brands and continuously educate their customers. Somewhat encouragingly, regulation is being considered, at least in the US, to help protect companies and consumers.²⁴ Technologies to embed authenticity markers into online content are also progressing.

“A lot of companies are using different technologies, whether it’s AI, blockchain, or digital watermarking, to indicate what is authentic to consumers,” says Srinivasan. “A company named Truepic recently closed a deal to include digital watermarking technology into smartphone cameras so if any content from a particular device is changed, it will be detected. A professor at Berkeley, Hany Farid, teaches digital forensics, misinformation and image analysis targeting the growing threat of synthetic media.”²⁵

The attention merchants

Despite these risks, online penetration will continue to increase, and the attractions of building direct relationships and increasing margins by cutting out middlemen mean D2C is here to stay.

“I see the emergence of many direct ‘hyper-targeted’ niche stores for virtually everything,” says Voyer. “Think The Hut Group strategy but with D2C, meaning one brand/website/app/e-store but for a niche brand, and as many viable niche markets as one can identify. D2C has the potential to reshape the whole e-retail landscape.”

We may also see the emergence of alternative targeting, for instance through online streaming embracing advertising and tailoring it based on viewers’ watching habits, or through interest-led publishers.

“UK-based publisher Future convincingly argued that one of the winners from the evolution of digital advertising is first-party, interest-led publishing,” says Meyrick. “Future argues that, for instance, subscribers to an amateur photography

magazine are very likely to be interested in cameras. It’s the dawn of a new hope for independent publishers that can demonstrate clear, interest-based audience behaviour without the need for any surreptitious tracking.”²⁶

Alternatives to the cookie-based business model are emerging, which may make it easier for D2C companies to maintain trust and withstand regulatory pressures. A cryptocurrency called the Basic Attention Token is reappropriating the business model. It is based on a web browser called Brave, which uses blockchain technology to anonymously track user attention, helping to compensate publishers based on advertising engagement. Additionally, users of the browser are rewarded with Basic Attention Tokens as compensation for their participation.

“I don’t know if it will be successful, but it could allow brands to better understand how their ads resonate with audiences, using engagement as the main metric,” says Freundlich. “Either way, I don’t think traditional advertising is going to be the same going forward” ●

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CLIMATE TECHNOLOGIES IN SEARCH OF WILD SOLUTIONS

No single technology is enough to tackle the climate crisis, a global and systemic issue that needs joined-up thinking. We pick out different pathways to address warming gases in the atmosphere, **five nature-based** and **five technical**, and ask what steps are needed next.

“Climate change is really the kind of threat that we as humans have not evolved to cope with. It’s too distant. It’s too remote. It just is not the kind of urgent, mobilising thing.”¹ These words from the eminent psychologist Daniel Kahneman perfectly capture the difficulty in persuading people to address the climate emergency.

Where to start?

There are numerous different approaches being advocated to reduce warming gases

in the atmosphere. Where can changes be made, fast? Analysis from Project Drawdown, a non-profit organisation and leading resource on climate solutions, is helpful, assessing what can be done immediately to bring forward the point when greenhouse gases (GHGs) decline.²

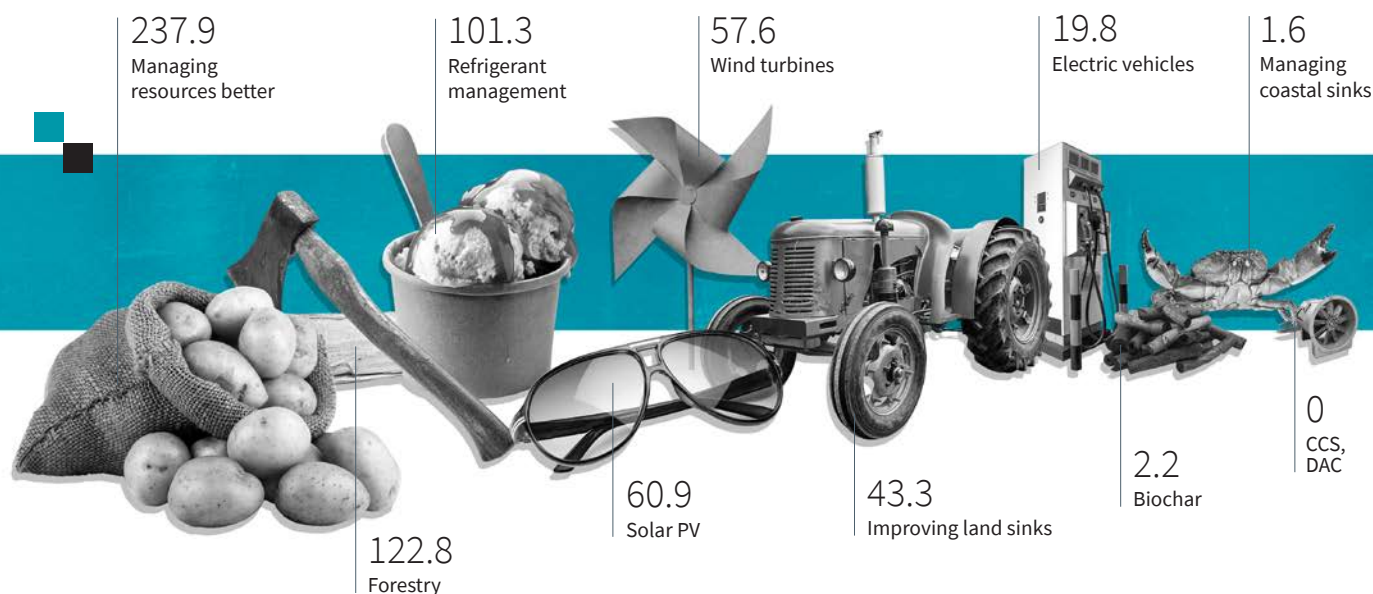
As Figure 1 shows, change starts with us.

Some evolving technological approaches like carbon capture and storage (CCS) fall outside Project Drawdown’s analysis.

However, CCS is included in the projections (‘model pathways’) used by the Intergovernmental Panel on Climate Change [the United Nations body that provides scientific updates on climate change]. Outcomes from early usage have been mixed, but as the approach is getting increasing attention, it is included in our analysis, too.

The question then is: what’s on the horizon? What do we need to bring big results, and do we need new tools in the box? ►

Figure 1: Questions of scale³ (gigatons CO₂ equivalent reduced/sequestered, 2020–2050)



Source: Project Drawdown, 2021.

IN SEARCH OF WILD SOLUTIONS

continued

1. PEOPLE POWER: CHANGE BEHAVIOUR

Being more mindful of our actions is a powerful (and swift) climate solution. We have the power to make changes – now.

Think Highest impact actions:⁴

- Cut family size
- Avoid unnecessary travel

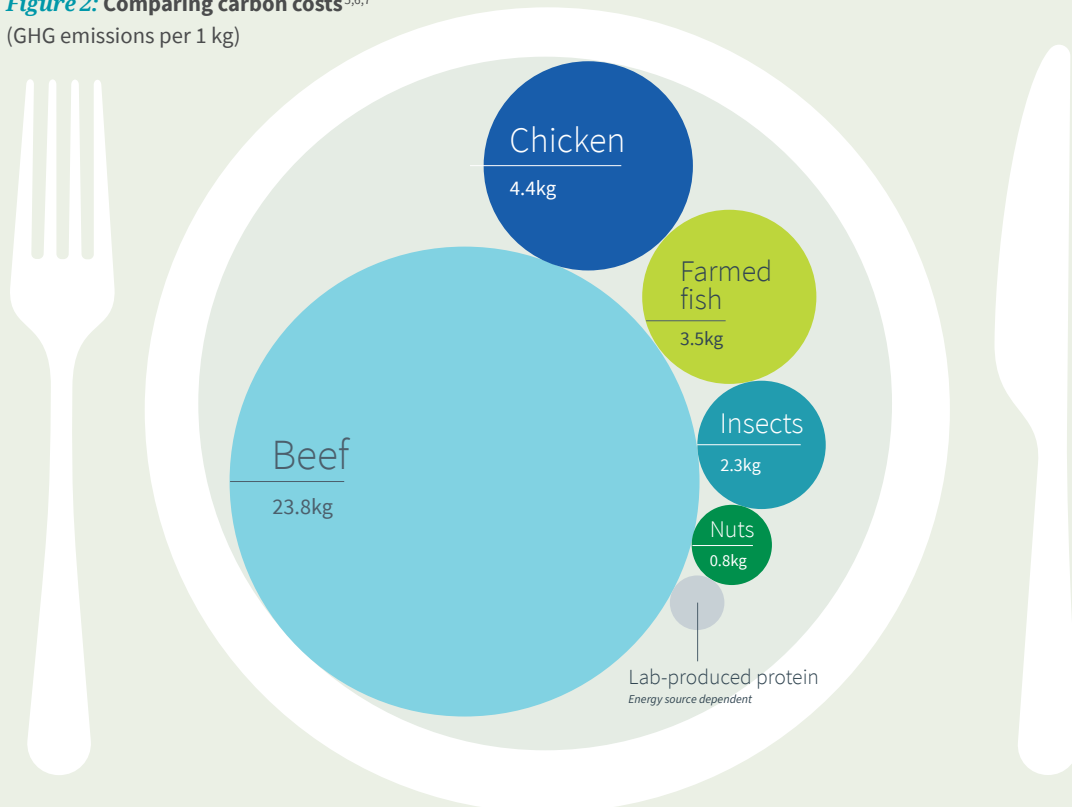
Education for all = more change



2. HUMAN FUEL: WHAT'S ON YOUR PLATE?

Selecting proteins carefully and minimising food waste bring big and immediate environmental impacts.

Figure 2: Comparing carbon costs^{5,6,7}
(GHG emissions per 1 kg)



Source: Poore and Nemecek, *Science*, June 1, 2018; *Science Nordic*, May 17, 2017.

Waste not, want not

- 30 per cent of food produced worldwide is wasted⁸
- Less waste could trim GHG emissions by eight per cent

Next? Vegetarian diets, including algae rich in Omega-3; lower-carbon proteins; and carefully avoiding waste can all reduce environmental impacts.



“Our research shows there isn’t good awareness of what people can do or what governments are doing on climate change. But most people think they have a responsibility to act and are taking some actions already, like changing their diets. Education is important, but it is even more important that we make it easy, attractive and normal to take action. Messaging is only part of what we need to do – we need policies to support and enable change.”

Professor Lorraine Whitmarsh

Director, Centre for Climate Change & Social Transformations,
University of Bath

3. PROTECT TROPICAL AND TEMPERATE FORESTS

Forests are a major carbon sink, and the removal of cover has diminished the amount of CO₂ locked into biomass and soil. This triggers macro-changes to global temperature regulation, biodiversity and the water cycle.



Becoming woodland custodians

- Forest cover down 33 per cent since 1750⁹
- Global timber demand forecast to rise almost 300 per cent by 2050¹⁰ for construction, packaging, bioenergy



“Forests play a critical role for life on our planet. And yet, just like oxygen, we risk taking them for granted until they are gone.”

Nicole Schwab

Co-director, Platform to Accelerate Nature-Based Solutions, 1t.org

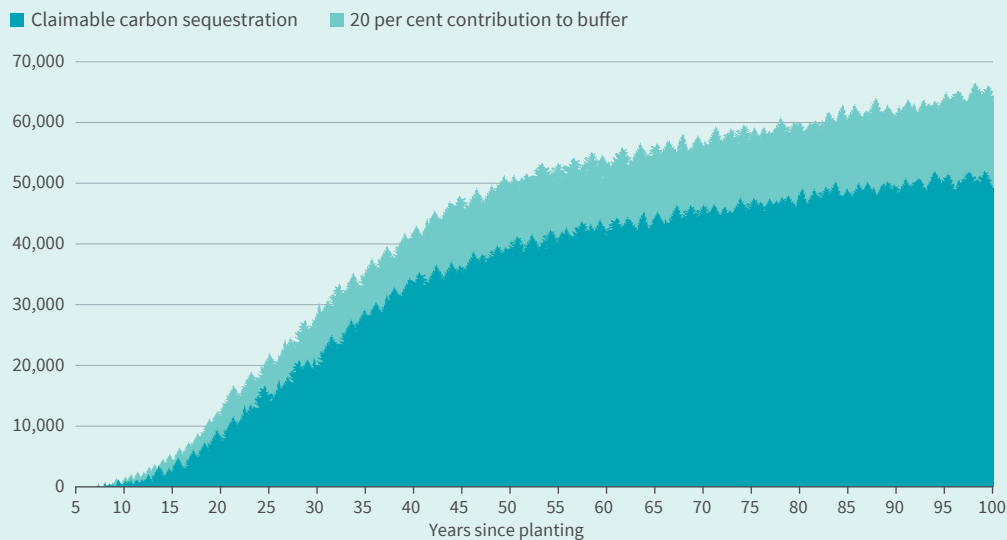
Next? Intensify conservation efforts and reward carbon farmers. Challenges include addressing sustainability and governance issues to ensure schemes aimed at storing carbon do what they say.

IN SEARCH OF WILD SOLUTIONS

continued

Buying carbon offsets can help put private capital to work to promote sustainable carbon farming. Equally, buying land to generate carbon credits offers a hedge against the rising cost of carbon. But ‘success’ will depend on how sensitively existing forests and newly planted woodland are managed.

Figure 3: Illustrative sequestration from managed woodland¹¹ (tCO₂e)



“Forestry is a long-term business. It is a challenge for land managers to commit to really long-term change. You are permanently moving from where you might have an annual decision to make about the way the land is put to use, to something set out years in advance.”

Dr Vicky West

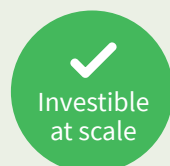
Woodland Carbon Code Manager

4. IMPROVE LAND MANAGEMENT AND RESTORE FARMLAND

Agriculture is a major source of GHG emissions. The fuel used in commercial land management, methane from ruminating livestock and carbon reduction from depleted soils all have an impact.

Caring for the soil

- Net carbon reduction in soil since modern commercial agriculture: 130 billion tonnes¹²



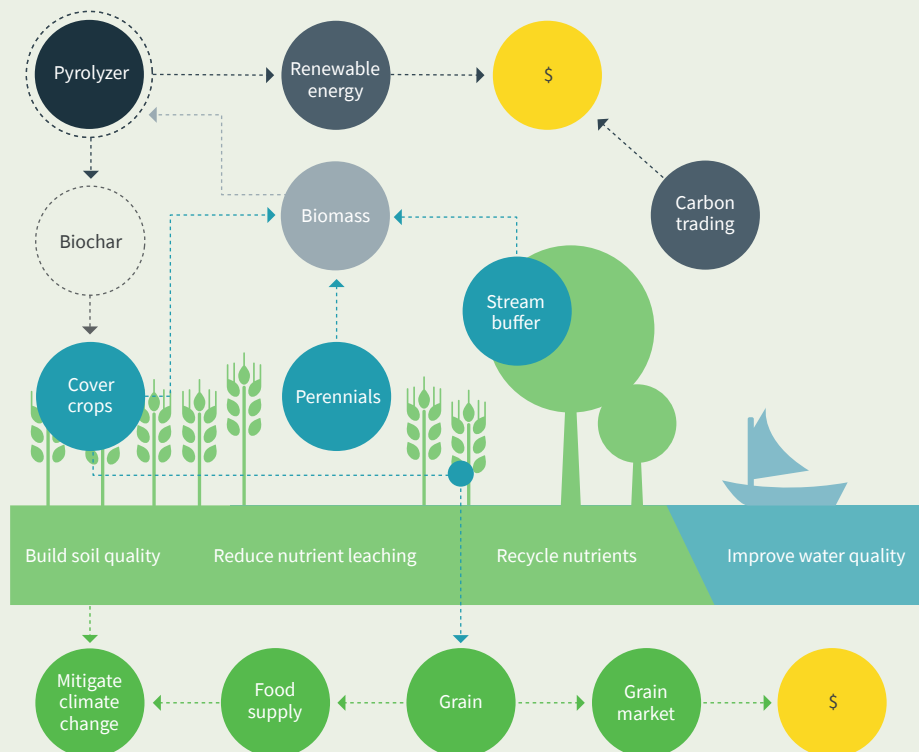
“Without healthy soils, we don’t have the basic building blocks of ecosystems and, hence, nature is in trouble. That is primary, but there are other reasons why soils are important. They relate to the soils’ productive potential, their ability to underpin agriculture and food production, and ultimately the security of our lives. Soils are also massive reservoirs of carbon and their mismanagement is a serious issue for climate change.”¹³

Dieter Helm

Professor of Energy Policy, University of Oxford

Next? Measuring soil sequestration better and more comprehensively; commercialisation of biochar as feed additive, in water treatment, insulation, ‘electrosmog’ protection; ‘next generation’ bioenergy crops.

Figure 4: Revitalising biochar and contributing to sustainable energy¹⁴



Source: Farm Energy and Aviva Investors, 2021.

“Biochar is arguably the only way to recapitalise soil. Heating straw or timber by-products at high temperature in the absence of oxygen converts them into forms whose natural analogue – charcoal – naturally degrades over longer timescales (hundreds to thousands of years, rather than months). So, adding biochar can gradually increase soil carbon levels, without committing future biomass resource.”

Dr Saran Sohi

UK Biochar Research Centre, University of Edinburgh

IN SEARCH OF
WILD SOLUTIONS
continued

5. PROTECT AND RESTORE MARINE ECOSYSTEMS (INCLUDING WETLANDS)

Marine ecosystems are important carbon sinks; some sequester carbon rapidly. Preservation and restoration of degraded wetlands will improve global carbon stores.



A lighter touch in the marine world

- Degrading coastal ecosystems release one billion tonnes¹⁵ of CO₂ annually = 19 per cent of emissions from tropical deforestation



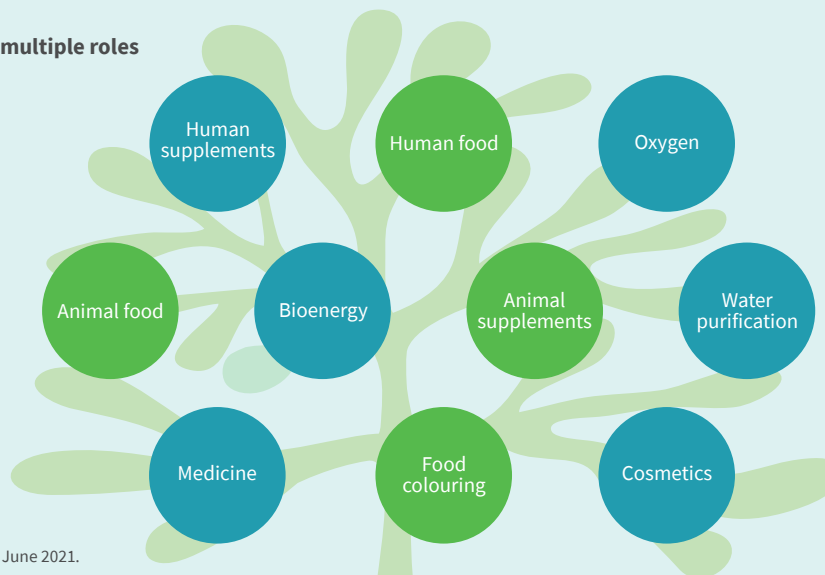
“Just as trees and other plants on land draw down carbon from the air through photosynthesis and then store it, the vegetation in marine ecosystems also sequesters carbon. Mangroves, saltmarshes, and seagrass habitats actively fix and store ‘blue carbon’, sometimes faster than the sequestration carried out in mature tropical forests. While a forest carbon store is mainly in the biomass, in trunks, stems and leaves, seagrass and saltmarshes store carbon in the rich sediments that develop around the plants, in stores up to six metres deep. Rewilding marine and coastal ecosystems around the world could sequester more than one and a half billion tonnes of CO₂, and that excludes the carbon stored in coral reefs, seaweeds, shellfish beds and seabed sediments.”

Dr Chris Tuckett

Director of programmes, Marine Conservation Society

Next? Algae: rapid yields for super foods and fuels?¹⁶

Figure 5: Algae's multiple roles



Source: Aviva Investors, June 2021.



6. MANAGE REFRIGERANTS MORE EFFICIENTLY

Cooling devices are essential for preserving food and medicine and increasingly being used to cool homes and buildings in climate extremes. But today's refrigerants have a significant impact on the climate.



“We are going to be deploying somewhere between 13 and 18 cooling devices per second for the next 30 years, and we are still not going to deliver cooling for all.”¹⁷

Toby Peters

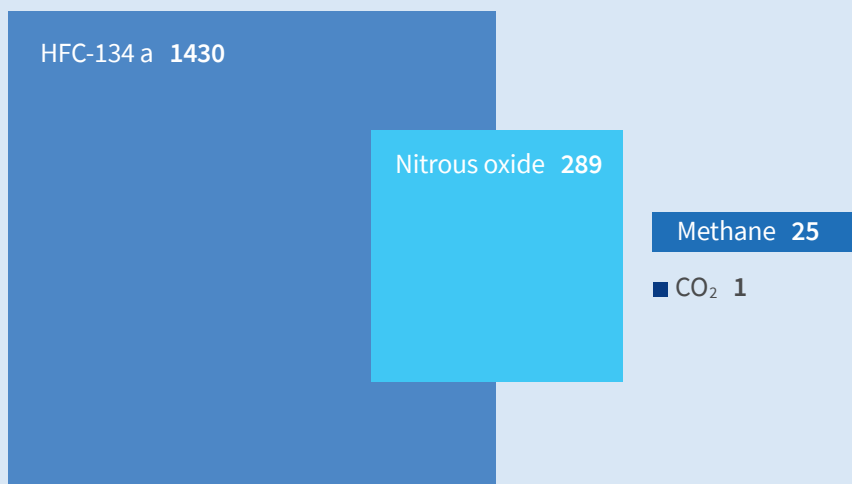
Professor in Cold Economy,
University of Birmingham

Chilling

- Fluorinated gases in refrigerants have much greater warming potential than CO₂ and some (banned) compounds damage the ozone layer
- Cooling equipment leaks while operating, then there is an end-of-life challenge
- Enforcing existing quotas and cleaning up are environmental priorities



Figure 6: Climate impact of refrigerants¹⁸ (kg CO₂ equivalent)



Source: UK Government Greenhouse Gas Conversion Factors 2021.

Next? Accelerate development of alternative refrigerants, and secure end-of-life.

IN SEARCH OF
WILD SOLUTIONS
continued

7. HARNESS THE SUN

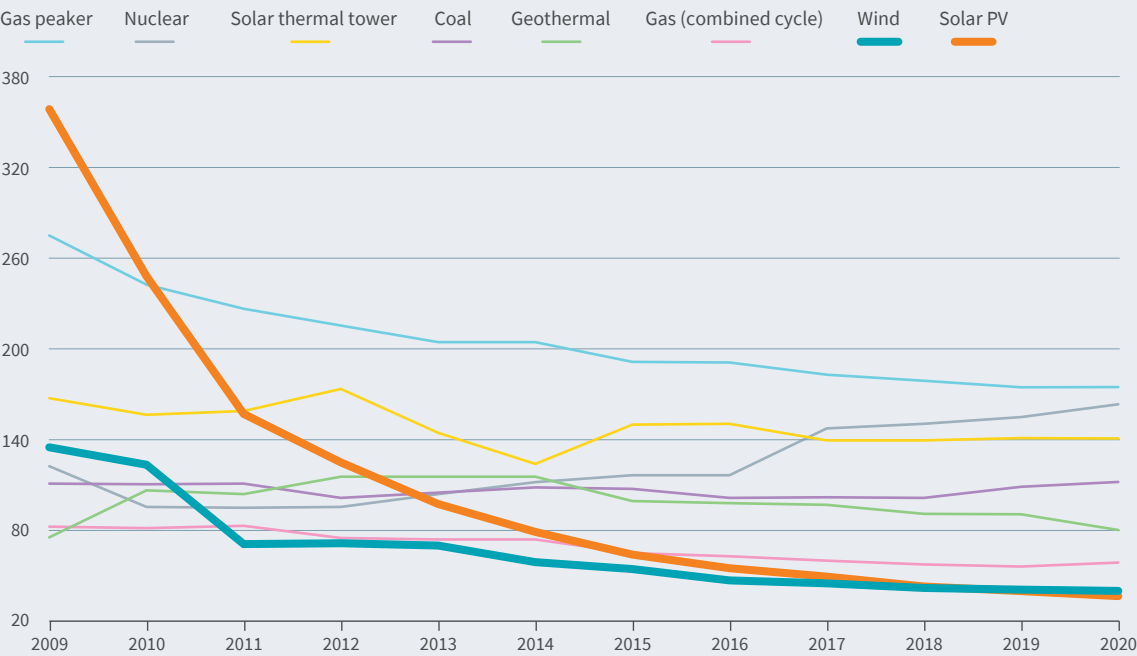
The sun is a powerhouse that produces the equivalent of 38,460 septillion (3.846×10^{26} W) watts per second,¹⁹ more than enough to meet current human energy requirements. Recent innovation has led to capacity forecasts being revised up.²⁰ But there is a challenge: how to store it.



Hot hot hot Solar: Already delivering the cheapest electricity in history²¹



Figure 7: Lazard levelised cost of energy comparison²² (per cent)



Source: Lazard, October 2020.

Next? Multi-junction cells with efficiencies close to 50 per cent, low-cost storage and transport options including solar-to-hydrogen, better management of millions of tonnes of PV waste.

“We are working on tandem or multi-junction cells, enabled by the discovery of the photovoltaic properties of a new material family known as perovskite. Perovskite operates as well as the best silicon but can be processed relatively easily at low temperature. By layering different absorbers on top of each other in a cell, we can optimise for different parts of the spectrum and boost overall efficiency. We only discovered the potential of perovskites comparatively recently; it’s equivalent to being in 1965 in silicon technology terms. There’s lots of room to improve.”

Henry Snaith

Professor of Physics and Becquerel Prize Winner 2020,
University of Oxford

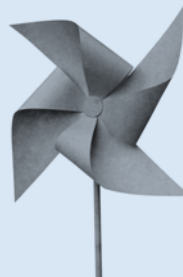
8. WHEN THE WIND BLOWS

Wind power has been an extraordinary success and next-generation floating platforms will make it possible to generate energy in deeper oceans. The problem? Same as solar: long-term storage.



Look at the cost!

Offshore wind: Cheaper than new fossil fuel capacity²³



“Wind power is at gigawatt scale; it is here to stay. One of the big leaps so far has been purely from the growth in turbine size, which has accelerated far ahead of any expectations. In 2015, we were still struggling to break the £100 per megawatt hour barrier and that was smashed shortly afterwards. Turbines got much, much bigger than anyone expected, and I think they will get bigger still.

Integration with the energy system is now becoming the fundamental challenge. As an appreciable part of the power mix is coming from more variable, renewable sources like wind and solar PV, we need more large-scale energy storage, and hydrogen is emerging as the most likely medium. That’s going to be the next big step change.”

Professor Simon Hogg

Ørsted Chair in Renewable Energy, University of Durham

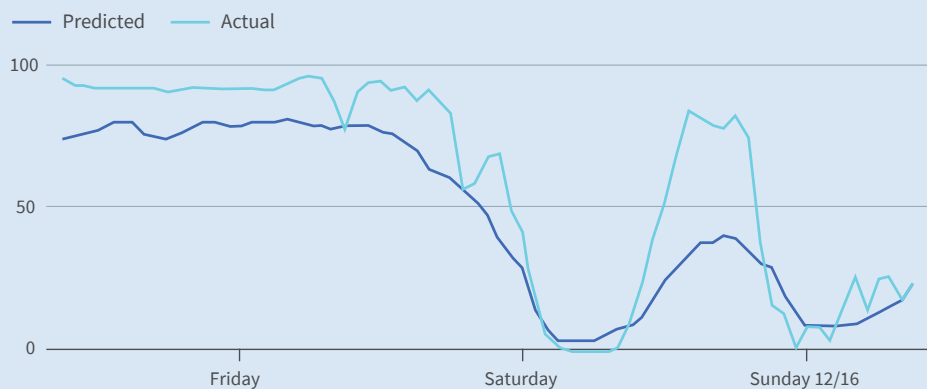
IN SEARCH OF WILD SOLUTIONS

continued

Next? Developing 100 per cent recyclable components, using artificial intelligence (AI) to anticipate wind power output.

DeepMind, a research subsidiary of Alphabet Inc, is using AI to predict wind power output 36 hours ahead, to shape forecasts and improve capacity management.²⁴

Figure 8: Using AI to improve energy efficiency (MW)



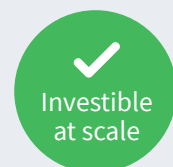
Source: DeepMind, February 2019.

9. ENERGY STORAGE BREAKTHROUGHS

Centralised energy systems need energy supply and demand in balance, which is inefficient, leading to over-capacity in some areas and none in others. So, demand for large scale, safe, flexible storage is growing but further advances are needed.

Battery storage costs tumble

- The cost of lithium ion batteries, the dominant energy storage technology in mobile phones and electric cars, has fallen rapidly
- Other cost-effective, long-duration storage is needed to maximise the potential of renewables

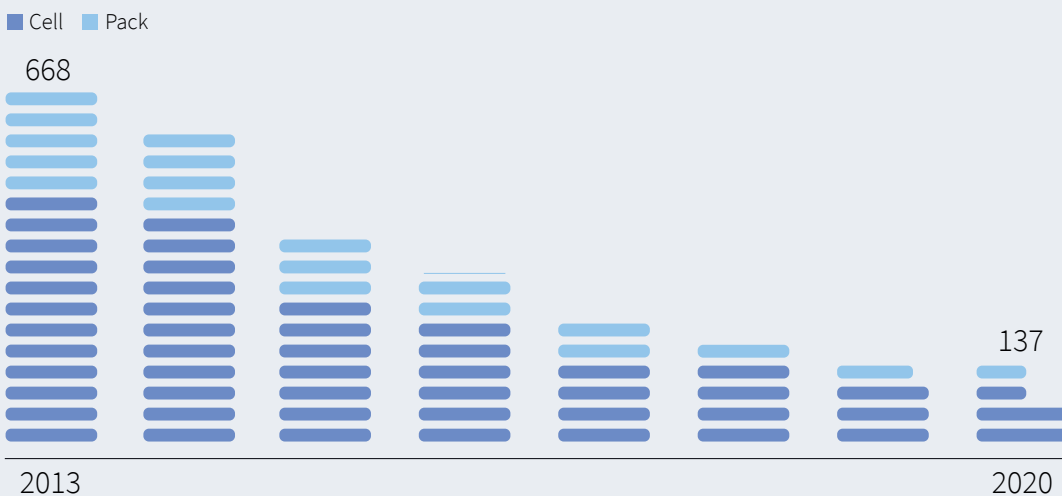


“Wind and solar are intermittent, so incapable of being integrated into baseload generation. Storage is the key. Without electricity storage, we cannot draw electricity from the sun when the sun doesn’t shine.”²⁵

Donald Sadoway

Professor of Materials Chemistry, Massachusetts Institute of Technology

Figure 9: Decline in electric vehicle battery costs²⁶ (\$/kWh)



Source: BloombergNEF, December 2020.

Next? Co-location with solar; new battery technologies including vanadium ‘redox flow’ or liquid metals; integrating and managing decentralised network flows; scaling up EV supply chains.

“The solar sells its power, and the battery earns its money through wholesale arbitrage, the balancing mechanism and ancillary services. What you achieve by co-locating them is a reduction in your capital and operational expenditure that lead to an increase in your internal rate of return.”

Mark Ryan

Director of asset management, Anesco²⁷

IN SEARCH OF WILD SOLUTIONS

continued

“We are beginning to see EVs becoming the norm... That means suddenly you take people off the forecourts, they are charging at home or in their business... You may start to see a lot of dynamic demand coming through from domestic customers that we have never seen before.”

Juliet Davenport
CEO, Good Energy²⁸

10. APPROACHES FOR CO₂ CAPTURE AND STORAGE

Reaching net zero means addressing two problems simultaneously: reducing emissions of warming gases and cutting background levels too.



The crux of the matter

- Carbon capture and storage (CCS): CO₂ captured from point sources and stored in depleted oil and gas reserves, deep reservoirs or other sub-surface cavities
- Direct air capture (DAC): CO₂ captured from ambient air using highly selective filter material

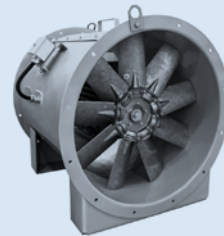
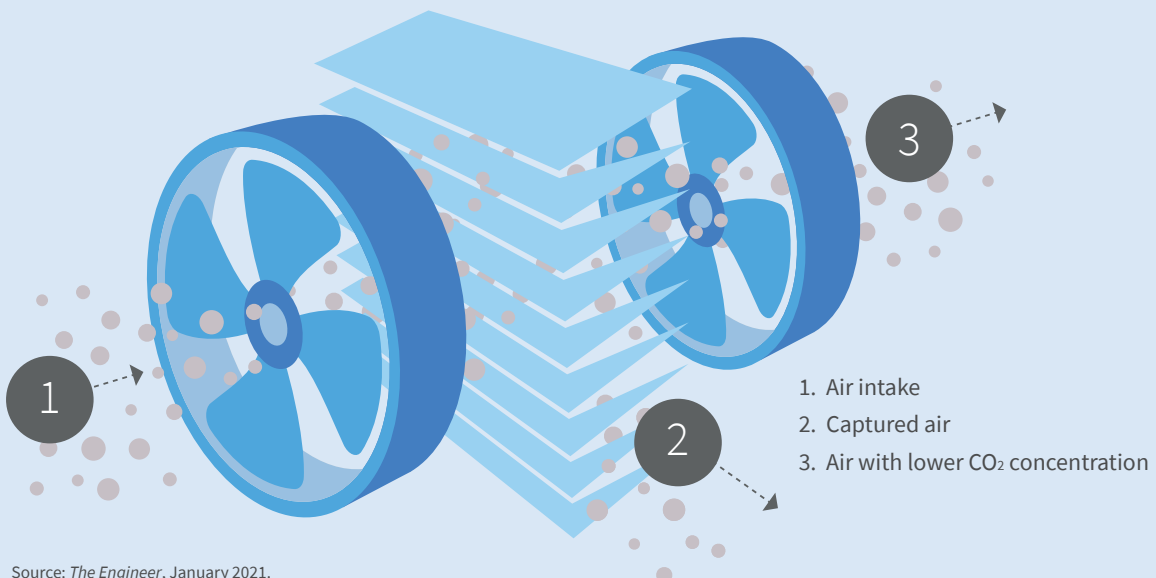


Figure 10: Capturing CO₂ from ambient air²⁹



Source: *The Engineer*, January 2021.

“Big industrial change has previously taken two to three decades. So, if we are going to hit net zero in 2050 with the tools we’ve got, one is certainly using CCS; DAC is another.

The cost of capture has already decreased a lot. The price of CCS has come down from around \$120 a tonne of CO₂ to \$80 a tonne. The price of DAC has also come down, from \$600 a tonne to around \$200 a tonne. I am optimistic we will see the price of DAC fall to \$150 or even \$100 per tonne of CO₂, captured and stored. Ultimately, a global maximum price on CO₂ will be set by the price of capturing it from the air, because you can do that anywhere.”

Stuart Haszeldine

Professor of Carbon Capture and Storage, School of GeoSciences, University of Edinburgh

Next? Clarify terminology around carbon capture (CC), CCS and carbon capture, utilisation and storage (CCUS); identify suitable geological sites for CCS, explore ‘U’ pathways, bring cost of DAC down using low-cost renewables, and develop and refine models for commercialising storage ●

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THE ANTI-SOCIAL NETWORK

SOCIAL MEDIA COMPANIES FACE
RECKONING OVER HATE SPEECH

Facebook, Twitter and other platforms are drawing criticism for their failure to tackle hate content. But will the hit to their reputation do any lasting commercial damage?

In April 2021, English football announced a boycott of social media. Players, coaches and pundits from across the sport shunned Twitter, Facebook and Instagram for four days in protest against racism on these platforms. Corporate sponsors including Adidas and Barclays also took part in the boycott.

A report from Kick It Out, English football's equality and inclusion organisation, illustrated why such action was necessary. It found a significant increase in racist and homophobic abuse of those involved in the sport since the beginning of the 2019-'20 season. Many social media users cited "unsatisfactory responses" from the big platforms after they had made initial complaints about hate speech.¹

The boycott was just the latest episode in a wider backlash against social media companies. In July 2020, more than 1,000 prominent advertisers launched a month-long boycott of Facebook as part of the #StopHateForProfit campaign, pressing the firm to do more to stamp out racist content in the wake of George Floyd's murder and the Black Lives Matter protests.²

Despite these controversies, social media companies continue to enjoy the confidence of the market. Share prices have risen in line with the wider tech sector amid growing demand for online tools, even as the bricks-and-mortar economy suffers under COVID-19 restrictions. But as advertisers pull out, users log off and regulators circle, some investors are warning the persistence of hate speech on social media could yet pose a serious threat to the future of the tech giants.

From dial-a-hate to the Twitter feed

Throughout history, advances in communications technology have enabled new forms of hate speech. In the 1960s, for example, extremist groups in the US set up automated voice messages connected to phone lines, broadcasting their views to a wide audience.³

The so-called "dial-a-hate" phenomenon drew the attention of Congress. Prevented from banning the recordings by First Amendment laws protecting freedom of speech, policymakers put pressure on telecoms company AT&T to tackle the issue. The company argued it was powerless to regulate the activity of private individuals on its phone lines.⁴

Today, social media giants such as Facebook and Twitter make similar arguments when criticised for the content that appears on their platforms. But hate speech is a far bigger problem in the internet era, when millions of people around the world can meet and instantaneously exchange information – or intimidate, bully or harass.

As defined by the United Nations, hate speech encompasses "any kind of communication in speech, writing or behaviour, that attacks or uses pejorative or discriminatory language with reference to a person or a group on the basis of who they are". This might include their religion, ethnicity, nationality, race, gender, sexuality or any other identity factor.⁵

In 2015, countries around the world committed to tackling the problem as part of the UN's 17 Sustainable Development Goals, many of which affirm the right to

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continued

freedom of expression and protection from harassment. For example, SDG 16 aims to “promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.”⁶ But moving from commitment to practice has proved more difficult.

“It’s clear that although countries have committed to protect people from harassment, the online reality is unfortunately quite different. Neither companies or governments have found a way to tackle online hate speech, but we expect to see both sides take more action as pressure increases from customers and voters,” says Marte Borhaug, global head of sustainable outcomes at Aviva Investors.

Hate speech has real-world effects beyond the internet, making it a fundamental human rights issue. In Germany, a correlation was found between anti-refugee posts on Facebook by the far-right Alternative für Deutschland party and physical attacks on refugees.⁷

“The 24/7 nature of social media, the amplification of content through sharing, clearly exacerbates the impact of these kinds of messages on wider society,” says Louise Piffaut, ESG analyst at Aviva Investors. “From hate speech to bullying, extremism to misinformation, there is a lot of content here that damages communities.”

The perpetrators of racist mass shootings in the US and elsewhere have publicised their acts to supporters on the major social media sites and even used the platforms to broadcast videos of their crimes. The shooter who murdered 51 people at two mosques in Christchurch, New Zealand in March 2019 streamed a video of the attacks using Facebook Live, and clips of the footage spread quickly across Facebook and YouTube.⁸

While this sort of activity tends to get taken down relatively swiftly, Facebook only blocked white nationalist content as a matter of policy in the immediate aftermath of the Christchurch attacks.⁹ YouTube and Twitter allowed Ku Klux Klan leader David

Duke to post on their networks for years before finally banning him in 2020.¹⁰

Social media firms have global reach and hate speech is a global problem. In Myanmar, military personnel used Facebook to spread propaganda demonising Rohingya Muslims ahead of a campaign of ethnic cleansing, according to a UN investigation. In India, lynch mobs have used Facebook-owned messaging service WhatsApp to coordinate attacks.¹¹

Echo chambers

Some experts point the blame at social media business models. Social networks encourage like-minded individuals to gather, so as to more-efficiently target them with advertisements. But as algorithms push users towards content that aligns with their pre-existing views, echo chambers can form. Without the corrective offered by opposing opinions or moderating voices, rhetoric can quickly spiral towards extremes.

“These companies want to keep people on the platforms because that’s what allows them to be targeted with advertising,” says Dr Jennifer Cobbe, coordinator of the Trust and Technology Initiative at Cambridge University, an interdisciplinary research project that explores the dynamics of trust and distrust in relation to internet technologies, society and power.

“Part of the problem with that is people collectively tend to be drawn to things that are shocking and controversial and which raise an emotional response,” she adds. “Hate speech is actually great for these companies’ business models, because that kind of controversial, shocking, emotional content will draw people in. As long as people are on their platforms, that’s all they want.”

Algorithms designed to promote engagement can exacerbate the problem. Take YouTube’s auto-play function, which has become notorious for displaying a series of ever-more incendiary videos to users who linger on the site. As *New York Times* columnist Zeynep Tufekci remarked: “You are never ‘hard core’ enough for YouTube’s

“*Hate speech has real-world effects beyond the internet, making it a fundamental human rights issue*”

recommendation algorithm. It promotes, recommends and disseminates videos in a manner that appears to constantly up the stakes. Given its billion or so users, YouTube may be one of the most powerful radicalizing instruments of the 21st century.”¹²

Each social media platform has its own, more or less stringent, rules over what is permissible. Facebook’s guidelines are “relatively detailed”, according to Piffaut; they describe the kinds of content that would violate its policies on both Facebook and Instagram. YouTube and Twitter also have clear guidelines over what should be removed – any incitement to violence is off-limits – and what should be allowed to remain with content warnings attached (this includes certain forms of hate speech).

Enforcement of these rules is patchy, however. To varying degrees, social media firms rely on three methods of policing content: artificial intelligence, human moderators and user reporting.

The algorithms used to detect and delete content that violates the rules are opaque: YouTube appears to have tweaked its algorithm to curb the “radicalising” effect of its auto-play function in recent years, but the logic behind its recommendations remains obscure. Facebook’s own data suggests automated methods are more effective at rooting out violent or graphic content than cases of harassment and bullying, which tend to be flagged by users in the first instance.¹³

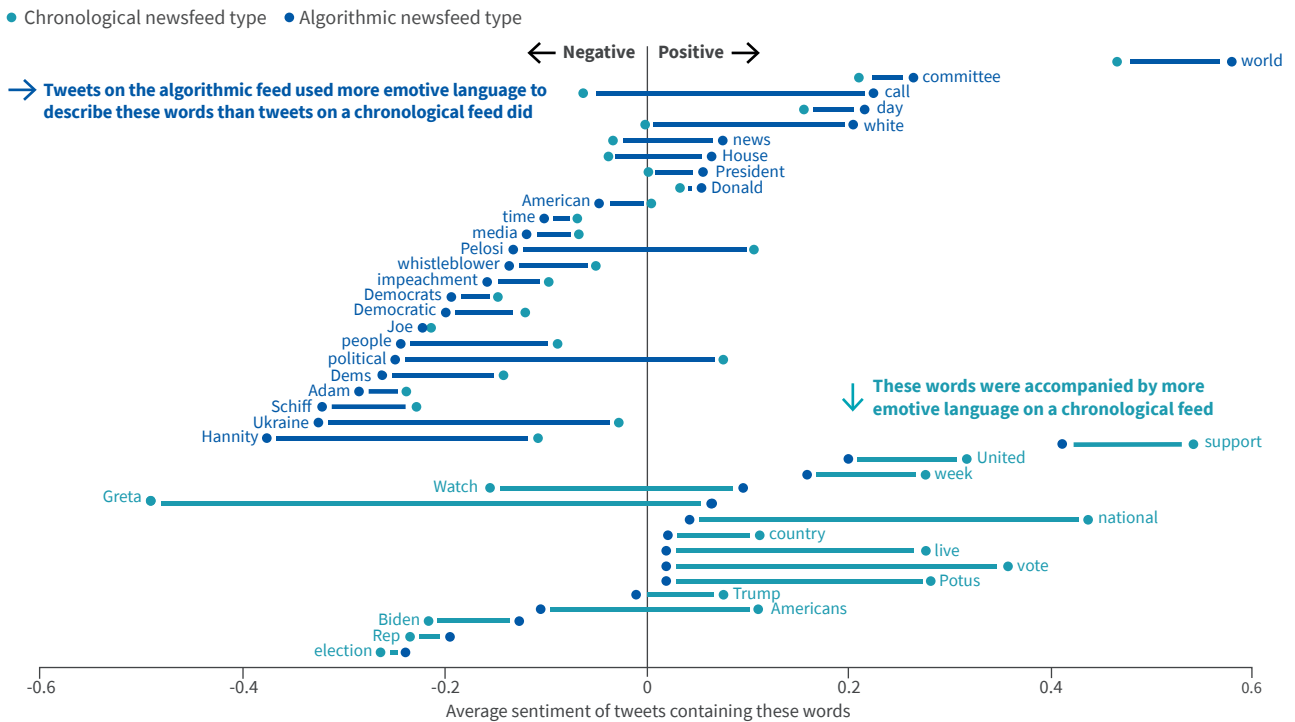
Human moderators, meanwhile, can quickly become overwhelmed by the thankless task of sifting through reams of disturbing content, which takes its toll on their mental health. Making things worse, such teams are often understaffed. In Myanmar, Facebook employed only two Burmese-speaking moderators at the time the anti-Rohingya propaganda was flooding its local platform.¹⁴

Tougher regulation

As global businesses whose operations span countries with very different laws on freedom of expression, social media companies must tread a fine line when deciding which content to ban or to flag as harmful.



Figure 1: Twitter's algorithm favours the most emotive and negative tweets¹⁷



Note: Sentiments of tweets served to a clone of Donald Trump's account by newsfeed type. Average for tweets containing 40 most frequent words, Sep-Dec 2019. Average for tweets containing 40 most frequent words, Sep-Dec 2019. Source: 'Twitter's algorithm does not seem to silence conservatives', *The Economist*, August 1, 2020.

In the US, senior Republican politicians have long accused Facebook and Twitter of being quicker to crack down on conservative voices than liberal ones. However, an independent civil rights audit, commissioned by Facebook in 2020, found the company contravened its own policies on hate speech by refusing to take down inflammatory posts from President Trump.¹⁵

Trump was eventually banned from both Twitter and Facebook after he contested Joe Biden's presidential election victory and incited a riot by his supporters at the US Capitol building in Washington DC in January 2021. Twitter said Trump's tweets around this time "were highly likely to encourage and inspire people to replicate the criminal acts that took place at the US Capitol".¹⁶

But Twitter's own technology may also play a role in spreading the most inflammatory

messages. A recent *Economist* study found that its algorithm often amplifies the most stridently negative conservative voices. Figure 1 shows the kind of messages served to a clone of Donald Trump's account: the president was more likely to see emotive tweets criticising his political rivals than would have been the case if his feed simply displayed tweets in chronological order.

In some quarters, the social media firms drew criticism for their delay in banishing Trump; in others, they were criticised for censoring free speech. The French and German governments were among those to protest Trump's ban: German Chancellor Angela Merkel argued decisions to limit free speech should be made by politicians, not private companies.¹⁸

Facebook CEO Mark Zuckerberg has asked governments to devise a consistent set of

“*Twitter's own technology may play a role in spreading the most inflammatory messages*”

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continued

rules for internet companies, including guidelines on how to deal with harmful content. The company has also set up an independent oversight panel – dubbed Facebook’s “Supreme Court” – to review content management decisions and potentially overturn them.¹⁹ In May this year the panel upheld Trump’s suspension, but said the indefinite nature of the ban was unusual and called on Facebook to be more transparent in its decision-making process.²⁰

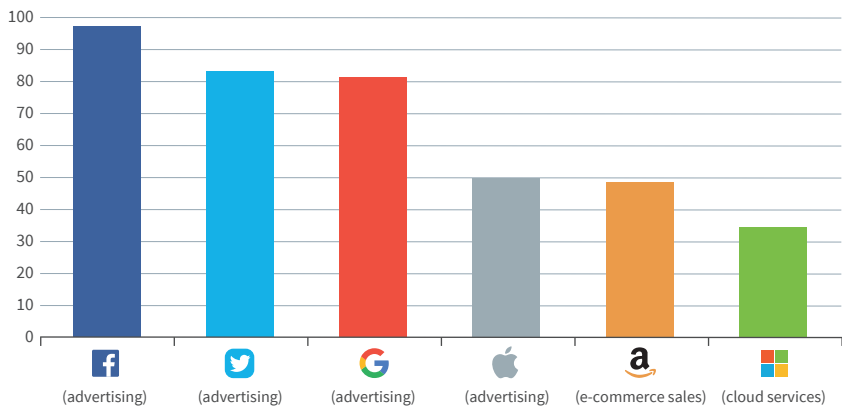
In setting up an independent commission to rule on content moderation, Zuckerberg may be hoping to ward off calls for punitive legislation. From the tech companies’ perspective, a worst-case scenario would be an amendment to Section 230 of the US Communications Decency Act, according to which technology companies are currently immune from prosecution from harmful or defamatory content published by third parties on their platforms.

In June 2020, Trump had issued an executive order aimed at limiting the protections offered by Section 230, ostensibly in response to Twitter’s decision to add fact-checks to his recent tweets on voting by mail (in the text of the order, the president denounced Twitter’s decision as “selective censorship”).²¹ His successor, Joe Biden, raised the possibility of repealing Section 230 altogether during his election campaign.

For its part, the European Commission is drawing up legislation that will force tech giants to remove illegal content or face the threat of sanctions under a comprehensive “Digital Services Act” due to be unveiled at the end of 2021. Germany has introduced the German Network Enforcement Act (NetzDG), which forces large social media companies to review complaints and remove any content that is clearly illegal within 24 hours.

“A tougher regulatory environment is long overdue,” says Cobbe. “We are now acknowledging the reality these platforms play such an outsized role in society that they need to have some kind of responsibility, and need to be brought under some degree of control.”

Figure 2: Leading source of revenue for tech companies (per cent)



Source: Facebook, Twitter, Alphabet, Apple, Amazon, Microsoft, March 2020.

“The German Network Enforcement Act is a good example; it’s not so much targeted at the content itself, as the content is still regarded as the speech of individuals, but it does focus on what the platforms should be doing. We need to look at algorithms of platforms and how they disseminate conspiracy theories, hate speech and violent extremism through their recommendation systems,” she adds.

Cobbe says regulations need to be enforceable and come with severe punishments to be effective. Facebook has already fallen foul of the NetzDG law: in July 2019 the company had to pay €2 million for under-reporting illegal activity on its platforms in Germany.²²

This is a small sum in the context of Facebook’s global revenues (\$85 billion in 2020), but other countries are seeking tougher punishments. In 2019, the Australian parliament passed the Sharing of Abhorrent Violent Material Act, introducing criminal penalties for social media companies, possible jail sentences for tech executives for up to three years and financial penalties worth up to ten per cent of a company’s global turnover. Based on their 2020 earnings, this would amount to \$370 million for Twitter, \$8.5 billion for Facebook and \$1.8 billion for YouTube’s parent Alphabet.²³

Commercial impact

The size of these figures shows that, quite apart from the moral impetus to act, hate speech poses a threat to these firms’ revenues. Even if they manage to avoid costly regulatory sanctions, it is likely they will have to invest much more heavily in content-management initiatives in the future, from improved automated systems to new armies of human moderators.

As operating expenses among tech companies tend to be high even before these added outlays – over 40 per cent of total revenue in 2020, in Facebook’s case – any increase in R&D and labour costs may have a material impact on the company’s profit margins, says Piffaut.

Advertising boycotts could also have a growing impact over time, given ad sales make up the vast majority of social media companies’ revenues (see Figure 2), though the impact so far has been small. Facebook’s ad revenues actually increased during the boycott in July 2020, partly because its customers are mostly local, “mom-and-pop” businesses that did not participate in the walk-out. Facebook has eight million active advertisers, and the top 100 brands, including the largest companies involved in #StopHateforProfit, generated only six per cent of its total revenue in 2019.²⁴



That's not to say the boycott will not work in forcing changes at Facebook's handling of hate speech, however. YouTube's response to its own ad boycott in 2017 may be a salient precedent.

"YouTube survived the exodus of advertisers, but only because it took fairly drastic action in response. Throughout 2017 and 2018 there was a wholesale shift in the content preferred by the platform, with regard to the allocation of monetisation rights, towards less controversial, more family-friendly content," says Charles Devereux, ESG analyst at Aviva Investors.

Investor engagement

This example shows tech companies will respond when sufficient external pressure is applied, indicating investor engagement could bear fruit. And the fate of the tech companies is certainly an issue of increasing significance to investors, for financial as well as ethical reasons. The five biggest technology companies (Alphabet, Amazon, Apple, Facebook and Microsoft) accounted for about 22 per cent of the total market capitalisation of the S&P 500 as of May 1, 2021.²⁵

With both moral and financial risks at stake, more investors are beginning to question the social media firms over content. Piffaut and Devereux set out a framework for engaging with these companies in key areas. They recommend investors should ensure social media firms are properly assessing how their operations affect human rights, developing more robust content policies in light of these principles and demonstrating how these are enforced.

Investors should also engage with social media firms to improve internal accountability and provide more transparency as to their actions on hate speech. Investment in more sophisticated detection algorithms would lessen the burden on human moderators, the analysts say.

"Progress has been made, but not enough yet," says Piffaut. "The issue is that the

measures taken so far have been very reactive, rather than preventative. We are looking for higher investments in technology, and for companies to take ownership of this issue instead of outsourcing the solution."

When devising an effective strategy for engaging with social media companies, investors need to be mindful of two further points. The first is that coordinated action is likely to be more effective than acting alone.

"Collaborative initiatives are important in this area," says Borhaug. "When you are initially raising concerns with companies that may not even want to meet with you – and tech companies are infamous for not talking to investors – it can be helpful for investors to collaborate globally."

Secondly, investors need to pay attention to the social and political context and maintain consistency in engaging with companies across borders. As well as pressure over hate speech, social media companies are facing calls to defend freedom of speech, and not only from hard-line US conservatives.

In July 2020, 150 global authors, academics and intellectuals from across the political spectrum signed an open letter published in *Harper's* magazine, defending freedom of speech against what they called a "culture of illiberalism" on both right and left.²⁶

Investors looking to engage with and apply pressure on social media companies need to recognise the delicate balance between damaging content on the one hand and freedom of speech on the other, particularly in jurisdictions where people are denied that basic human right.

While social media companies in the West face criticism for being lax in shutting down abusive content on their platforms, technology firms elsewhere may be too quick to restrict debate at the behest of authoritarian governments. In those countries, the onus is on investors to pressure companies to defend individual

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Investors need to pay attention to the social and political context and maintain consistency in engaging with companies
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freedoms and maintain their access to information where possible.

“Across many emerging markets, social networking is dominated by Western companies: Instagram, Facebook, Twitter. Those where it isn’t tend to be countries where freedom of speech is not a policy priority, such as Russia and China,” says Alistair Way, head of equities at Aviva Investors.

“For social media companies in those markets, such as Tencent or TikTok owner ByteDance in China, or Mail.ru Group in Russia, we talk to them about how they manage the line between not falling foul of the government and giving users access to information and maintaining their rights. These issues are front and centre in our conversations with these firms,” he adds.

Reputational risk

Striking the right balance when engaging globally with social media companies over content management may be tricky, but investors must be willing to do this if they are to invest according to their own moral framework and defend the value of those investments. After all, if hate speech is allowed to flourish, calls will grow to rein in the social media firms with stronger regulation, and perhaps even to break them up.

Cobbe argues the power of the big tech platforms has grown to an extent they are effectively unmanageable. She believes they should be scaled down so they can be properly overseen and regulated.

“If governments want to address hate speech or the other problems with these platforms, they need to address the structural problems of scale and power, and that’s where I would begin with trying to address this,” she says.

During the election campaign in 2020, Biden signalled he would take a tough line on Facebook. In June he wrote an open letter to the company in which he criticised its content-management policies and ordered it to “move fast and fix it”, referring to the problems of hate speech and misinformation; he and his supporters disseminated this slogan on the network.²⁷

This follows a remark Biden made in 2019, when he told the Associated Press that breaking up the company “is something we should take a really hard look at”.²⁸ Despite this, Biden’s own strategy illustrated the importance of the platform as an essential communications tool in modern politics. Biden spent over \$85.2 million on Facebook ads during the presidential campaign, a little less than Trump’s \$89.1 million (Biden outspent his rival on Google ads, spending \$60 million, around \$4 million more than

Trump).²⁹ After his victory, Biden hired former Facebook executives to run his transition team, although other senior members of his administration are vocal critics of the company.³⁰

“This is very much a political issue, and there is no doubt social media companies will face increasing regulatory risk, as it is on the agenda for politicians – see the US congressional antitrust hearings in 2020. The key question is around the speed of change, and that is difficult to answer,” says Piffaut. (Read our in-depth feature on the potential antitrust threat to Big Tech, pp. 8-15.)

Domino effect

Whether or not regulators decide to break up the larger tech companies, users could become disaffected by the increasingly poisonous atmosphere on social media platforms. This could create a negative feedback loop, whereby a decline in user engagement removes the incentive for companies to pay for ads over the long run.

New disruptors could emerge to nab user attention and the associated advertising cash, much as Facebook dislodged one-time social media leader Myspace, a platform widely considered to have an unassailable monopoly as recently as 12 years ago.³¹ One reason Facebook was able to displace its rival is that it offered a more family-friendly alternative to Myspace, which struggled to filter out spam,



phishing scams and unwholesome ads, in much the same way Facebook is failing to get a grip on hate speech today.³²

There are already signs users don't value Facebook particularly highly in monetary terms. This makes the pact between users and the platform – free access in exchange for personal data that will be used for commercial purposes – somewhat precarious, especially when compared with more diversified tech companies like Google, whose portfolio includes search engines and other tools such as maps.

Consider a recent study led by Erik Brynjolfsson, director of the Initiative on the Digital Economy at the Massachusetts Institute of Technology. It asked Facebook users how much they would have to be paid to forgo search engines for a year. Respondents offered an average figure of \$17,500; they were willing to give up access to Facebook for less than \$600.³³

“Even if a company looks like it has an unregulated monopoly, there is always a tacit societal contract that constrains how it can act and how much money it can make. Businesses need to stay on the right side of the ‘value-for-money’ equation,” says Giles Parkinson, global equities portfolio manager at Aviva Investors. “Compared with Google, Facebook elicits more of a shrug from users – they like it but don’t love it. This means that when regulatory or societal scrutiny comes to bear, Alphabet should find itself in a better position than Facebook.”

To grasp the risk, one only needs to consult Mark Zuckerberg himself, or at least his fictional alter ego in the 2010 biographical film, *The Social Network*. In a key scene, Zuckerberg frets about how quickly the fortunes of his company could turn: “Users are fickle,” he says. “Even a few people leaving would reverberate through the entire user base. The users are interconnected. That is the whole point. College kids are online because their friends are online. And if one domino goes, the other dominos go. Don’t you get that?”

As hate speech threatens to trigger a domino effect among Facebook’s users, advertisers and investors, the real Zuckerberg would do well to heed the warning ●

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Even if a company looks like it has an unregulated monopoly, there is always a tacit societal contract that constrains how it can act and how much money it can make

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LEVELLING UP

HOW COVID-19 IS ACCELERATING A
DIGITAL REVOLUTION IN CONSTRUCTION
AND MANUFACTURING





The coronavirus pandemic has spurred companies to upgrade their digital capabilities, boosting productivity and creating investment opportunities in previously overlooked niches.

In his new book, *Post Corona: From Crisis to Opportunity*, the author Scott Galloway rejects the widespread view that the COVID-19 pandemic has fundamentally transformed the world. Instead, he argues the crisis “has been an accelerant of trends that were already well underway”.¹

Take companies’ investment in digital processes. Many firms had gradually implemented digital upgrades in recent years, but the pandemic has given these projects a new urgency. Over the last 12 months, companies have stepped up investments in technology to ensure they can communicate remotely with customers and keep their businesses running under lockdowns.

Predictably, Big Tech companies have been among the main beneficiaries amid turbocharged demand for online services. On an earnings call in April 2020, Microsoft CEO Satya Nadella cited surging usage of its collaboration platform, Teams. “We’ve seen two years’ worth of digital transformation in two months – from remote teamwork and learning, to sales and customer service, to critical cloud infrastructure and security,” he said.²

Other tech sectors have seen even faster growth. According to one study, e-commerce penetration in the US more than doubled in the first quarter of 2020,

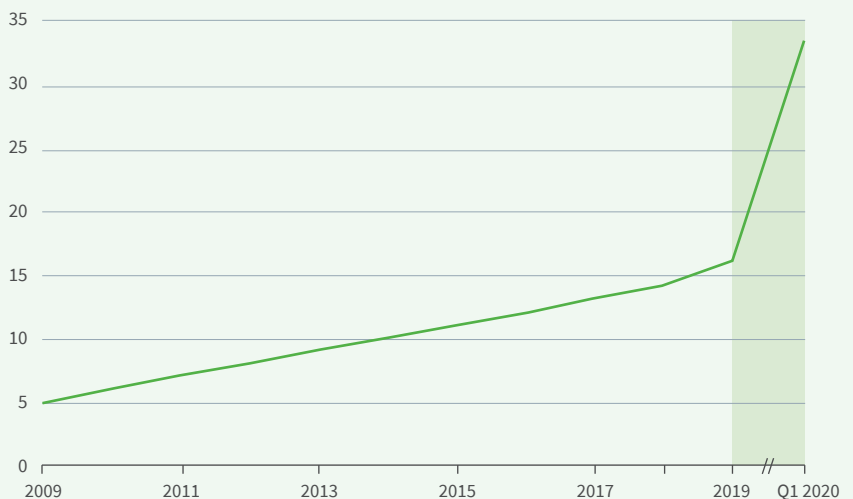
as consumers who had previously been slow to shop online, such as the over-65s, logged in en masse – equivalent to ten years’ worth of growth in just three months (see Figure 1).³ Similar trends are being observed in other global markets.

“In retail, the pandemic starkly illustrated the divide between companies that have good digital offerings and those that don’t,” says Trevor Green, head of UK equities at Aviva Investors. “While sales at Asos and Amazon surged, Primark couldn’t sell anything as it had no online presence. Most firms are trying to avoid that fate – they are ramping up projects to invest in their websites and improve the user experience.”

Companies in other sectors, too, have sought to accelerate investment in digital solutions, including those that have traditionally lagged in this regard. One simple way of tracking progress on digital implementation is to compare sectoral investment in IT as a percentage of overall revenue. A global 2017 study from Deloitte showed finance, professional services and education were the leaders in IT spending; manufacturing and construction were at the bottom of the list (see Figure 2).⁴

This is partly a reflection of the technology required – it is much harder to digitise a construction site or assembly line than a trading floor or classroom. But the

Figure 1: Growth in US e-commerce penetration during pandemic (per cent)



Source: Bank of America; Forrester Analytics; ShawSpring Research; US Department of Commerce; McKinsey analysis.

LEVELLING UP

continued

pandemic, coupled with the advent of 5G technology, is creating a revolution in these niches, as companies find ways to link the physical and digital worlds with new design tools and connected machinery. (A note on terminology here: digitisation refers to the process of converting an analogue process into a digital one; digitalisation denotes the use of technology to improve the way businesses operate.)

“The pandemic has accelerated a digital wave that is rolling through all avenues of human activity,” says Alistair Way, head of equities at Aviva Investors. “It’s starting with the most easily digitalised workplaces and rolling onwards. But the earlier you are in this process, the more years of growth you have ahead of you. That’s where the most attractive investment opportunities are – in the sectors where the runway for growth is longest.”

Figure 2: Global IT spending across sectors as a percentage of revenue



Source: Deloitte 2016-2017 Global CIO Survey.

PART 1: CONSTRUCTION GOES DIGITAL

Picture a construction site. Cranes swivel overhead and bulldozers leave trails across the grit. This most physical and tangible of environments is being rapidly transformed by the immaterial worlds of data and virtual design.

Construction firms have long been hampered by low productivity. According to one recent study, the industry, which accounts for 13 per cent of global GDP, has posted an annual productivity growth rate of just one per cent over the past two decades (see Figure 3).⁵ Even well-run firms regularly deliver projects late and over budget. And an estimated 20 per cent of the global construction workforce is set to retire over the next three years – a significant problem in an industry that has traditionally struggled to attract recruits.⁶

The pandemic has, in some cases, shut down construction sites and cast uncertainty over schedules, presenting further

challenges. But the crisis has also acted as a spur to investment in digital tools that promise to improve productivity by cutting waste and boosting efficiency.

The digital element of the construction process used to end with the computer-aided design (CAD) tools used in the architect’s office. Now, companies are using building information modelling (BIM) software to simulate and cost the entire project, using collaborative interfaces that bring together multiple sources of data and track progress in real time.

Digital methods are also powering the construction process. Leading firms will now fly survey drones over a site before the build starts, gathering high-resolution, three-dimensional images to generate geospatial maps. This data is plugged into smart bulldozers equipped with machine-control technology; as the vehicles move, they collect information that is fed back to office-based teams so progress can be monitored remotely.

While not every construction firm is ready to connect its sites in this way, the end-to-end digital approach is set to become more widespread in the wake of the crisis. Two-thirds of industry respondents to a recent survey thought COVID-19 would accelerate adoption of digital methods in construction.⁷ Global spending on BIM will more than double between 2020 and 2024, from \$6 billion to \$13 billion, according to Berenberg estimates.

“Putting these digital methods in place requires investment, but in most cases the outlay is quickly recouped thanks to the savings in terms of cost efficiencies and waste reduction, especially when companies can more closely connect the initial digital modelling through BIM to the practical execution of the plan in the field,” says Way. “The commercial pressures of the COVID-19 crisis have made companies wake up and recognise the advantages these digital solutions can bring.”

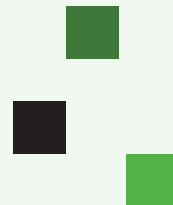
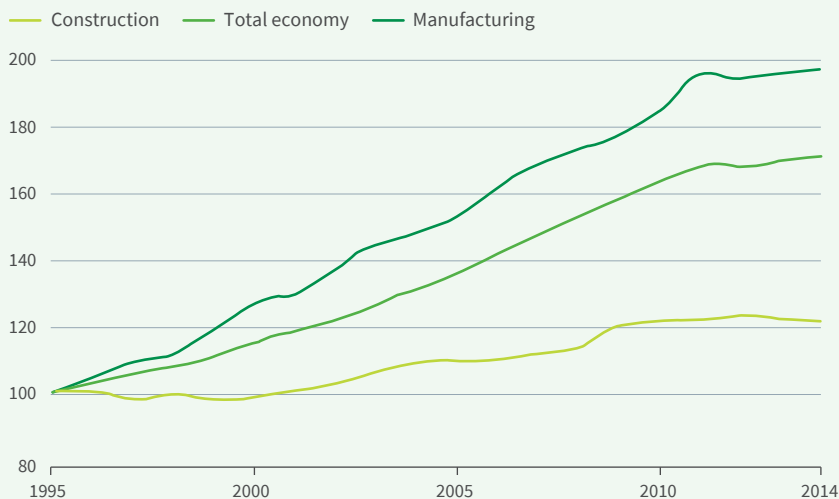


Figure 3: Labour productivity in construction and manufacturing



Source: McKinsey Global Institute.

“Value should accrue to companies across the supply chain, which stands to become leaner, cleaner and more productive”

The savings in both cost and material waste can be substantial. A commercial concrete contractor recently announced the results of its first project using 3D-modelling software, which vastly improved accuracy and eliminated waste almost entirely.⁸ Similarly, an infrastructure contractor found machine-control technology sped up road excavation by 44 per cent and improved accuracy by 75 per cent.⁹

As more companies take up digital methods, the industry as a whole could become cleaner and more efficient – an important consideration given building and construction account for 40 per cent of the world’s carbon emissions, making it one of the principal contributors to the climate crisis, according to the United Nations Environment Programme.

Over the coming years, new building standards and green regulation are likely to compel further improvements in sustainability and efficiency. Around 90 per cent of industry experts believe such regulations will have a major impact on construction operations over the next decade (and 20 per cent think new

regulation will arrive even sooner, within the next 12 months).¹⁰

Companies such as Trimble, Autodesk and Graphisoft provide BIM software, machine-control technology and other digital solutions. But value should accrue to companies across the supply chain, which stands to become leaner, cleaner and more productive. Construction firms using BIM see an average return on investment of 20-25 per cent, according to McGraw Hill Construction, a consultancy (see Figure 4).

Digitally connected sites offer further advantages after projects are completed; BIM-powered buildings typically come with “digital twins”, or virtual facsimiles that serve as a reference point for refurbishments and upgrades. This could prove useful for asset owners in the post-COVID era, as they seek to renovate and adapt their buildings. Office blocks look set to become more open, collaborative spaces to complement increased home working, according to research from Aviva Investors’ real assets team.¹¹



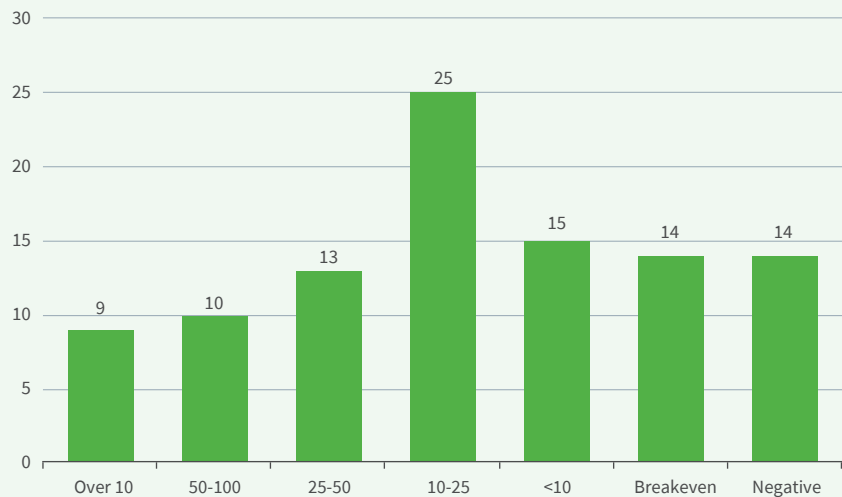
LEVELLING UP

continued

Meanwhile, manufacturers of components such as elevators, air-conditioning units and door locks can take advantage of improved connectivity to monitor performance and offer maintenance before problems arise, minimising disruptions for a building's owners and tenants. For their part, such manufacturers are able to retain lucrative service contracts.

"Elevator manufacturers such as Kone and Schindler can continue to monitor their lifts after installation and gauge when they need preventative maintenance," says Giles Parkinson, global equities fund manager at Aviva Investors. "Some elevator manufacturers have also begun to provide supplementary services, such as data-driven, people-flow management tools that can reduce waiting times and ease crowding in office buildings. Tenants are often willing to pay higher rents for offices equipped with these digitised lifts" ●

Figure 4: Contractors' return on investment using BIM tools (per cent)



Source: McGraw Hill Construction.

PART 2: INDUSTRIAL MANUFACTURING AND THE INTERNET OF THINGS

Digitalisation is also yielding positive results in another area: advanced manufacturing. Experts have talked for years about the possibilities of the fourth industrial revolution, big data and the Internet of Things (IoT). But it is only now that companies are beginning to fully appreciate the value of these tools, as 5G improves connection speeds and the coronavirus pandemic forces companies to devise new ways of working.

"The industrial manufacturing world has long been aware it needed to upgrade its operations by enhancing connectivity, but COVID-19 has been a massive accelerant," says Parkinson. "When the pandemic first hit, companies put the brakes on new investment. But many firms soon realised

they weren't equipped to manage or maintain their factories remotely and there has been a push forward on digitising."

Market intelligence firm IDC has identified rising investment across the industry in two categories: product engineering software, or digital tools and services that help companies design and manage industrial products, such as CAD, computer-aided manufacturing (CAM) and product lifecycle management (PLM) systems; and operational technology, which helps with manufacturing and related services. It expects industrial companies to spend \$21 billion on these areas by 2024, up sharply from \$14 billion in 2020.

But firms are also exploring more sophisticated ways to link hardware and software, using cutting-edge technologies such as artificial intelligence and augmented reality (AR). As industrial products such as

cars and aeroplanes increasingly resemble computers, so the factories that make them are taking on a digital character. Machinery is becoming autonomous, with each part of the assembly line connected with the others using data and cloud infrastructure that can be linked to the company's broader CAD and PLM systems, allowing it to monitor the entire installed base to analyse data and quickly identify issues.

While they hold great promise, these systems can be fiendishly difficult (and expensive) to roll out. Consider the example of General Electric's Predix, which was launched in 2013 as the company aimed to transform itself into a hybrid industrial-software firm. GE called Predix "a first of its kind industrial strength platform that provides a standard and secure way to connect machines, industrial big data and people".¹²



AR glasses equipped with sensors and cameras can display virtual renderings of components for installation



Despite GE's heavy investment into Predix – over \$5 billion a year – the platform struggled to connect machines across GE's global systems, partly because of their differing vintages and distinct coding. Although it is persisting with Predix, GE spun off its main digital division into a separate company in 2018.¹³

Given these difficulties, industrial firms usually prefer to collaborate with third-party digital specialists rather than build in-house platforms. UK-based digital services provider Aveva, for example, has expertise in the oil and gas industry and offers predictive maintenance technology to its customers. By using connected hardware installed at refineries, energy firms can monitor the status of their facilities and fix problems remotely.

“A decade ago, oil giants would have to fly staff out on helicopters to fix components at their refineries. Now, with digital maintenance methods, this work can be done from afar, and that's particularly useful given the current travel restrictions,” says Green. “The savings in terms of costs and

reducing downtime are huge; greater efficiency improves the sustainability profile of the project.”

Aveva is also among the companies that offer AR applications, a method of visually overlaying digital information on physical environments. The best-known example is the mobile video game Pokémon Go, which uncannily deposits fantastical creatures into real-world scenes. But AR has a range of more serious applications in industry.

At defence and aerospace contractor Lockheed Martin, for instance, engineers building F35 fighter planes and NASA spacecraft now wear AR glasses equipped with sensors and cameras, which display virtual renderings of components with instructions on how and where they should be installed. The glasses have improved accuracy and allowed engineers to work 30 per cent faster, bringing substantial savings in labour costs.¹⁴ The company reports that using AR saves \$38 in labour for each metal fastener it installs on its spacecraft – to put that figure in context, it buys around two million fasteners every year.¹⁵

Meanwhile, the US-based industrial software company PTC says its AR tools can help manufacturing teams quickly monitor the status of equipment, simulate the effects of new component installations or provide immersive training experiences for staff. The company has forged strategic partnerships with tech giant Microsoft and hardware specialist Rockwell Automation. This is indicative of a growing trend for collaborations between software and hardware firms across the manufacturing industry, says Parkinson.

Further along the supply chain, digitalisation is also transforming the ways in which products are marketed and distributed. For example, German manufacturer Klöckner has launched XOM, a digital marketplace on which companies can sell steel, metal or industrial products to a wider range of customers than might be accessible using their own proprietary sales platforms¹⁶ ●

PART 3: INVESTMENT IMPLICATIONS

While there are parallels between the digital tools being rolled out across construction and manufacturing, investors should be mindful that the competitive dynamics of each industry are very different.

In construction, the market for digital solutions is concentrated around a few providers. These first movers have a significant advantage, partly because construction engineers and architects who have trained on one BIM platform tend to be reluctant to switch to another. These firms also tend to have significant brand recognition, as reflected in industry parlance; “to Trimble” has become a verb referring to any form of sophisticated digital

upgrade in construction, whether or not Trimble is involved.

By contrast, the structure of the manufacturing industry militates against the supremacy of any one software platform. Digital providers tend to leverage their expertise in a particular field – Aveva in oil and gas, PTC in consumer goods, and Dassault Systemes in car-making and aerospace, for example – in which they can consolidate their positions in CAD and PLM and upsell value-added services in areas such as predictive maintenance and AR. But expanding across the verticals into new territories is difficult.

The complex nature of the manufacturing ecosystem creates opportunities for more specialised firms, including so-called

“historians” that collect, aggregate and interpret data from multiple industrial sources.

One historian firm, OsiSoft, was acquired in 2020 by Aveva in a \$5 billion deal, a transaction that could herald further M&A activity across the industry. Aveva itself merged with the industrial software arm of French energy group Schneider Electric in a \$3 billion deal in 2017.¹⁷

Another recent deal saw Capgemini, a European consulting firm, acquire industrial technology specialist Altran, increasing its exposure to end markets in the aerospace, automotive, defence and energy industries. The company aims to offer IT services that help manufacturers connect disparate hardware and software components and speed up the digital transformation process.¹⁸ ►

LEVELLING UP *continued*

“Unlike office-based IT, where a blockbuster product will sometimes come along and dominate a particular function – think of the way Salesforce emerged to corner the market for customer relationship management software – industrial manufacturing is a much messier, more complicated environment, and there will be opportunities for companies that can connect the dots,” says Way.

“Proprietary ‘walled garden’ platforms are less likely to succeed in this sort of diverse ecosystem, which may be why GE’s Predix failed to resonate. In a way, that’s good for investors, because they can focus on the value opportunity in each vertical without worrying too much about a new competitor coming in and changing the landscape overnight,” he adds.

Both construction and manufacturing rely on myriad relationships between customers and suppliers, and investors conducting due diligence should be prepared to speak to companies across the supply chain in order to assess risks and identify pockets of value. Whether meeting with contractors or

developers, Parkinson recommends asking questions about the problems the pandemic exposed them to and how technology is being used to address them.

“The damage COVID-19 inflicted due to companies’ lack of preparedness was so clear and obvious that most are aware they don’t have a choice now but to digitalise; if they don’t, they will fall behind, and not just if there’s another global pandemic. Competitors that go digital are going to realise efficiencies in their business operations and develop competitive advantages. Firms are going to have to invest aggressively to keep up.”

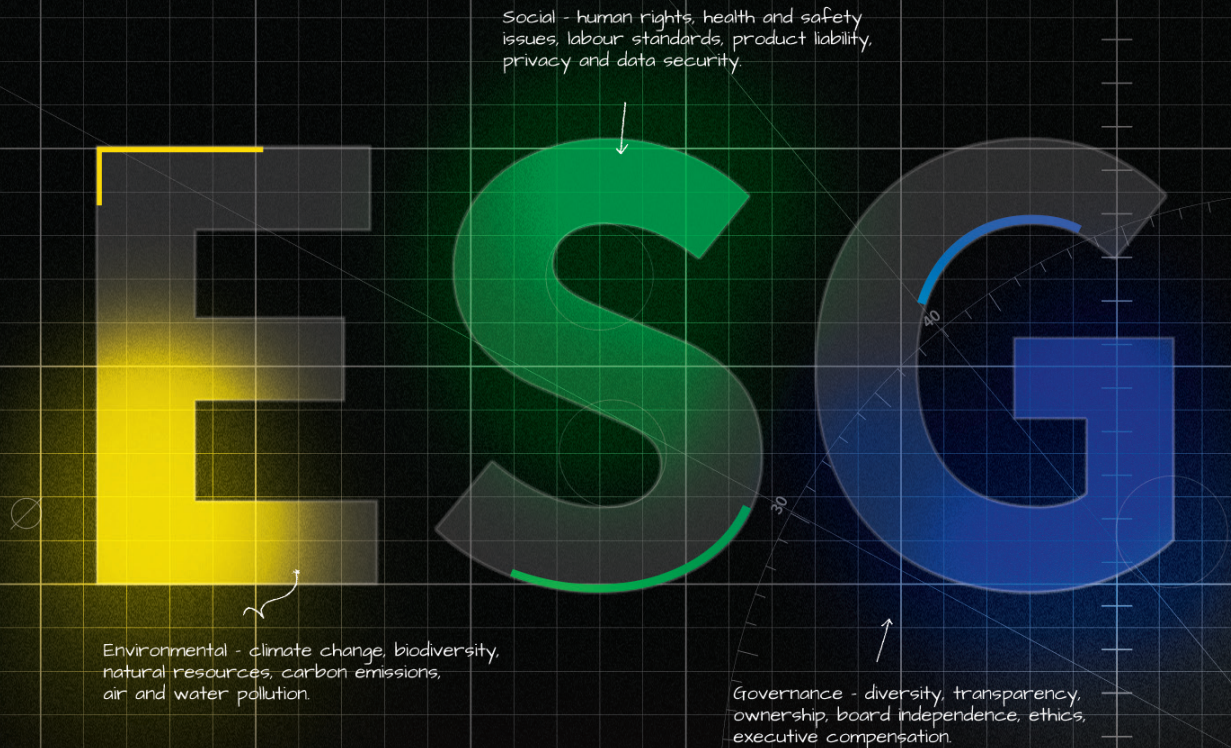
Green agrees. “In their meetings, investors need to make sure company management are embracing digital technologies. They need to be clear: companies in construction and manufacturing that don’t invest for the future will lose their competitive positioning. The momentum behind this digitalisation trend is only going to build over the coming years,” he says ●



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