



FUTURE OF **FINANCE**

**REVIEW ON THE OUTLOOK
FOR THE UK FINANCIAL SYSTEM:
WHAT IT MEANS FOR
THE BANK OF ENGLAND**

Chaired by Huw van Steenis

June 2019

CONTENTS

Foreword	2
Executive Summary	6
Summary of recommendations	18

Recommendations for the Bank	
1 Shape tomorrow's payment system	25
2 Enable innovation through modern financial infrastructure	41
3 Support the data economy through standards and protocols	56
4 Champion global standards for finance	67
5 Promote the smooth transition to a low-carbon economy	80
6 Adapt to the needs of a changing demographic	90
7 Safeguard the financial system from evolving risks	102
8 Enhance protection against cyber-risks	116
9 Embrace digital regulation	129

Appendix	
Glossary	144
Acknowledgements	145

FOREWORD

The Governor asked me last year to lead a review of the future of the UK's financial system, and what it might mean for the Bank of England's agenda, toolkit and capabilities over the coming decade.

We agreed this work should be grounded in how finance serves the economy. And in turn, how the Bank can enable innovation, empower competition and build resilience. The team and I have kept this uppermost in our minds.

Over the past nine months, I have met with over 300 entrepreneurs, financiers, tech firms, global investors, consumer groups, charities, policymakers and business leaders across the United Kingdom and overseas.

At each roundtable or meeting I asked for workable suggestions for how to improve finance and what we can learn from other markets or pilots. For example, CEO Tom Blomfield and his team at Monzo are harnessing technology to authenticate and provide basic bank accounts for people who have been granted asylum in the UK. Better digital identification in the UK, he argued, could help reduce the cost of finance to less advantaged groups. At OakNorth, co-founder Rishi Khosla is using machine learning to bring large business lending techniques to underserved small and mid-sized businesses. Permissioned sharing of public data, such as tax returns, he thought could help unlock savings for small businesses.

I also looked at how data standards and protocols can improve the plumbing of capital markets and empower competition. It is striking from my meetings that the world's largest asset owners, insurance companies, asset managers and index providers don't yet feel they have sufficiently robust data to assess whether individual companies are transition-ready for climate change.

I have investigated new vulnerabilities and evolving risks. Do UK financials have top cyber-security and how can it improve? What could happen if the big tech firms that are dipping their toes in financial services dive in? What can we learn from the Chinese experience of leading online platforms moving into financial services? Where are the vulnerabilities from a decade of ultra-low rates around the world? I have sought to balance cutting-edge thinking with evidence and realism. For instance, the CEO of Visa Europe, Charlotte Hogg, described how their teams are using artificial intelligence to drive reductions in fraud and friction in payments. The payment system could be more resilient if firms had pre-agreed plans to 'step in' for each other if they had outages, she argued.

Throughout, I have kept a critical eye on whether the many new rules and bodies in the past decade work in practice and are efficient. What are the unintended consequences? Is Open Banking achieving its ambitions? Could the UK's highly complex payments regulation improve? Has an uncoordinated regulatory landscape added cost or held back innovation? For instance, the Executive Chair of Santander, Ana Botin, argued payments regulation needs to be reviewed for the digital age, as it has inadvertently created an unlevel playing field. Instead she argued that to enable financial services to bring their customers the full benefits of the digital age, data sharing should be reciprocal. Davide Serra, founder of Algebris, stressed the importance of scenario analysis to explore financial stability risks from large technology platforms entering financial services — if they are not treated in an equivalent way for the same activity.

PRIORITIES

Let me highlight a few priorities in the recommendations.

The first section explores how the Bank can support the digital economy to enable innovation and empower competition, while ensuring monetary and financial stability.

One example is the payments system. In Sweden, cash payments have fallen by 80% over the past decade. Our analysis suggests the UK may only be four to six years behind. ATM usage is down 9% so far this year, an acceleration on 2018. Digital payments bring many benefits. But the Swedish experience shows that without a co-ordinated plan, the pace of change risks excluding some groups in society. That's why a joined-up roadmap for payments infrastructure without leaving anyone behind — alongside next generation payments regulation — should be a priority.

Another priority should be for financial services to embrace cloud technologies, which have matured to the point they can meet the high expectations of regulators and financial institutions. Shifting from in-house data storage and processing to cloud environments can speed up innovation, enable use of the best analytical tools, increase competition and build resilience. For mid-sized firms in particular upgrading to the cloud can materially improve cyber-security. The CEO of Finastra, Simon Paris, told me that 43% of UK financials believe complex regulatory requirements are the main barrier to adopting cloud technology. To enable UK and international financial firms to innovate and compete on a level playing field, the Bank should play a leading role in taking advantage of public cloud in a resilient way in the financial sector.

The second section addresses financing major transitions, such as changes in demographics, climate change or addressing the shifts in global markets.

The transition to a low-carbon economy is vital for the planet. It poses risks and opportunities for the financial sector and the economy. The Bank is already a world leader in focusing on climate change. Roundtables highlighted that investors, lenders and insurers lack a clear view of how companies will fare as the environment changes, regulations evolve, new technologies emerge and customer behaviour shifts. Without this information, financial markets can't price climate-related risks and opportunities effectively. The Task Force on Climate-related Financial Disclosures has made important progress in fashioning a standard. The Bank should champion the mainstreaming of decision useful climate disclosures to help stakeholders assess if a company is transition-ready. Armed with this data, it should also undertake a climate change stress test of UK financial institutions.

The third section explores how the financial system can build resilience and address the unbundling of financial services.

The Bank should be a world leader in the use of digital regulation. Machine learning and new data sets can strengthen the Bank's armoury to spot irregularities and get a better picture of the system's overall health and emerging risks. There is huge scope to use advanced analytics and new data sets for macroeconomic trends, financial surveillance and supervision. The explosion in data in finance demands new techniques. Supervisory teams now receive the equivalent of twice the entire works of Shakespeare of reading each week. This is going to continue to increase. The COO of HSBC, Andy Maguire, told me the amount of data HSBC stores on its servers doubles every two to three years. It is up to 240 petabytes.

Regulation is complex. The Bank's rulebook is longer than the Old Testament. No one individual can keep up with its frequent updates. And current practices are expensive. McKinsey and Company estimates that regulatory reporting for UK banks costs the industry £2 billion–£4.5 billion per year in run costs and risk change costs alone. When considering a new data strategy, I recommend the Bank should explicitly consider both the cost to the regulator and the efficiency of the overall system, including the costs to the private sector. That's why the Bank should embrace digital regulation to become more efficient and effective.

The financial system is under almost constant cyber-attack. Firms, in collaboration with authorities, are preventing the overwhelming majority of incidents and investing to stay ahead. Individual institutions cannot prevent all attacks, yet in our connected world a paralysing attack on one firm could potentially cause loss of confidence in others. To protect customers, financial institutions and public confidence, the Bank and private sector should look to enhance data recovery in the event of a major incident, including a mechanism for firms to step in for each other. This should ideally be led by the private sector. Meanwhile, the Bank will want to continue to help up the game of individual institutions alongside other authorities.

WHERE NEXT?

The UK has long played a highly influential role in charting the course of finance. The recommendations in this review will, I hope, create substantial benefits for UK consumers and businesses and underpin a more resilient, effective and efficient wholesale and retail financial system. I hope they will also prove useful to the many central banks around the world wrestling with similar challenges.

My remit was to look beyond the immediate challenges posed by the UK's withdrawal from the EU. I have sought to identify longer-term trends shaping the economy and finance and how the Bank can support this evolution for the good of the people of the United Kingdom. Brexit will be a critical context for the Bank's decisions going forward. But Brexit or no Brexit, there are many areas where the Bank, with others, can make progress in the years ahead. For instance, the Bank will want to continue to be a

leader of global regulatory standards supporting a safe global economy and the UK remaining at least as influential in the years to come as it has been since the crisis.

All forecasts demand humility. To make my recommendations as all-weather as possible, I have taken a dual approach developing scenarios, including with help from industry experts, while also analysing developments elsewhere in the world.

I am delighted that many of my recommendations are already being taken forward by the Bank, some before publishing this report. But there remains much to do in the years ahead. The job of protecting the financial system is never done.

THANKS

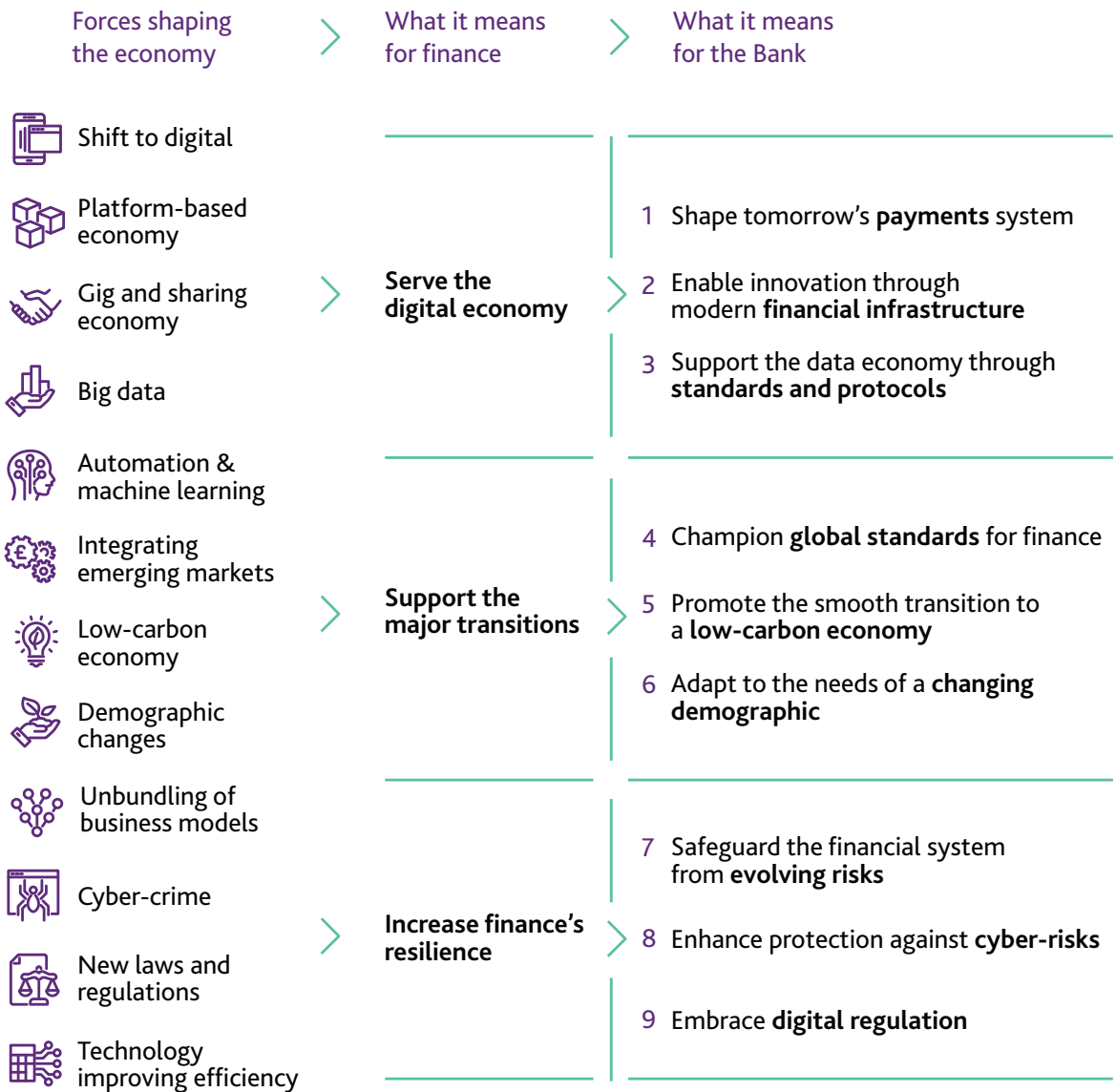
I would like to thank the Governor for his generous support and vision in establishing this review. I would also like to thank Sir Dave Ramsden, Sir Jon Cunliffe, Ben Broadbent and Sam Woods for their guidance, and my Advisory Group: Sandy Boss (Chair), Alex Brazier, Andy Haldane, Mark Yallop, Sarah Breeden, Sonya Branch, David Bailey, Victoria Cleland, James Proudman, David Rule, Vicky Saporta, Rob Elsey and Andrew Hauser.

This review has benefited from a collaborative spirit and a wide variety of inputs across the Bank, public and private sectors. I would like to express my thanks for everyone's contribution and challenge, as well as the hosts of our regional and overseas roundtables. I would also like to thank the following for their research and support on scenario analysis: McKinsey & Company on payments and digital regulation; The Boston Consulting Group on retail/SME banking and insurance; and Oliver Wyman on wholesale and capital markets and asset management. Finally, I would like to thank all colleagues at the Bank, and in particular, Tom Mutton, Varun Paul and Julia Kowalski who have been tireless and highly effective in their efforts.



Huw van Steenis
June 2019

APPROACH AND RECOMMENDATIONS AT A GLANCE

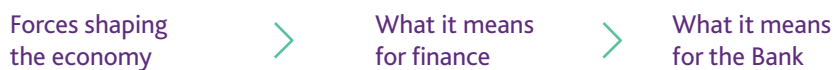


EXECUTIVE SUMMARY

SCOPE AND APPROACH

At his Mansion House speech entitled “New Economy, New Finance, New Bank” June 2018, the Governor announced a review: *“to set out a vision for the medium-term future of the UK financial system, with a particular focus on what this might mean for the Bank, and what steps the Bank’s Executive might take to ensure the institution is able to provide appropriate support to that vision, both now and in the future”.*

The approach has been to look at how the economy is changing; how finance can serve and support these changes; and what it could mean for the Bank of England.



The recommendations in this report cover:

- what the Bank has direct responsibility for, particularly how it could change its hard and soft infrastructure to support innovation and promote resilience in finance;
- areas of interest to the Bank where it is not the primary actor, and so may wish to collaborate or contribute expert advice to affect change; and
- where the private sector will lead.

Over the past nine months, I have engaged with entrepreneurs, investors, consumer groups, charities, business leaders, and policymakers across the country and overseas. I have looked beyond the immediate challenges posed by the UK’s withdrawal from the EU to identify longer-term trends shaping the economy and finance — and how the Bank can support this evolution for the good of the people of the United Kingdom. I have sought to be ambitious, but not idealistic, and leverage existing initiatives where possible to focus on better outcomes and to maximise the impact of my recommendations.

FORCES SHAPING THE NEW ECONOMY

A new economy is emerging driven by changes in technology, demographics and the environment.

Technology is changing how we work, spend and live. It has major implications for the UK’s economy and, in turn, finance. Consumers are increasingly shopping online. Platforms connect businesses to consumers across the country and overseas. This is generating vast quantities of data that can be used to improve services. But this data also raises numerous hazards of misuse and abuse of privacy.













We increasingly collaborate through the sharing economy. And the freelance and gig economy work are growing in importance.

Technology is enabling us to be ever more closely connected to the rest of the world through global trade and communications.

New business models are disrupting industries — and allowing an unbundling of business models with profound consequences. Automation, including machine learning, is taking on more tasks.

The UK is also undergoing several major transitions that finance has to respond to. We’re living longer. We better understand the value and importance of sustainability. We’re starting to reduce emissions and shifting to a low-carbon economy with major implications for business and investment. And the need for efficiency and lower costs in finance is an ongoing challenge. Britain’s role as a financial trading hub will evolve as emerging markets grow and political decisions on the UK’s relationship with the EU are made.

All of these factors will drive significant changes in the economy and, in turn, finance. They also raise some fundamental challenges to traditional models of regulation, economic modelling and central banking as a result of these technological and economic changes.

- 
Shift to digital
 19% of retail sales are online compared to 11% five years ago.
- 
Platform-based economy
 83% of SMEs use a mobile banking app.
- 
Gig and sharing economy
 One third of UK adults are expected to be self-employed by 2025, up from 20% today.
- 
Big data
 The UK data economy could be worth £95 billion in 2025 from £73 billion in 2016.
- 
Automation & machine learning
 Up to 30% of jobs in the UK are at risk of automation by 2030, likely offset by a range of new jobs.
- 
Integrating emerging markets
 Emerging markets' share of external financial assets globally could reach a third by 2030, up from 10% today.
- 
Low-carbon economy
 The transition to a low-carbon economy will require infrastructure investments of more than US\$90 trillion globally over the next decade.
- 
Demographic changes
 3 million more people will be over 55 years in the UK by 2025.
- 
Unbundling of business models
 Over 40% of financial services may be cloud hosted in a decade.
- 
Cyber-crime
 Global cyber-premiums are predicted to rise to US\$8.2bn in 2020 from US\$4.8bn last year.
- 
New laws and regulations
 Post-crisis regulatory reforms have meant that the BCBS published twice as many regulatory standards between 2009–17 than in the 20 years before.
- 
Technology improving efficiency
 Machine learning could increase efficiency delivering a 20% uplift in firms' financial performance.

WHAT DOES THIS MEAN FOR FINANCE?

Finance will help households and businesses adjust to and take advantage of the new economy, if firms and policymakers rise to the challenge.

Finance enables people and businesses to save, borrow, invest, transfer risks and make payments. It also helps safeguarding finances and financial identities. It fuels economic growth by putting savings to use and allocating capital to optimal projects. All of the above can foster competition and innovation and contribute to rising prosperity.

I've kept the "purpose of finance" uppermost in the work, as I consider how the system may evolve and the implications for the Bank.

- Finance can harness technology to make services more personalised, accessible, instantaneous and secure.
- Finance can help support the transition to a lower-carbon economy by financing clean energy infrastructure and embracing better disclosure on carbon footprint to help price risks and measure progress.
- Finance and regulation will have to adapt to an ageing society as well as help those entering the workforce, especially those in the gig and sharing economies.
- Innovation can support financial inclusion and help the vulnerable. This includes through building financial literacy, giving more control over finances and supporting more effective digital identification to help with inclusion.
- Finance can help businesses take advantage of international opportunities. It can reduce the cost of cross-border transactions and bring access to new markets.

Finance is likely to undergo intense change over the coming decade. The shift to digitally-enabled services and firms is already profound and appears to be accelerating.

- Today the world's largest financial service firm is China's Ant Financial with over one billion clients — without any branch. A decade ago it was Citigroup with 200m customers.
- In the US, 38% of unsecured personal lending was issued by new fintechs in 2018, up from 5% in 2013, according to Transunion, and nothing a decade ago.
- The cost of investing in major stock markets via ETFs and index funds has fallen by well over 50% over the past decade, according to Oliver Wyman.
- In Sweden, one of the most cash-light economies, the number of retail cash payment transactions per person has fallen 80% since 2008. New work for this report shows the UK may be only four to six years behind Sweden.

The shift from banks to market-based finance is likely to grow further.

- Half of all financial intermediation globally now happens outside the banking system according to the Financial Stability Board. The assets of non-bank financial institutions have grown by over 50% since 2008.
- 45% of lending to UK companies comes from market-based finance today compared to just 37% in 2006 according to think tank New Financial.
- In Sweden, 60% of consumer finance comes from specialist players, whereas one decade ago it was one third.

Ultra low rates, new regulations and the need to invest in updating their businesses mean many UK and global banks are struggling to make their cost of capital. This will drive changes to firms' business models as they look to improve efficiency, resilience and customer experience. Technology is enabling unbundling of activities which historically were done under one roof. While a more distributed model has many advantages, it is a far more complex system to oversee. For instance, many players which have historically not been regulated or held to the same standards are becoming active in core financial services processes. The Bank, and others, will wish to ward against this to realise the benefits.

Brexit and political and policy changes around the world will also impact the shape of financial services. It will also be critical context against which the Bank will need to make decisions going forward. But Brexit or no Brexit, there are numerous areas where the Bank can make progress in the years ahead.

Risks are likely to shift. Innovation can solve problems but also bring new risks — as well as old risks in new forms. Online fraud and cyber-hacking of digital accounts have surpassed traditional theft of banknotes and gold. Cyber-risk was cited as the biggest threat to finance after Brexit/UK political risks' in the latest Bank of England *Systemic Risk Survey*. Ultra low rates around the globe have changed investor behaviour and may lead to new vulnerabilities in markets. Firms and regulators will need to be agile and constantly look out for risks. They also have to update their toolkit and take advantage of a huge increase in effectiveness from data science and new technologies.

Regulators and the private sector have to collaborate in new ways as technology breaks down barriers. Moving to digital payments without leaving anyone behind will require significant upgrades to broadband and mobile telephony networks. Open finance will require competition authorities, data regulators, financial regulators and lawmakers to think about problems holistically, as opening up data may create unintended risks. The large number of regulatory projects requiring major technology upgrades would benefit from being co-ordinated so firms can invest in their own technology infrastructure.

Finance is hugely important to the UK. It provided over £300bn of real-economy finance in the UK last year, helping 700,000 people buy homes. It represents 11% of tax revenues and over one million financial services jobs, two thirds of which are outside Greater London. The UK's role as a global hub and market for buyers and sellers of securities and insurance is unique and offered a trade surplus of 3% of GDP in 2017. The UK's fintech sector is a world leading centre of innovation. It generates almost £7bn in revenues annually, according to Innovate Finance. Given the size and dynamism of this sector, little wonder that fieldwork underscored firms' interest in hiring talented staff, both home grown and from overseas: 42% of those working in fintech are from overseas, of which two thirds are from Europe according to WPI Economics. But there was also a passion for improving skills at UK schools and universities.

The right infrastructure can support new finance. The private sector will offer services for consumers and businesses. But it needs the right conditions to innovate and thrive. This means creating appropriate hard infrastructure, such as state-of-the-art systems to support new products and services, including through renewing the Bank's RTGS system. And the right soft infrastructure, including a well-respected legal and judicial system, rules, regulations and standards to empower competition and ensure safety and soundness.

WHAT DOES IT MEAN FOR THE BANK?

The Bank has already taken many important steps in the past few years to adapt its capabilities, policies and shape markets. So in many cases our recommendations are building on a very strong foundation and initiatives under way.

1 Shape tomorrow's payment system

As our payment habits shift, we need a joined-up strategy to improve our payments infrastructure and regulation — which doesn't leave anyone behind.

The proportion of transactions using cash has fallen from six in 10 payments a decade ago to just under three in 10 last year. It could approach one in 10 in a decade, according to UK Finance. The pace of change seems to be accelerating as we use cards and our phones more: for instance, withdrawals from ATMs are down 9% on last year. As we use less cash, the costs of running the network are likely to require changes in how it operates and is funded.

Joint roadmap for payments

First, the Bank should help shape a joint roadmap for cash and digital payments which reflects society's choices. Simply put, a National Payments Strategy Council. It should critically include broadband and mobile telephony in addition to financial services firms and regulators, building on some of the findings of the recent and well argued Access to Cash Review. The Bank, with others, needs to consider options to improve the sustainability of the cash payment model including considering merits of a "utility" cash distribution model similar to Finland, Sweden and the Netherlands. The Bank should contribute to a debate about whether cash distribution over the longer term may require State support if the current model becomes uneconomic.

Next generation payments regulation

Second, the Bank should help prompt next generation payments regulation to oversee a far more complex system and reflect the shifting risks. Payments are the number one area of interest for big tech platforms and new entrants. The UK is already one of the most open to new players in the world: >10% of UK card revenues, as estimated for 2017 revenue pools, have been captured by firms who have entered the market in the past 10 years. In light of increasing fragmentation of the payments chain and new entrants, the review should include the merits of tiering of regulation, adequacy of supervision of the entire payments value chain, and ways to simplify the highly complex regulatory structure. In Chapter 8 payments is also included as a focus area for ever greater cyber-resilience.

Infrastructure to improve cross-border payments

Third, the Bank should continue to promote a more robust and innovative payments infrastructure domestically and across borders. The UK has been a leader in innovation in the wider payments ecosystem. It will want to keep pace with customer demands for payments that are seamless, reliable, cheap, and secure. It will wish to keep abreast of developments such as new messaging standards and the developments of digital tokens. Crypto assets that are not backed by currency are an unreliable store of value, inefficient medium of exchange and simply won't cut the mustard. In light of the potential for continued innovation, the Bank with other authorities will need to keep on top of developments for tokenisation of fiat currency for payments to make sure the regulatory, legal and infrastructure implications are understood, and monetary and financial stability safeguarded. This review does not see a compelling case for a central bank digital currency given numerous uncertainties. These include legal uncertainties, risks around deploying the technology at scale, the potential impact on monetary transmission, and critically the risk of diverting attention away from improving today's systems for customers. Improving efficiency and cyber-security and enabling the core payment systems to be a platform for private sector innovation should remain the priority.

2 Enable innovation through modern financial infrastructure

Innovative payments infrastructure to enable alternative payments

The Bank will wish to introduce an innovative infrastructure to enable alternative payment methods. The Bank was the first G20 central bank to open up access to its payment services to non-bank payment service providers. A review may include how new providers can access the Bank's infrastructure and

application programming interfaces (APIs) to allow improved information retrieval and sharing from payment systems. Ideally, this should coincide with new tiering of payments regulation, as well as very high standards and a clear “package” at the Bank, to ensure companies with access are appropriately regulated.

Support better digital identification

Better digital identification will be essential for households and firms to benefit from the digital economy. The high cost of identification means finance is expensive and underserved. I realise this goes well beyond the remit of the Bank. But considering how central identification is to accessing finance, curbing cyber-fraud and reducing costs the Bank may wish to be an influential champion of better trusted digital identification where the UK has lagged. The Netherlands and the Nordics have voluntary digital identification schemes, all built in co-operation with financial services, which have 75%–90% take up versus less than 5% in the UK. This is likely to include supporting ways to build upon and open up high-quality data sources, tagged with unique identifying numbers, such as passports, driving licences, social security and tax numbers. It is also likely to require a change in how the government thinks about the liability and reliability of using these data sources. More broadly the role of financial firms collaborating on digital identification merits consideration.

Embrace the cloud

The Bank should embrace cloud technologies, which have matured to the point they can meet the high expectations of regulators and financial services. It offers the advantages of business agility, faster innovation and cyber-defences to provide better services to households and businesses. It also enables large firms to take advantage of the skills and talent in small and medium-sized businesses. Research suggests up to a quarter of the activities of largest global banks may already be on the public cloud or software hosted on the cloud. UK banks and insurers lag global leaders, and many firms I met are keen to take advantage of cloud at scale. Forty-three per cent of UK financials said they thought complex regulatory requirements were the key barrier to adopting cloud collaboration according to a new Finastra survey.

This said, given almost every vendor to financial services, and many fintechs, are cloud hosted, indirectly the UK system is already highly reliant on cloud. Looking forward, up to 40%–90% of banks' workloads globally could be hosted on public cloud or software as a service in a decade, according to McKinsey & Company. Policies will need to respond to this emerging reality. If the UK wishes to remain a leading venue for international finance, and ensure UK financial firms are competitive and are on a level playing field to new business models, the Bank will need to build expertise and play a leading role, in collaboration with other authorities, shaping use of public cloud in the financial sector.

Air traffic control for major projects

To improve resilience and support innovation, I recommend the Bank and all financial regulators create an “air traffic control” forum to map out and identify critical junctures for ongoing and major new regulatory projects and their implications for firms' IT/operational resilience — as well as their impact on innovation. Flurries of uncoordinated demands from regulators with tight deadlines add cost and risk. They also can reinforce the patching up of old systems at the expense of long-term investments in new infrastructure. Every regulator has its own objectives and independence, but sharing information could create a common understanding of challenges and through feedback a better understanding of the complexity of implementation.

3 Support the data economy through standards and protocols

Automated decision-making based on machine learning is one of the most important trends in technology today.

Machine learning and AI are expected to become widespread in financial services. So how customers' data is used — and its privacy — will take on ever greater prominence. While financial services are arguably already one of the most heavily regulated sectors for the use of data, rules must be revised to keep pace with the emergence of new data sets (including social media), developments in data science and new analytical techniques. Data privacy and the responsible and legal use of algorithms is going to be a huge topic in finance and the UK will wish to be at the leading edge of its development in finance.

Responsible AI principles

To get ahead of these issues and encourage responsible use of machine learning/AI in financial services, the Bank and FCA should create a working group for the use of ethical AI principles in finance. These responsible AI principles — such as fairness, accountability, transparency, security and responsible usage — could then guide where rules need refreshing. Ideally this should be across wholesale markets, banking and insurance. This should also include consideration of the possibility of collaborations, for example with the FMSB in wholesale market standards for the use of AI.

Support richer credit files for small and medium-sized business lending

Data standards and protocols are the bedrock of a robust and dynamic financial system. They can enable innovation, open up markets and boost the efficiency and effectiveness of finance. The portability of individual and business data generated online and through platforms, and the incorporation of this data into lending decisions has the potential to make the flow of finance more efficient, fair and accessible. The biggest beneficiary of open banking may prove to be businesses, not individuals. I recommend the Bank adds its voice to supporting data-sharing via APIs and enriching of credit files to help households and small and medium-sized enterprises access a broad range of finance. Field work highlights the single most helpful thing to open up SME finance would be company permissioned use of tax data. This is likely to coincide with better identification including the wider use of legal entity identifiers (LEIs).

4 Champion global standards for finance

Strong international standards are vital to underpin the efficient and safe flow of capital.

As one of the largest international financial centres, the UK has more to gain, and lose, than other countries from the prosperity of the global economy, how it hosts markets, and developments in the financial system. The UK's withdrawal from the EU is likely to have a profound change in the shape of cross-border business, but my remit has been to look beyond this to other areas of focus. The Bank continuing to play a world leading position shaping standards with the private sector and other policy makers will be a critical tool.

Champion global standards

The Bank already plays a highly influential role to promote strong international standards and deep supervisory co-operation to underpin efficient and safe global finance. Irrespective of Brexit, the Bank should have the ambition to be *at least* as influential and well represented in a decade as it is today. It will also want to play a leading role on emerging topics, such as data localisation.

In addition to the direct influence the Bank exerts on standards developed by the public sector, the Bank will also want to use its convening power to focus attention on road blocks to more effective finance by exploring the adoption of private sector standards. Particularly focusing on data standards in “post trade” infrastructure. A good place to start would be the swaps and collateral markets around ISDA's common domain model.

Engage on the evolving needs of emerging markets

Over the coming decade, the risk of fragmentation in global financial flows, or data, looms. But seams of opportunity are likely, as cross-border flows are expected to increase from the long-term growth potential of China and other emerging economies. The Bank should continue to engage internationally to explore ways in which the UK can use its expertise to meet the needs of global markets — such as by providing green finance, greater insurance for cyber-risk and supporting offshore local currency bonds.

Future of financial services

The confluence of a number of factors means the current or any future government may wish to explore the competitiveness and shape of the UK financial sector in the decade ahead. These include Brexit, the opportunities afforded by fintech and a reassessment as a decade of regulatory reform nears its end, whether the rules are working as intended, are as efficient as possible and what unintended consequences there are. If so, the Bank, *within the scope of its mandate*, should be open minded to contribute, or respond, if the Treasury wants to explore pro-growth changes to financial services regulation and other policies to be a world leading centre for fintech.

5 Promote the smooth transition to a low-carbon economy

The transition to a low-carbon economy poses both risks, and opportunities, for the economy, and the financial sector.

Investors, lenders and insurers don't yet have a clear view of which companies will struggle, endure or prosper as the environment changes, regulations evolve, new technologies emerge and customer behaviour shifts. Without this information, financial markets can't price climate-related risks and opportunities effectively.

The transition to a low-carbon economy will require large-scale reallocations of capital and investments in infrastructure — on some estimates more than US\$90 trillion globally over the next decade. The Bank could continue to use its convening power to support standards and ensure incentives are appropriate for this transition.

Mainstream climate change disclosure

The Bank should encourage the widespread adoption of the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) and monitor climate-related disclosures among supervised firms. It should also advocate their inclusion in mainstream financial reporting, ideally in the next five years, as well as enhanced disclosures across the real estate sector. Consideration of the appropriate base line and disclosure of firms' strategy will be the priority.

The Bank may, of course, wish to lead by example and hold itself to the same standards and publish its own climate disclosure, risk management and any internal targets for reducing energy usage.

Embed climate risk management

The Bank will want to build on current momentum to embed a climate risk management culture in financial services firms, including the successful Climate Forum. The Bank should ensure that firms are "transition ready" for a lower-carbon economy including working on best practice scenarios with firms and explore a new climate-risk scenario to explore transition readiness in a future biennial exploratory stress test.

6 Adapt to the needs of a changing demographic

Each generation's different financial needs and circumstances will have implications for the provision of finance.

As people live longer and bear more of the risk for funding their own retirement, finance should be able to help share longevity risk. Budgeting for old age is incredibly difficult, not least with growing health costs and uncertainty about how long you may live. Low prospective returns compound this. Making access to products which help people to save for their old age, and provide an income in an increasingly long retirement, are of paramount importance.

Security in retirement

The prudential regime for insurance companies has a significant bearing on the availability and price of risk-sharing products. As this is harmonised across Europe it leaves modest scope for interpretation or discretionary choices by the Bank about how those regulations work. However other jurisdictions such as the Netherlands and France have found ways to start to sharing longevity risk in new ways. The Bank should explore if the risk margin should be examined in the light of sharing longevity risk.

Support wider investment choices

Rates remaining ultra low for even longer could also raise questions about investment choices and suitable long-term assets to fund pensions, such as infrastructure. The Bank may wish to argue for wider investment choices including providing its expertise to help challenge firms and authorities to consider what financial products or protections gig and sharing economy employees need and the implications for firm risk management.

7 Safeguard the financial system from evolving risks

Innovations and regulatory change can solve problems, but also bring new risks — or old risks in new forms.

That can be from changing business models, new ways of working or how the system as a whole interacts. Meanwhile, the implications of technological developments are likely to be immense. History suggests the balance between financial stability and the desire to promote innovation and competition is unlikely to ever be entirely successful. Stability will require constant vigilance, an open mind and co-ordination.

The unbundling of the banking system could raise some fundamental challenges to traditional models of regulation, modelling the economy and how central banks operate.

Ensure regulation and infrastructure keep pace with innovative business models

The Bank will want to ensure regulation and infrastructure keep pace with innovative business models. The Bank should review who can access its infrastructure, including reserves accounts, to support greater innovation, focusing also on the “regulatory package” for access. It should keep evaluating how financial innovation and changing business models will impact financial stability. This includes the growth in market-based finance (ie funding via the bond and stock markets) and the unbundling of financial services value chains.

The Bank will also need to consider in depth the implications of separation of payments and lending from deposit-taking and the implications for the core banking system. A healthy financial system is a profitable one, and there are numerous risks to navigate. Regulators have to watch out for new platform-based businesses outside finance entering parts of financial services if they take on risks deemed as regulated activities. For instance, today the Big Tech firms are only dipping their toes in financial waters. The implications if they dive in could be profound. This could shift the focus from the current entity to greater emphasis on activity-based approaches. Policymakers will also need to consider the implications for monetary policy of a different banking model.

And regulators will want to continue to explore the implications of a very different wholesale market structure as central banks around the world seek to exit a decade of quantitative easing and in some jurisdictions negative rates.

Dynamic regulatory regime

Rules will need to be written, struck off and adjusted to ensure they work in practice. The Bank could establish a dedicated ‘regulatory evaluation and response’ unit to assess how effective major policies are throughout their life cycle. This would include reviewing their impact such as anomalies, unintended consequences and continued relevance.

Open Banking policy framework

Open Banking is a powerful idea to give customers more control over their finances in the next decade. But it also poses issues around security, who bears the costs, system structure, level playing field on data sharing and legal liability. The UK is the first country in the world to undertake this experiment, so the onus is on regulators to get it right, or adapt fast. UK Finance estimates it has already cost the nine largest banks up to £1.5bn to kick-start. Yet Boston Consulting argue data available through Open Banking does not enable the most attractive use cases and few customers are using Open Banking. Law firms have told us concerns around the legal liability model remain unsatisfactorily resolved for a scaled initiative. Many across industries also think data exchange should not just be from bank to others, but a broader plan for sharing data smartly, as Jason Furman recently argued in his review on unlocking digital competition. The Bank should work with the FCA, OBIE and others to suggest a Treasury-led review of lessons learned from the first 18 months of Open Banking and how to mitigate risks, make adjustments and galvanise opportunities. And see how open banking may dovetail with smart data initiatives across the economy.

8 Enhance protection against cyber-risks

The financial system is under almost constant cyber-attack.

Firms are preventing the overwhelming majority and invest to stay ahead. Co-ordination between National Cyber Security Centre, the Bank and the private sector is yielding results. They run industry-leading cyber-penetration tests with regulators and share intelligence. But cyber-incidents are growing rapidly in number, scope and sophistication.

Enhance data recovery

Regulatory and private sector initiatives must keep evolving to safeguard the system from this dynamic threat. I recommend the Bank should look to enhance data recovery across the system in the event of an incident. This would include mapping the mechanisms for data recovery and firms 'stepping in' in the event of a major cyber-incident. This should include exploring lessons from the US cyber-resilience initiative, 'Sheltered Harbor'.

Conduct cyber-exercises

Second, the Bank in combination with others may wish to enhance the frequency of domestic and international cyber-penetration tests. Payments and the full value chain of providers should be a growing focus. So should the consequences of the more open financial system.

Data to build the cyber-insurance market

Third, the Bank could encourage better information disclosure on cyber-threats domestically and internationally to help develop the data required for a more effective cyber-insurance market. Insurance can help businesses manage the mounting risks in the digital economy by providing greater protection against the potentially devastating costs of a cyber-incident.

9 Embrace digital regulation

The Bank will want to embrace regtech and data science techniques to improve its productivity and effectiveness.

There is huge scope for the Bank to use analytics for analysis of macroeconomic trends, financial surveillance and supervision. Machine learning and new data sets can strengthen the Bank's armoury to spot irregularities and get a better picture of the system's overall health and emerging risks. Routine tasks should increasingly be automated. Supervisors spend more time on relatively manual gathering and manipulation of information than they do on value-adding activities like analysis, interpretation and recommendations. A shift will free up resources to focus on value-added analysis. New tools will be essential to digest the extraordinary growth in data. Over the longer term, the Bank will also want to decide whether to reach out for data rather than waiting for it to be submitted.

A mindset shift in the approach to investment needs to occur — away from just the cost to the regulator of compliance, to efficiency of the overall system, including the costs to the private sector. McKinsey & Company estimates regulatory reporting for UK banks costs the industry £2 billion–£4.5 billion per year in run costs and risk change costs alone. There is a strong public interest in the efficiency of the financial system. A strategic plan and joined-up process would help unlock cost, prioritise spending better, and also enable firms and tech vendors to include new functionality in their own package upgrades. This could include some aspirational targets — for instance the Monetary Authority of Singapore has announced an aim to achieve zero duplication in data requests to financial institutions.

The Bank will need to make practical investments in data and processes to address clear pain points with industry. A more substantial joint effort and significant industry investment could transform how regulatory data is managed. It would also have a meaningful impact on the big end-to-end cost of regulation.

The Bank could also embrace new techniques in how its rule book is structured and used over time. At over 638,000 words, the PRA Rulebook is longer than the Old Testament. Machine-readable rules could ensure better adherence and save the private sector a significant amount.

Digital data strategy

So I recommend: first, the Bank develops and consults on a new medium-term regulatory data strategy (ideally three to five years) with specific initiatives to improve how it captures, shares and uses data under a new Chief Data Officer. An industry advisory panel will be an important leg to this. The Bank should foster its data science capabilities and deliver a medium-term roadmap for the Bank's digital transformation. This includes a recruitment and training strategy that meets the need of a central bank of the future. It should include a pilot to retrain economists with strong probability maths to become data scientists. When considering a new data strategy, the Bank should explicitly consider both the cost to the regulator and the efficiency of the overall system, including the costs to the private sector.

Digitalisation of supervision

Second, the Bank should digitalise processes within the regulatory area and bring ever more data science to underpin its toolkit. This should include considering how new regulatory and supervisory technologies could make data capture and analysis of firm information less resource-intensive, and educating staff on the value and potential uses of data.

WHAT COULD THIS VISION MEAN?

Looking back in a decade — what would one ideally like to see a result of this vision and these steps? I have the humility to know none of us can predict the future, but I have thought about outcomes the Bank and others may want to see.

<p>I Finance is serving the digital economy</p>	<p>Finance can support the emerging digital and platform economy by developing diverse payment options that are efficient, fast, secure, low-cost and cross-border. Integration into e-commerce and mobile apps will allow households and businesses to pay conveniently and securely around the world. Digital payment options will develop alongside rather than in place of cash to ensure that no-one is left behind.</p> <p>The portability of individual and business data generated online and through platforms and the incorporation of this into lending decisions will make the flow of finance more efficient, fair and accessible.</p> <p>Accessing big data and using AI and machine learning technology will make finance innovative, effective and inclusive. It will offer more customised and keenly priced products. This could include providing financial products to individuals and businesses in the gig economy and small and medium-sized enterprises who are traditionally underserved by the financial system.</p> <p>The Bank's own infrastructure decisions have helped catalyse innovation, competition and provided a key backbone to the economy.</p> <p>More effective digital identification has reduced fraud, costs and friction.</p> <p>And UK is seen as one of the world's fintech centres of expertise.</p>
<p>II Finance has supported major transitions in society</p>	<p>The broad-based growth and further opening of emerging market economies create an opportunity for the UK as a global financial centre to support their integration into the financial system. The UK's wholesale finance sector has a long heritage in bringing buyers and sellers together in trusted market places. The UK's markets and infrastructure can help meet emerging markets' domestic financing needs and investment through local currency issuance. Finance can also help firms export and facilitate cross-border supply chains.</p> <p>Investment products will need to evolve to provide greater security in retirement and to allow individuals to manage the longevity risk associated with living longer. They will also take into account changing customer preferences by offering investment and savings products that measure up against sustainable, impactful and ethical metrics.</p> <p>A smooth transition to the low-carbon economy will require support from the financial sector to mobilise private finance for projects and infrastructure that reduce carbon emissions. Improving the quality of information available to stakeholders and investors is critical to breaking down barriers to informed investment, unlocking better decision-making and enabling more effective risk management.</p>

**III The system
has become
more resilient
to old and new
risks**

Embracing new technology and making data accessible can make finance more dynamic by helping to create new services and products that meet customer demands.

Technological innovation, an evolving market landscape and new regulation have led to pressures of changing business models and an unbundling of activities. Incumbent firms will need to be responsible for and manage the risks of unbundling business models. They must also consider how they can innovate or partner with new providers to deliver a better service for customers.

A dynamic regulatory framework that safeguards the system against new and evolving risks. Regulation proportionate to risks. And rules updated to the new economy and old rules, which no longer fitted, rethought or removed

Finance will need to **work together to ensure it is resilient to cyber-risks.** Insurance can help businesses manage the mounting risks in the digital economy by providing greater protection against the potentially devastating costs of a cyber-incident. Mitigating the impact of cyber-risk helps to prevent disruption to economic activity and sustain employment.

And finance can **work with authorities to improve the efficiency and effectiveness of compliance, regulation and supervision.** New technology and aligning systems will allow cost savings, which will provide a more efficient service.

SUMMARY OF RECOMMENDATIONS

This represents a summary of the recommendations contained in this report. The order in which these are presented reflects the structure of the report and not any kind of suggested prioritisation.

To help finance serve the digital economy, the Bank should:

- 1 Shape tomorrow's payment system
- 2 Enable innovation through modern financial infrastructure
- 3 Support the data economy through standards and protocols

1 SHAPE TOMORROW'S PAYMENT SYSTEM

1.1 PRODUCE A ROADMAP FOR PAYMENTS OPTIONS	<p>The Bank should:</p> <ul style="list-style-type: none">• Join a group of regulators (including non-financial ones such as Ofcom) and the private sector convened by the Treasury to fashion a co-ordinated response to society's shift to digital, without leaving anyone behind. In effect, a national payments strategy council.• This could include a roadmap to:<ul style="list-style-type: none">- foster cost-effective and resilient payments for the future;- understand dependencies such as broadband and mobile coverage;- ensure that no one is left behind through 'digital exclusion';- consider with the private sector options to improve the sustainability of the cash payment model, including potential merits of a 'utility' distribution model similar to Finland, Sweden and the Netherlands; and- contribute to a longer-term debate about whether cash distribution may require state support if the current model becomes uneconomic for the private sector.• Explore any hurdles to faster, cheaper and more widespread peer-to-peer and inter-bank payment options — especially those powered by mobile apps — with the Financial Conduct Authority and the Payment Systems Regulator. This should include the role of appropriate fees for PSD2 transactions.
1.2 CONTRIBUTE TO THE NEXT GENERATION OF PAYMENT REGULATION	<p>The Bank should:</p> <ul style="list-style-type: none">• Suggest the Treasury lead a cross-authority review of payments regulation to evaluate:<ul style="list-style-type: none">- the appropriateness of the regulatory framework for the risks posed by different payment activities, including tiering of firms;- how to ensure effective supervision of the overall payments value chain;- the role of data-sharing between platforms and payment companies; and- ways to reduce fragmentation and complex regulation in the UK.

1 SHAPE TOMORROW'S PAYMENT SYSTEM

1.3 DEVELOP THE INFRASTRUCTURE TO MAKE CROSS-BORDER PAYMENTS MORE EFFICIENT AND CHEAPER	<p>The Bank should:</p> <ul style="list-style-type: none">• Implement richer messaging standards and common identifiers to facilitate more effective and accurate global co-ordination.• Open access to a broader range of payment providers who operate across borders.• Continue to work with international bodies, such as the Committee on Payments and Market Infrastructures, to explore opportunities to make cross-border payments more efficient and cheaper.• Keep abreast of digital tokens and explore greater interoperability with other central banks to improve payments for households and companies.
--	--

2 ENABLE INNOVATION THROUGH MODERN FINANCIAL INFRASTRUCTURE

2.1 BUILD AN INNOVATIVE PAYMENT INFRASTRUCTURE TO ENABLE ALTERNATIVE PAYMENT METHODS	<p>The Bank should:</p> <ul style="list-style-type: none">• Consider how alternative providers might access the Bank's infrastructure including balance sheet and payment systems, and an appropriate package for obligations which come with these rights. This will need to dovetail with new payments regulation to ensure any new members are appropriately capitalised and supervised. Careful thought would also need to be given to the implications for monetary and financial stability of any further extension.• Create an API to allow improved information retrieval and sharing from payment systems.
2.2 CHAMPION TRUSTED DIGITAL IDENTIFICATION	<p>The Bank should:</p> <ul style="list-style-type: none">• Engage with the financial sector to establish its requirements for a digital ID, including discerning the features that would:<ul style="list-style-type: none">- help reduce fraud in financial transactions;- reduce costs of on-boarding new customers and anti-money laundering and Know Your Customer processes; and- expand access to those excluded from the financial system.• Champion these requirements in broader engagement with public and private sector participants. The government should consider the merits of secure and efficient information gateways to trusted official sources, so the private sector can improve the effectiveness of identification verification.
2.3 EMBRACE SAFE CLOUD USAGE	<p>The Bank should:</p> <ul style="list-style-type: none">• Work with the private sector to help firms realise the benefits of public cloud usage without compromising resilience by:<ul style="list-style-type: none">- understanding and mapping concentration risks and interoperability, as well as building expertise within the Bank;- testing operational resilience, including to cyber-risk;- setting standards and guidelines for cloud usage; and- collaborating with international regulators on a longer-term approach to cloud oversight.

2 ENABLE INNOVATION THROUGH MODERN FINANCIAL INFRASTRUCTURE

2.4 SUPPORT AN “AIR TRAFFIC CONTROL” OF MAJOR PROJECTS	<p>The Bank should:</p> <ul style="list-style-type: none">• Argue for a new forum with all major regulatory bodies to map and identify critical junctures for ongoing and new regulatory projects. These include: The Payment Systems Regulator, the Financial Conduct Authority, the Open Banking Implementation Entity and the Competition and Markets Authority. While respecting each institution’s statutory duties, sharing information on the timing and impact of major projects would reduce risk to operational resilience. It would also limit the risk of crowding out innovation through the bunching of regulatory initiatives. Indirectly, it may build a richer roadmap of tech transformation for financial infrastructure.
---	---

3 SUPPORT THE DATA ECONOMY THROUGH STANDARDS AND PROTOCOLS

3.1 PROMOTE THE RESPONSIBLE USE OF MACHINE LEARNING AND AI	<p>The Bank should:</p> <ul style="list-style-type: none">• Establish a public-private financial sector working group with the Financial Conduct Authority to:<ul style="list-style-type: none">- monitor developments in the use of machine learning to understand possible micro and macroprudential implications of widespread adoption;- develop principles, and share best practice, for the responsible, explainable and accountable use of machine learning in finance;- explore the intersection with current rules (including Senior Managers Regime) and where old rules need updating; and- feed into the Centre for Data Ethics and Innovation’s work on maximising the benefits of artificial intelligence and managing the risks in finance.• A wholesale working group (or subgroup) should also involve or could be championed by the Fixed Income, Currencies and Commodities Markets Standards Board.
3.2 SUPPORT BETTER CREDIT FILES FOR SMES	<p>The Bank should:</p> <ul style="list-style-type: none">• Use its knowledge of LEIs in finance to support wider adoption.• Contribute analysis on the value of better credit files for small and medium-sized enterprises and individuals. This could include considering permissioned access to high-level company tax data. The Treasury may wish to establish a competition for private innovators to help build better credit files for the gig and sharing economy.

To help finance support the major transitions, the Bank should:

- 4 Champion global standards for finance
- 5 Promote the smooth transition to a low-carbon economy
- 6 Support adaption to the needs of a changing demographic

4 CHAMPION GLOBAL STANDARDS FOR FINANCE

<p>4.1 CHAMPION GLOBAL STANDARDS</p>	<p>The Bank should:</p> <ul style="list-style-type: none">• Promote strong public sector standards and deep supervisory co-operation, including through maintaining and optimising influence in forums such as the Financial Stability Board, the Basel Committee on Banking Supervision and the International Monetary Fund.• Convene and catalyse private sector standards through discussions on road blocks to more effective finance, particularly in post-trade and deepening supervisory co-operation. A good place to start would be the swap and collateral markets along the lines of the International Swaps and Derivatives Association common domain protocols. The Fixed Income, Currencies and Commodities Markets Standards Board can play a useful role on this.
<p>4.2 ENGAGE ON THE EVOLVING NEEDS OF EMERGING MARKETS</p>	<p>The Bank should:</p> <ul style="list-style-type: none">• Continue to engage internationally to explore ways in which the UK, as a global financial centre can use its expertise to meet the needs of international markets. This includes through providing green finance, greater insurance for cyber-risk and offshore local currency bonds.
<p>4.3 ENGAGE WITH FUTURE OF FINANCIAL SERVICES INITIATIVES</p>	<p>The Bank should:</p> <ul style="list-style-type: none">• Contribute within the scope of its mandate, if the Treasury wants to explore pro-growth changes to financial services regulation and other policies to be a competitive vibrant centre of financial services and be a leader in fintech, not least as Brexit choices become clearer.

5 PROMOTE THE SMOOTH TRANSITION TO A LOW-CARBON ECONOMY

5.1 ADVANCE THE ADOPTION OF CLIMATE CHANGE DISCLOSURE	<p>The Bank should:</p> <ul style="list-style-type: none">• Encourage widespread adoption of the Task Force on Climate-related Financial Disclosures' (TCFD) recommendations.• Monitor climate-related disclosures among supervised firms.• Work with the Department for Business, Energy and Industrial Strategy and relevant authorities to explore the merits of making climate-related financial disclosures mandatory in mainstream financial disclosures, ideally within five years.• Consider climate disclosure for its own operations.
5.2 EMBED CLIMATE RISK MANAGEMENT	<p>The Bank should:</p> <ul style="list-style-type: none">• Ensure that the firms the Bank supervises are embedding scenario analysis in their risk management.• Engage internationally to develop templates for scenario analysis.• Facilitate the sharing of best practices in the management of climate-related financial risks.• Include a new climate-risk scenario for the Biennial Exploratory Scenario (BES).

6 ADAPT TO THE NEEDS OF A CHANGING DEMOGRAPHIC

6.1 CONSIDER FORCES DETERMINING SECURITY IN RETIREMENT	<p>The Bank should:</p> <ul style="list-style-type: none">• Consider what opportunities finance presents to share longevity risk.• Explore any regulatory impediments to security in retirement, starting with the treatment of risk-sharing products and products that help protect savers from outliving their savings if they live longer.
6.2 SUPPORT WIDER INVESTMENT CHOICES	<p>The Bank should:</p> <ul style="list-style-type: none">• Provide its expertise to help challenge firms and authorities to consider what financial products or protections gig and sharing economy employees may need and the implications for firms' risk management.• Assess how firms are responding to the changing investment desires of younger demographics and whether they are strategically resilient to changing preferences.• Share expertise from climate-disclosure work to help investors develop principles for broader sustainability metrics.

To ensure that finance increases resilience to new risks, the Bank should:

- 7 Safeguard the financial system from evolving risks
- 8 Enhance protection against cyber-risks
- 9 Embrace digital regulation

7 SAFEGUARD THE FINANCIAL SYSTEM FROM EVOLVING RISKS

<p>7.1 ENSURE REGULATION AND INFRASTRUCTURE KEEP PACE WITH INNOVATIVE BUSINESS MODELS</p>	<p>The Bank should:</p> <ul style="list-style-type: none">• Remain vigilant to developments in the financial system and be ready to act to protect resilience when needed. To do so, regulatory approaches and macroprudential tools may need to evolve. This report can provide suggestions on topics and risks to watch closely.• Evaluate the appropriate level of access to central bank infrastructure, including its balance sheet, for non-banks in order to support greater innovation while safeguarding monetary and financial stability.
<p>7.2 FOSTER A DYNAMIC AND RESPONSIVE REGULATORY REGIME</p>	<p>The Bank should:</p> <ul style="list-style-type: none">• Establish a dedicated 'regulatory evaluation and response' unit to assess the effectiveness and impact of major policies across their life cycles. This includes anomalies, unintended consequences and continued relevance.
<p>7.3 CONTRIBUTE TO AN OPEN BANKING POLICY FRAMEWORK</p>	<p>The Bank should:</p> <ul style="list-style-type: none">• Work with the Financial Conduct Authority to suggest a Treasury-led review of lessons learned from the first 18 months of Open Banking. The Bank should consider how to mitigate risks and galvanise opportunities, including the implications of unclear liability for data loss and failed payments.

8 ENHANCE PROTECTION AGAINST CYBER-RISKS

<p>8.1 ENHANCE DATA RECOVERY</p>	<p>The Bank should:</p> <ul style="list-style-type: none"> • Map the mechanisms for data recovery and the potential for firms 'stepping in' in the event of a major cyber-incident. • Consider the merits of the US private sector 'Sheltered Harbor' initiatives.
<p>8.2 CONDUCT CYBER-EXERCISES</p>	<p>The Bank should:</p> <ul style="list-style-type: none"> • Enhance the frequency of domestic and international cyber-penetration tests. Growing focus should be on payments from traditional and new entrants and the full value chain of providers.
<p>8.3 ENCOURAGE BETTER INFORMATION SHARING</p>	<p>The Bank should:</p> <ul style="list-style-type: none"> • Encourage better disclosure on cyber-threats domestically and internationally to help develop the data required for developing a more effective cyber-insurance market.

9 EMBRACE DIGITAL REGULATION

<p>9.1 CONSULT ON A NEW DIGITAL DATA STRATEGY</p>	<p>The Bank should:</p> <ul style="list-style-type: none"> • Develop and consult on a medium-term regulatory data strategy, ideally for three to five years, with specific initiatives to embrace data-driven and intelligence-led risk monitoring. • Foster data science capabilities and deliver a medium-term roadmap for its digital transformation. This includes a recruitment and training strategy that meets the need of a central bank of the future. • Consider making its rulebook machine-readable so it can be interpreted more efficiently and accurately. • Consider not just the cost of its own regulatory functions but the total cost of regulation for the UK financial system.
<p>9.2 ENHANCE RISK MONITORING THROUGH DIGITALISATION OF SUPERVISION</p>	<p>The Bank should:</p> <ul style="list-style-type: none"> • Consider which new regulatory and supervisory technologies could make the data capture and analysis of information from firms less resource-intensive. • Increasingly automate routine tasks and so free up resources to focus more on value-added processes. • Over the longer term, make a choice about reaching out for data rather than ask for it to be submitted.

1 SHAPE TOMORROW'S PAYMENT SYSTEM

THE OUTCOME WE SEEK

An effective UK payment system which is fit for the future — secure, resilient, inclusive, innovative and reliably serving households and businesses across the UK at an affordable cost.

- Our payment habits are shifting as we increasingly use our cards, phones and electronic wallets instead of cash. The underlying infrastructure will need to adapt to these changes.
- Business models are also changing: fintechs, start-ups and big technology companies are moving into payments.
- As our payment habits shift, we need a national payments strategy to improve our payments infrastructure and regulation — which doesn't leave anyone behind. Payments regulation also needs to be updated to reflect how risks are shifting and to reduce complexity.

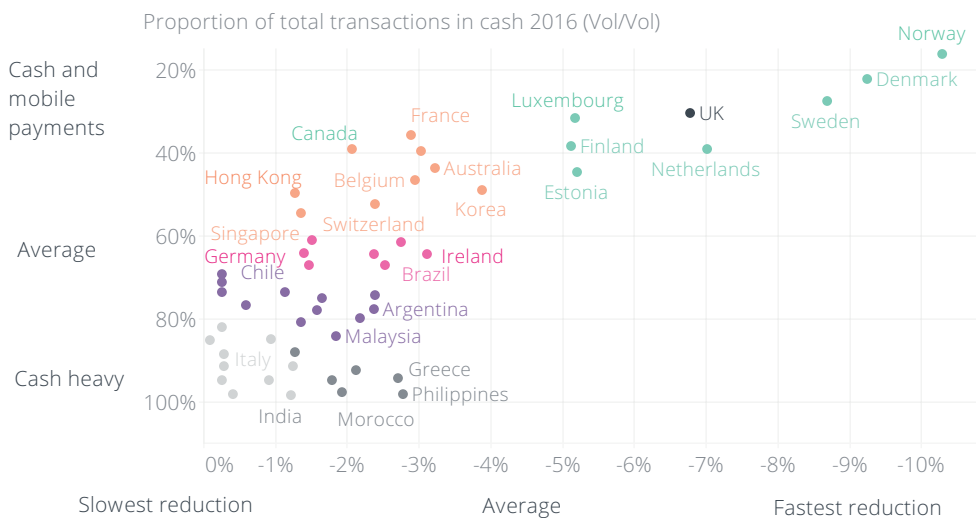
KEY DEVELOPMENTS

The shift from cash to digital

The defining trend around the world is the growth of electronic payments for every day purchases and the consequent decline in the use of cash for basic transactions. Technology is allowing customers to pay in new ways, with mobile payments becoming increasingly important.

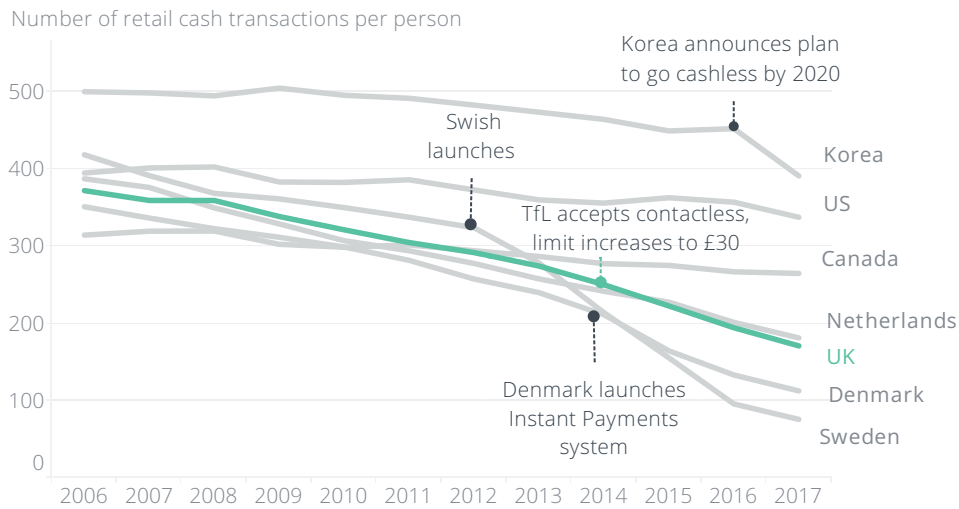
The number of retail cash payments per person made in the UK has been falling at an estimated rate of 10% pa in the five years between 2012–2017, according to McKinsey & Company. The UK is already amongst the most cash-light economies globally. Some economies, such as Denmark, Norway and Sweden, have seen even faster rates of cash decline (**Figures 1 and 2**). Norway is the lowest, where cash usage is only six percent of value and eleven percent of number of transactions at point of sale.¹

Figure 1: The UK is one of the countries which is shifting fastest from cash



Source: McKinsey & Company, Bank for International Settlements, European Central Bank, central banks, Euromonitor, Retail Banking reports, McKinsey Global Payments Map.

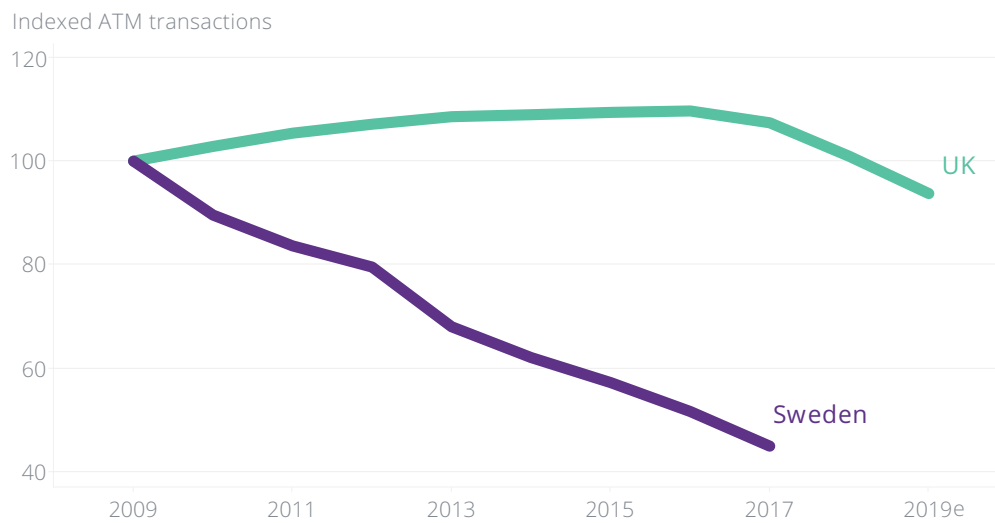
Figure 2: Number of retail cash payment transactions per capita



Source: McKinsey & Company, McKinsey Global Payments Map, press search.

The value of withdrawals from the UK’s largest ATM network LINK is seeing the largest decline in its 50-year history (**Figure 3**). Last year, the number of withdrawals fell by more than 6%.² This has sped up to 9% so far in 2019. Based on current trends, this would imply a fall by a third over the next five years. Meanwhile debit card transactions overtook cash payments for the first time in 2017, according to UK Finance.³

Figure 3: The decline in ATM transactions is accelerating



Source: LINK, Sveriges Riksbank.

Analysis and interviews with major retailers and payment firms suggest the share of cash usage is falling at a modestly accelerating rate. Changes in consumer behaviour have been reinforced by greater penetration of contactless on mass transit and the high costs of handling cash for banks (c.5–10% of operating costs for some retail banks, according to research by McKinsey & Company). The UK Access to Cash review suggests a direct cost of £5bn for cash infrastructure but one estimate suggests approximately double this when including indirect costs.⁴ Given the scale of this cost at a time when UK banks are not making their return targets, it is likely that retailers, payment firms and banks will all look to make savings. Without a coordinated plan, the pace of change could accelerate even faster and there is a risk of some groups in society being at a disadvantage.

Whilst these factors may reinforce each other, experience elsewhere suggests the rate of decline in cash may not move dramatically unless prompted by major interventions, often made by policymakers, such as the transportation system going contactless, or the introduction of new payment services (eg Swish in Sweden, **Box 3**). London/South East was an early adopter of contactless travel in terms of its transport network — but Edinburgh, Manchester, Liverpool and Leeds just have or are about to go contactless, too.

Whatever happens, cash is likely to be used significantly less than digital payments over the next decade. UK Finance estimate just over six in 10 transactions were in cash a decade ago — and just under one in three last year.⁵ They forecast only one in 10 will be made with cash in a decade. Therefore, as the shift to digital payments occurs, it will be important to ensure that it does not lead to financial exclusion.

Technological advances may not always be available to vulnerable groups. As the UK Access to Cash Review argues, businesses don't always focus on those who are the least affluent and least commercially attractive, but arguably most in need. In addition, mobile and broadband connectivity could create large regional disparities in the use of mobile and electronic payments, with rural communities most at risk.

The rise of new business models

Technology companies are increasingly moving into the payments industry. They have a variety of economic motivations and business models but offer choice and convenience to customers. Often their services are overlays or bundled with existing ones.

The transformation from cash to digital in the UK has so far been led by card networks which have provided secure and largely reliable means of payment; consumer protection; and financial incentives for issuers and consumers. Nearly half of all payments (47%) were made with credit and debit cards in 2018.⁶

However, new payment providers have sprung up across the payment cycle, ranging from fintech start-ups to established global technology firms. New analysis for this report from McKinsey & Company suggests that an estimated >10% of 2017 UK card revenues have been taken by new firms — most of which did not exist a decade ago. According to McKinsey & Company, approximately 35% of the total number of fintechs and financial innovations in the UK relate to payments.

New firms, such as Stripe and Square, seek to address pinch points for merchants processing card payments and handling cash. They make revenue by offering fast onboarding for customers, data analytics and e-commerce functionality. Some of the world's biggest tech companies now also offer payment services (**Figure 4**). These developments underscore the considerable strategic value in payments.

Figure 4: Overview of selected payment providers

	Ant Financial	Tencent	Google	Facebook	Amazon	Apple	PayPal
Type of firm	Online retail	Tech	Tech	Social media	Online retail	Tech	Electronic payments
Payment solutions	Alipay	WeChat Pay (previously Tenpay)	Google Pay (previously Google Checkout, Android Pay, Tez (India))	Facebook Messenger Payments and Whatsapp Pay (India)	Amazon Pay	Apple Pay	PayPal, Venmo, Braintree, Xoom
Launched	2004	2005	2011	2015	2007	2014	1999
Estimated number of users (data cannot directly be compared)	1 billion users ^a	1 billion users (of WeChat) ^b	25 million users ^c	2.4 billion active Facebook users ^d 210 million active Whatsapp India users ^e	33 million+ made a purchase via a "Pay with Amazon" button ^f	383 million users ^g	250 million users ^h
How it works	Balance stored in a digital wallet linked to a bank account or card. QR codes initiate payments	Balance stored in a digital wallet linked to a bank account or card	Payment cards linked to and authenticated by mobile phone; Credit transfers	Debit cards linked to Facebook Messenger	Embeds payment cards; credit transfers; direct debits; e-money online	Payment cards linked to and authenticated by mobile phone	E-money account can be funded through cards, credit transfers, and direct debits

a See intl.alipay.com/.

b See www.statista.com/statistics/255778/number-of-active-wechat-messenger-accounts/.

c See economictimes.indiatimes.com/small-biz/startups/newsbuzz/google-pay-now-has-25m-monthly-active-users/article-show/65865946.cms.

d See www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/.

e See www.ft.com/content/e045cdd2-0503-11e9-99df-6183d3002ee1.

f See www.forbes.com/sites/greatspeculations/2017/02/14/heres-how-amazon-payments-can-drive-profitability-for-the-company/#63fc70a4d228.

g See www.statista.com/statistics/911914/number-apple-pay-users/.

h See www.paypal.com/uk/webapps/mpp/personal.

E-commerce and social media ecosystems

Some firms offer seamless payments within their own ecosystems. And they have been able to use the additional information from the ecosystem to offer customised commercial and financial products, such as loans and insurance. This can increase financial inclusion. China is a good example of this

(Box 1). Several large e-commerce and social media companies have integrated financial services into their platforms. Alipay and WeChat Pay, had an estimated 94% share of the mobile payments market in China in 2017.⁷

Box 1: Innovation in Chinese payments

China has transitioned from a cash-based society into a leader in mobile payment services and cashless transactions in a few years.¹ In 2017, mobile payment transactions in China totalled US\$15.4tn.² This is significantly more than the combined total global transactions processed by Visa and Mastercard (US\$12.5tn).

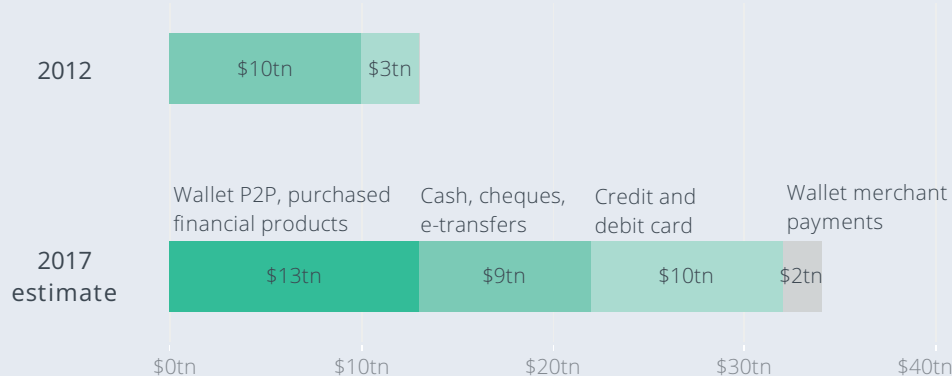
The shift to mobile payments was enabled in part by a significant growth in online retail

services and online and mobile phone usage. Regulation has also played a role. Until recently, e-money was not backed fully as is the case in the UK. In 2019, the People's Bank of China (PBoC) raised backing requirements to 100%.³

Several "big techs" have now integrated financial services, including payments, into their platforms.

Figure 5: Consumer payments in China

Consumer payments by value (\$ trillion)



Source: McKinsey & Company, McKinsey Global Payments Map, McKinsey Payments Practice, iResearch, PROC, press search.

1 www.ft.com/content/539e39b8-851b-11e8-a29d-73e3d454535d.

2 www.wsj.com/articles/china-tech-giants-costly-wars-to-go-cashless-1528977600.

3 www.reuters.com/article/china-pboc-payments/china-cbank-to-raise-reserve-funds-ratio-for-payment-firms-to-100-pct-idUSB-9N1TE02Q.

Box 1 continued: Innovation in Chinese payments

Alipay

Alipay is an online and mobile payment platform of ANT Financial that grew out of the Chinese e-commerce giant Alibaba. It has a market share of 35% of all Chinese electronic payments and 54% of mobile payments.¹ Chinese customers can use Alipay outside of China.

WeChat Pay

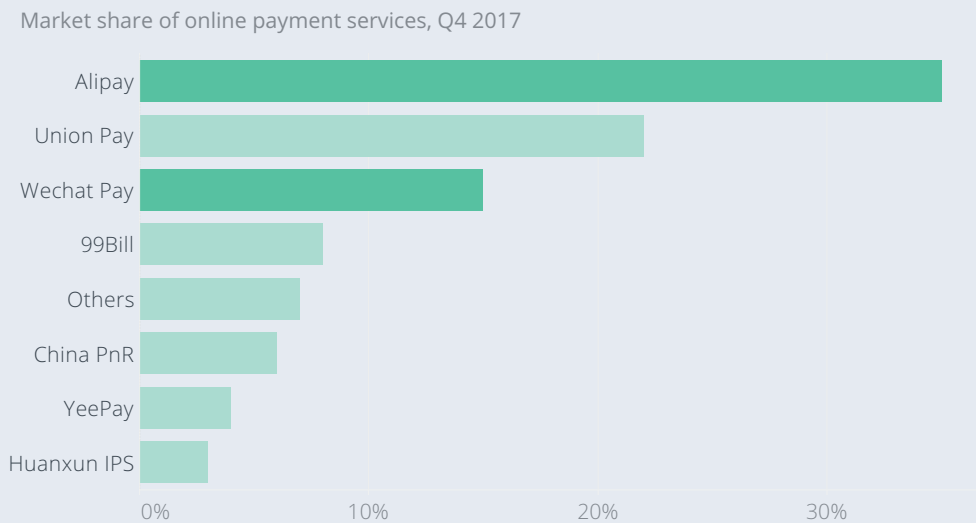
WeChat Pay is an integrated digital wallet within Tencent's WeChat application. WeChat Pay accounts for 15% of all Chinese electronic payments and 39% of all Chinese mobile payments.² WeChat Pay now allows the use of Hong Kong dollars in mainland China.³

Alibaba and WeChat have used the data gathered through payments for credit scoring their customers.⁴ Millions of Chinese citizens lack traditional credit histories making it difficult for

them to obtain credit from traditional financial institutions. Alibaba's Zhima Credit (Sesame Credit) creates a credit score based on social networks and payments history, which allows lenders and merchants to establish a borrower's creditworthiness.⁵

Ecosystems like Alibaba and WeChat harness huge data and leverage scale. The Chinese experience emerged in a different policy context to that in the UK with Chinese authorities strongly promoting financial deepening, including through faster payments. It nevertheless shows that the traditional link between consumers and banks can break down, if new players successfully integrate payments into their lifestyle proposition. The Chinese firms are also world leaders in the use of machine learning to help curb fraud, drive business and personalise offerings.⁶

Figure 6: Payment providers in China



Source: Chinese SEO Shifu.

- 1 See www.ft.com/content/b472f73c-859e-11e8-96dd-fa565ec55929.
- 2 See www.ft.com/content/b472f73c-859e-11e8-96dd-fa565ec55929.
- 3 See www.chinadaily.com.cn/a/201809/27/WS5bac4168a310eff30327fc06.html.
- 4 See technode.com/2019/01/11/wechat-credit-score-sesame-credit/.
- 5 See www.ft.com/content/ba163b00-fd4d-11e8-ac00-57a2a826423e.
- 6 See www.inc.com/magazine/201809/amy-webb/china-artificial-intelligence.html.

Peer-to-peer payments

The UK has not experienced the significant growth of peer-to-peer payments some other countries have. In the Netherlands around 60% of all e-commerce transactions are made through iDeal (see **Box 2**).⁸ Penetration is also very high in Sweden, Norway and Denmark. In other European markets the development of a mobile peer to peer app was often championed by the largest banks and authorities sometimes worked to help. Furthermore, the cost of peer-to-peer payments is often cheaper than using card networks. It also enables the bank to retain data on customers spending patterns.

Box 2: Account-to-account payments

Some countries — such as the Netherlands, Sweden, Denmark — have seen considerable success from the introduction of peer-to-peer apps — to enable sending money between individuals. In most markets the success has been huge and led to incredibly fast adoption as an alternative option to cash. And as a way to enable cheap, trusted payments, there could be a clear benefit for UK consumers.

The Swedish and Dutch experiences show that for account-to-account payments to take off, a consortium of banks, often with support from authorities, has to coalesce around a solution. This solution — built on the necessary payment infrastructure — often provides a convenient customer interface and a recognisable brand in order to build momentum and encourage adoption.

iDeal (e-commerce solution)

iDeal is an account-to-account payment solution that was launched as an initiative by the three largest Dutch banks in 2005. It enables consumers to pay online direct from their bank account. Payments are in real-time and consumers enter their bank details using a two-factor authentication model.

Today around 60% of all e-commerce transactions in the Netherlands are made through iDEAL.¹ Like Swish, it has expanded its functionality to include point-of-sale payments in retailers.

Swish (mobile account-to-account solution)

Swish is an account-to-account mobile payment app launched by six large Swedish banks in collaboration with the Riksbank in 2012.² It allows consumers to pay quickly, securely and easily, sending money to a recipient's mobile phone. The payment is authenticated using an electronic ID issued by a consortium of Swedish banks that links to the national ID system.³

Swish started as a person-to-person (P2P) platform, but expanded to business-to-customer (B2C) in 2014. It has grown rapidly with 60% of the Swedish population using Swish today (up from 10% in 2014).⁴ Similar solutions exist elsewhere, eg MobilePay in Denmark and Finland, Venmo in the US and PayPal.

Factors that may have additionally contributed to the expansion of Swish include a national digital ID leveraged across institutions, high levels of mobile connectivity, financial literacy and trust among the population on consumer privacy. Person-to-person transactions, especially among younger people, were first to take off with Swish, followed by adoption from merchants.

Several other countries have seen high growth of mobile payments. In Hong Kong, HSBC and Hang Seng, the largest bank, have developed PayMe and over one in seven citizens have downloaded the app.⁵

1 See www.ideal.nl/cms/files/Factsheet_iDEALpayments_UK.pdf.

2 See www.getswish.se/about-swish/.

3 See medium.com/@etiennebr/swish-the-secret-swedish-fintech-payment-company-created-by-nordic-banks-and-used-by-50-of-swedes-cfcf06f59d6f.

4 *Payment Patterns in Sweden*, Riksbank, (2018). This is based on the question "Have you used Swish in the last month?".

5 See payme.hsbc.com.hk/personal.

Cross-border payments

Cross-border payments are an area where frictions and inefficiencies continue to exist. McKinsey & Company research shows that processing a cross-border payment is, on average, ten times more costly than processing a domestic Automated Clearing House (ACH) payment.⁹ Each payment has to cross multiple jurisdictions and infrastructures through the correspondent banking network which makes it slow, costly and lacking transparency. Manual reconciliation of transactions with unclear payee details further contribute to the costs. 63% of corporates report that they are unsatisfied with the time taken to process cross-border payments.¹⁰

Regulation and the changes in the payments landscape

The payments landscape has undergone significant changes, including thorough regulations and policy making. The advent of PSD2 and Open Banking (see Chapter 7) was designed to accelerate the trend towards greater diversification in payments in the UK, catalysing the emergence of payment initiation and aggregation service providers (PISPs/ASPs) and offering greater choice and lower costs for customers. While potentially transformative, a number of challenges will need to be addressed — notably around liability, reciprocity of data, incentives for banks, cyber-security and operational resilience. These are embedded in wider questions about the take up and medium term viability of some of the providers and design of the programme.

By definition, payments have strong network effects. Technological change has accelerated firms' ability to leverage these effects, as the collection of greater amounts of customer data has allowed firms to gain valuable insights into consumer preferences and behaviour. Policy makers and authorities have been monitoring these developments and should continue to do so in the future to account for changes in market structure.

New electronic payment chains consist of an increasing number of parties that are interdependent but do not always have the same interests. They may be under the supervision of various authorities or even under no supervision at all. For example new businesses have emerged providing front end services to help customers initiate payments. These lengthen the payments chain. Depending on whether the initiated payments move from account to account or through card rails different regulatory regimes may apply.

Some other jurisdictions are recognising the need to evolve payment regulation to keep up with new business models. Switzerland has a broader range of payment firm licences than the UK.¹¹ Singapore has recently introduced a three tiered regulation for payment firms.¹²

Crypto-assets and digital currencies

Technological developments and the fall in confidence in the banking system in the crisis have contributed to the cryptocurrency revolution. Simon Gleeson, author of *The Legal Concept of Money*, divides crypto-assets into three broad buckets, although many permutations are possible.¹³ Independent of the technological design, benefits and challenges, each has quite profound different legal, regulatory, and monetary consequences.

- First, a “true cryptocurrency”, which has no “issuer”. It is not backed by any assets and exists merely in the form of an entry on the ledger. Examples include Bitcoin.
- Second, an “asset-backed crypto-asset”. Each registered unit carries an entitlement to a share of an underlying “property” which could be backed by one of one by fiat currency (so called stable coins) or a basket of investments. They can be issued for settlement convenience, payment processing or as an investment.
- Third, a “sponsor-issued cryptocurrency”, mostly backed by a bank. This is a permissioned register operated by a sponsor manager or issuer and generally fully backed with assets. Each carries a right to redeem value by submitting a claim to the issuer. As a result, there is credit risk involved. Use cases suggested include making capital market settlement simpler.

For the first category, supporters argue that a fixed supply (in some cases), being outside of the traditional banking system and anonymity make it appealing to a range of users. Set against this, crypto-assets, fail the classic “tests of money” — or of good innovation.¹⁴ Their volatility which in many cases arises because they are not backed by assets, mean that they are not a good store of value. Moreover, so far, they are an inefficient medium of exchange. The technology limitations of some crypto-assets mean the networks do not have the capacity nor reliability to be widely used in day to day transactions.¹⁵ On top of this, scams were rife in some networks.¹⁶ This does not appear a particularly fertile area for today's payments.

For innovation in retail payments and wholesale markets, much attention is currently focused on the second category of “stablecoins”¹⁷ or their near cousins which are backed by a basket of investments. They seek to offer the benefits of crypto-assets but without the price volatility. So far, the stability of such coins is unproven, and subject to considerable scrutiny. If not fully backed by a single currency, but for example a basket of backing instruments, they would also display a degree of volatility against the unit used to price goods, and that depending on the volatility. This may discourage their use as a payment to some extent.¹⁸

To displace existing payments systems with a new one would require it to be dramatically better than today's set up to justify the expense of a shift. That means cheaper, faster or simpler to use. In general, retail transactions are already very fast and benefits would probably be linked to cost or convenience especially for the remittance market. Increasing the speed of corporate and wholesale market transactions could free up cash and collateral.¹⁹

There is close interest in the potential of technology to offer new ways to pay and transact. Use cases being piloted include wholesale markets, trade finance, and domestic and cross border payments. The optimism around such technologies for payments is based on the potential to create efficient and resilient distributed networks, enabling multiple parties (or “nodes”) to transact in a frictionless way. DLT based payment networks also offer potential benefits in transparency and security, and the integration of the network with other technologies such as “smart contracts” which could automate aspects of the operation of financial transactions, boosting speed and efficiency.²⁰

If receiving money in exchange for tokens is seen as a form of deposit banking (which is a policy choice still to be made), then the only possible providers are either commercial banks or the central bank.

Given rapid payments innovations and growing maturity in the available technology, the Bank should ensure it remains at the forefront of research into these topics. It should also increase its engagement with financial institutions who wish to use DLT in their business models; and to understand their needs from a policy and infrastructure perspective. The use of digital currencies has societal and economic implications that a broad range of policy makers will have to address.

Central bank digital currencies (CBDCs)

The exploration of new technology for payments and settlement is not confined to the private sector. Central Banks, from Sweden to Cambodia have announced they are exploring the potential of so called “Central Bank Digital Currencies” (CBDC), offering individuals access to central bank money in electronic form.²¹ Motivations for CBDC experiments include exploring the potential benefits for financial inclusion, adding diversity in payment options, and responding to falling cash volumes.²² However, the concept of a CBDC available to individuals raises significant policy questions relating to the transmission of monetary policy, financial stability and operational feasibility.²³ Many of these unanswered questions relate to the potential for a CBDC to “disintermediate” the banking sector, a process whereby bank deposits are switched into CBDC, with implications for the provision of credit to the economy, and how changes in interest rates are passed on to savers and borrowers.²⁴ Moreover, if one reason for providing a CBDC is as an alternative to today's digital payments if the system went down, it is not entirely obvious a CBDC would be more resilient, for example to power outages or a cyber-attack. This rationale may therefore not justify a shift.

At present the Bank of England states that it does not plan to issue a CBDC, preferring to focus on policy and infrastructure choices that could enable diversity and resilience in the next generation of electronic payments.²⁵ This review does not see a compelling case for a central bank digital currency given numerous uncertainties. These include legal uncertainties, risks around deploying the technology at scale, the potential impact on monetary transmission, and critically the risk of diverting attention away from improving today's systems for customers. Improving efficiency and cyber-security and enabling the core payment systems to be a platform for private sector innovation should remain the priority.

LOOKING TO THE FUTURE

A number of scenarios can help to explore the implications of changes in payments for consumers and policy makers. The scenarios are based on the expectation that cash use will continue to fall. They are extrapolated from trends in the UK and abroad.

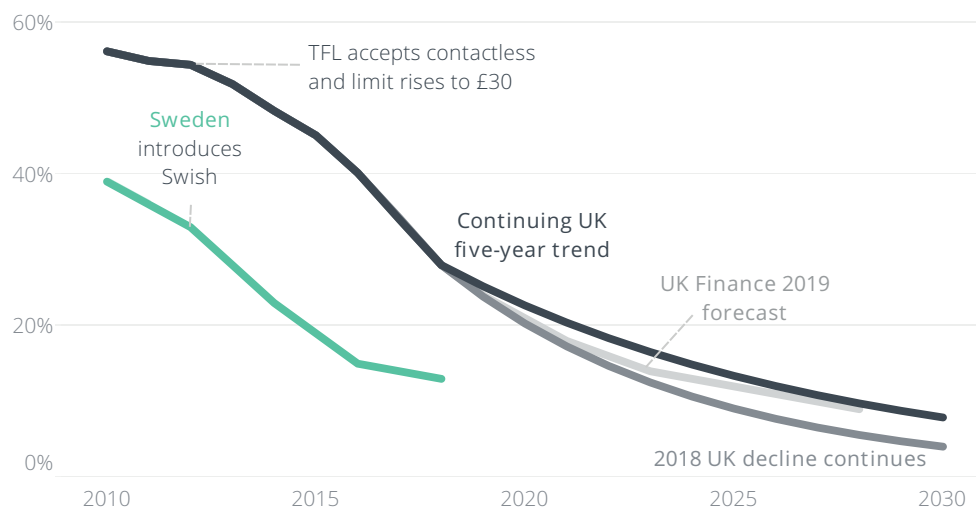
As illustrated for Sweden (**Box 3**), a further decline in cash has many important implications for policy makers. They must observe what replaces cash and whether it adds diversity or increases concentration in the payment system. And they need to ensure that cash distribution across the country is maintained even if cash is used far less to ensure the inclusion of those who rely on cash.

The extent to which traditional payment value chains are “unbundled” with implications for the business model viability and resilience of providers, whether they are banks, NBPSs or bigtechs, will be of interest to policymakers.

The UK Access to Cash Review (ACR) commissioned by LINK and chaired by Natalie Ceeney published a number of recommendations in February 2019 which seek to ensure that access to cash and/or payments is maintained in the next 10–15 years.²⁶ These include providing a guarantee to the public that they will have access to cash, an efficient cash distribution infrastructure and digital solutions that are designed to allow their provision across a wide customer base. It also identified the need for a coordinated oversight of cash through HM Treasury (HMT).

Several scenarios for the future of payments may be plausible (see **Figure 7**). Cash use may fall at the measured rate we have observed over the past five years with card networks remaining the most popular electronic payment method, offering consumer protection and familiarity. In this scenario, card networks might consolidate their value chain by expanding their capabilities and making mergers and acquisitions. This might cause little disruption but would pose questions about the implications of concentration of payment methods.

Figure 7: The use of cash could follow different paths
Proportion of total payments made in cash



Source: Sveriges Riksbank, UK Finance June 2019, Bank of England calculations.

Note: UK actuals include consumer and business payments. The Bank's direct involvement in cash distribution is limited to issuing new banknotes, withdrawing banknotes following the launch of a new series and destroying banknotes that are no longer fit for circulation. Notes are distributed by members of the Note Circulation Scheme (NCS) who have a contractual relationship with the Bank.

Box 3: The decline of cash in Sweden

Swedish households are increasingly using electronic means of payment such as bank cards and the mobile payment system Swish.¹ Cash use has declined significantly in the last five years to 13% in 2018.²

The total value of ATM cash withdrawals, an alternative measure of cash, has also materially declined in Sweden (from SEK270bn in 2006 to SEK110bn in 2016) in a similar fashion as the UK's number of withdrawals has declined since 2017.

Policy makers raised concerns around financial inclusion and the viability of the cash distribution system in 2016, when it became increasingly difficult to maintain cash services in sparsely-populated areas and have since introduced distribution thresholds to maintain inclusion.³ When policy measures were taken it was largely felt that the pace of change had accelerated too far and authorities needed to push back to prevent further decline. In 2018 the number of coins and notes issued increased again for the first time in a decade.

The decline in cash has been facilitated by Swedish legislation, whereby no central authority is responsible for the distribution of cash;

banks do not have to offer cash services and retailers do not have to accept cash in return for purchases made.

Competition authorities opposed a proposal in 2018 to force the country's largest banks to handle cash to try to limit the rapid decline of cash.⁴ This was on the grounds that it would distort competition. They also argued that securing access to cash should be a responsibility of the state. The Riksbank suggested that all banks and other credit institutions that offer payment accounts should be obliged to handle cash.⁵ Going further, they also suggested important activities for society — such as pharmacies, special transport services, food shops, petrol stations — should be compelled to take cash.⁶ The discussions are ongoing.

The lesson from Sweden is that it is important to get ahead of trends, as once infrastructure is closed, it becomes inaccessible. Furthermore, it may be necessary for the state to support the cash economy as a public good, as without this, the incentives for many actors will be to reduce the use of cash.

Figure 8: Cash usage in Sweden vs UK

	2010	2012	2014	2016	2018
Sweden	39%	33%	23%	15%	13%
UK	56%	54%	48%	40%	34%

Source: UK Finance, Sveriges Riksbank, Bank of England. UK actuals (% of transactions) include consumer and business payments. Swedish data refers to retail payments only (% of those surveyed indicating having used cash in the last year).

1 [Payment patterns survey, Riksbank, \(2018\).](#)

2 [Payment Patterns in Sweden, Riksbank, \(2018\).](#)

3 See www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/notices/2018/all-banks-should-be-obliged-to-handle-cash/.

4 See www.bloomberg.com/news/articles/2018-10-22/swedish-atm-operator-says-cash-provision-is-state-responsibility.

5 See www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/notices/2018/all-banks-should-be-obliged-to-handle-cash/.

6 [Consultation response on Secure access to cash, Riksbank, \(2018\).](#)

Cash use may fall faster, as electronic payments and new mobile interfaces integrate payments into e-commerce and lifestyle platforms. This might engender more competition for incumbents, including from outside the traditional financial sector. In the UK, this could happen if many people start using payment services offered by big techs, such as Google, Apple, Amazon or Facebook.

Alternatively cash may fall faster due to a shift to account-to-account payments, like in Sweden and the Netherlands. New entrants could create a direct-to-account solution with a major brand that has a convenient interface and is used by all major financial institutions and vendors.

Policy actions will have to be tailored to the trends observed and authorities will have to find new ways of maintaining access to and the distribution of cash if the rate of decline accelerates. This would be necessary if more bank branches close and customers can't access cash services at their local post offices or shops via cash back or smart ATMs, which can receive deposits.

In anticipation of changes in the payments landscape several countries are, or have recently, undertaken reviews of their regulatory regimes for payments in the light of developments in the sector. For example,

- the Canadian Department of Finance is consulting on amending Canada's approach to payments oversight so that it defines the payments industry and its players by what they do versus what type of organisation that they are in order to allow for innovation to happen in a safe and predictable environment;²⁷
- the Dutch Central Bank (DNB) is considering whether they have adequate powers and/or need to introduce new or different types of supervision of payments to reflect the increasing fragmentation of the payment chain and to be able to supervise effectively from a chain-oriented perspective.²⁸ The DNB has committed to "formulate a vision with respect to these important questions in the coming years".

IMPLICATIONS FOR THE BANK

As payments transition from cash to electronic payments this can produce a range of benefits for consumers, merchants, banks and the economy, including:

- Convenience of digital payments and personalisation achieved through increased integration;
- Increased economic efficiency through a decline in the costs of transacting and risks of cash handling.

In order to achieve these benefits, payments innovations have to be resilient and the shift away from cash orderly and inclusive. Several lessons can be learnt from Sweden and the UK's own experience which show that there is a continued need to understand the risks to resilience from increased diversity of electronic payments and consider interventions that can help shape a payments system that serves all customers.

The transition to digital payments poses three fundamental questions for the Bank's oversight of payments systems and the provision of central bank infrastructure:

- (i) Does the infrastructure for electronic payments have the capacity, durability and reliability needed?
- (ii) Are there implications both for the Bank's "hard" and "soft" infrastructure, e.g. the Bank's high value payment systems and what does it mean for "soft" infrastructure (rules, regulations)?
- (iii) What implications does a potential acceleration in the decline of cash have on the viability of existing structures to distribute cash?

Some key issues to consider in shaping the payment system of tomorrow:

- The payments sector must be resilient to increasingly sophisticated cyber-attacks. The complexity of payment networks including the growing dependence on shared solutions, such as APIs, can create common vulnerabilities.
- The Bank should ensure the framework for cash distribution is sustainable.
- Greater clarity on who holds liability and carries risks for consumer redress under new market structures will help the market to innovate. This includes the areas of AML/KYC, fraud, failed transactions, mis-selling, cyber-risks and privacy where an equitable market needs to provide certainty of expectations to all participants. Whether the liability and risks sit with incumbents or new payment providers has implications for innovation and market stability.
- The regulatory framework for firms involved in the payment chain may need amendments to make sure providers have enough financial resources to protect their customers if things go wrong, irrespective of their size or maturity. This is likely to require changes to payment regulation
- The Bank together with other authorities will continue to provide the hard and soft infrastructure to enable innovation, ease frictions and provide resilient payment networks.
- Increasing competition could impact banks' business models and financial stability in more extreme scenarios. If banks can't harness technology for their products and services, it could erode fee income and lower overall profitability, reinforcing a cycle of low profitability (see Chapter 7).
- In the next few years, the Bank will have to closely watch developments around the introduction of central bank as well as private sector digital currencies as these may pose more profound questions for payments oversight.

RECOMMENDATIONS

1.1 Produce a roadmap for payments options

Why does the Bank need to act?

- While moving to a cash light (not cashless) economy brings many benefits for consumers, businesses and financial institutions, it also has implications for inclusion and the viability of the current cash distribution network. These could be compounded by large regional challenges from poor broadband and mobile connectivity.
- The well-argued Access to Cash Review (ACR) commissioned by LINK and chaired by Natalie Ceeney MBE published a number of recommendations which seek to ensure that access to cash and/or payments is maintained in the next 10–15 years.
- As a result of concerns raised in Sweden, the government decided to intervene in the payments market in 2016. Given the UK may only be 4–6 years behind Sweden in the trajectory towards a decline in cash, similar issues may need to be considered in the UK in the next few years.
- Currently there is no single authority responsible for overseeing cash or digital payments, and payments depend upon enabling technologies well beyond finance, such as broadband and mobile. Authorities would benefit from a more detailed roadmap to inform discussions on the likely reduction in cash. The current regulatory framework for payments is fragmented and may lead to inefficient outcomes.

What can the Bank (and others) do?

The Bank should:

- Join a group of regulators (including non-financial ones such as Ofcom) and the private sector convened by the Treasury to fashion a co-ordinated response to society's shift to digital, without leaving anyone behind. In effect, a national payments strategy council.
- This could include a roadmap to:
 - foster cost-effective and resilient payments for the future;
 - understand dependencies such as broadband and mobile coverage;
 - ensure that no one is left behind through “digital exclusion”;
 - consider with the private sector options to improve the sustainability of the cash payment model, including potential merits of a “utility” distribution model similar to Finland, Sweden and the Netherlands; and
 - contribute to a longer-term debate about whether cash distribution may require state support if the current model becomes uneconomic for the private sector.
- Explore any hurdles to faster, cheaper and more widespread peer-to-peer and inter-bank payment options — especially those powered by mobile apps — with the Financial Conduct Authority and the Payment Systems Regulator. This should include the role of appropriate fees for PSD2 transactions.

<p>1.2 Contribute to the next generation of payment regulation</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • The regulatory framework for payments involves multiple authorities, which may not deliver the best outcomes overall as transactions become more digital and new players grow in size. • As payment methods are evolving, it can be difficult to establish where they sit in existing regulatory frameworks. New types of activities and services may have to be brought into the regulatory perimeter, or their regulatory treatment amended.
	<p>What can the Bank (and others) do?</p> <p>The Bank should:</p> <ul style="list-style-type: none"> • Suggest the Treasury lead a cross-authority review of payments regulation to evaluate: <ul style="list-style-type: none"> - the appropriateness of the regulatory framework for the risks posed by different payment activities, including tiering of firms; - how to ensure effective supervision of the overall payments value chain; - the role of data-sharing between platforms and payment companies; and - ways to reduce fragmentation and complex regulation in the UK.
<p>1.3 Develop the infrastructure to make cross-border payments more efficient and cheaper</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • McKinsey & Company research shows that processing a cross-border payment is, on average, ten times more costly for banks than processing a domestic ACH payment. Each payment has to cross multiple jurisdictions and infrastructures through the correspondent banking network which makes it slow, costly and lacking transparency. 63% of corporates report that they are unsatisfied with the time taken to process cross-border payments. • The main challenges include effective messaging standards to identify and authenticate recipients; complex KYC/AML regulations and high capital and liquidity cost of settlement. • Given the importance of cross border payments to trade, investment and remittances, they are a matter of priority which requires ongoing coordination between public and private bodies.
	<p>What can the Bank (and others) do?</p> <p>The Bank should:</p> <ul style="list-style-type: none"> • Implement richer messaging standards and common identifiers to facilitate more effective and accurate global co-ordination. • Open access to a broader range of payment providers who operate across borders. • Continue to work with international bodies, such as the Committee on Payments and Market Infrastructures, to explore opportunities to make cross-border payments more efficient and cheaper. • Keep abreast of digital tokens and explore greater interoperability with other central banks to improve payments for households and companies.

ENDNOTES

- 1 See www.europeanpaymentscouncil.eu/news-insights/insight/taking-closer-look-norways-payment-landscape.
- 2 LINK Statistics, (2019).
- 3 UK Payment Markets Study 2019, UK Finance, (2019).
- 4 Access to Cash Review, (2019).
- 5 UK Payment Markets Study 2019, UK Finance, (2019).
- 6 UK Payment Markets Study 2019, UK Finance, (2019).
- 7 Chinaeconomicreview.com/unionpay-struggling-mobile-payments-era/.
- 8 See www.ideal.nl/cms/files/Factsheet_iDEALpayments_UK.pdf.
- 9 Global Payments 2016: Strong Fundamentals Despite Uncertain Times, McKinsey & Company, 2016). ACH payments are electronic payments made through Automated Clearing House (ACH) Network.
- 10 Webcache.googleusercontent.com/search?q=cache:zO7rzD_qFSJl:https://www.saxopayments.com/wp-content/uploads/2015/11/Saxo-Payments-Infographic-Branded.pdf+&cd=3&hl=en&ct=clnk&gl=uk.
- 11 Competitivecompliance.co/fintech-license-comes-in-effect-in-switzerland-on-january-1st-2019/.
- 12 Strengthening Singapore's payment services through regulation, PWC, (2018).
- 13 The Legal Concept of Money, Simon Gleeson, (2019).
- 14 Five reasons why bitcoin fails the innovation test, Financial Times, (2018).
- 15 See www.bankofengland.co.uk/knowledgebank/what-are-cryptocurrencies.
- 16 The Future of Money, speech given by Mark Carney, Inaugural Scottish Economics Conference, March 2018.
- 17 Can "stablecoins" be stable, Bank Underground, Ben Dyson (2019).
- 18 Crypto-asset markets: Potential channels for future financial stability implications, Financial Stability Board (FSB), (2018).
- 19 See www.finextra.com/blogposting/17238/blockchain-and-stable-coins-opening-the-crypto-markets.
- 20 Cryptoassets Taskforce final report, HM Treasury, FCA, Bank of England, (2018).
- 21 Proceeding with caution - a survey on central bank digital currency, BIS Papers No 101, Bank for International Settlements (BIS), (2019).
- 22 E-krona project, report 2, Riksbank, (2018).
- 23 Central banks and digital currencies, speech by Ben Broadbent, London School of Economics, March 2016.
- 24 Broadening narrow money: monetary policy with a central bank digital currency, Staff Working Paper No. 724, Barker et al., 2018.
- 25 See www.bankofengland.co.uk/research/digital-currencies.
- 26 Access to Cash Review, (2019).
- 27 See www.fin.gc.ca/activity/consult/rcpa-elcp-eng.asp.
- 28 DNB Payments Strategy 2018-2021, De Nederlandsche Bank, (2018).

2 ENABLE INNOVATION THROUGH MODERN FINANCIAL INFRASTRUCTURE

THE OUTCOME WE SEEK

Modern public and private financial infrastructure that enables innovation and resilience. This includes upgrades in convenience, cost, speed and security.

- The next generation of financial firms will likely widely use public cloud technology. Firms should be able to benefit from the agility, cyber-security and platform for innovation that this technology offers. The Bank will need to build expertise and play a leading role in making sure firms use it in a safe and sustainable way.
- Less costly and more reliable digital identification will be essential to harness the benefits and opportunities of the digital economy for UK households and firms.
- Better co-ordination of major regulatory projects could help innovation and improve resilience, while increasing operational effectiveness of firms.

KEY DEVELOPMENTS

Modern infrastructure

Markets and innovation thrive with the right public and private infrastructure. Hard infrastructure ranges from transport to payments architecture, while soft infrastructure includes the rule of law, market practices, codes of conduct and regulatory frameworks. The Bank of England works to keep the financial system safe and to ensure the public financial infrastructure allows innovation and competition to prosper.

Cloud technology is increasingly mainstream

Financial businesses are increasingly likely to be hosted online by third-party providers. This is known as public cloud technology and ranges from pure infrastructure services through to data applications and analytics.

Cloud services are increasingly important for the digital economy. They have potential to reduce technology infrastructure costs by 30%–50% according to McKinsey & Company.¹ In finance, a quarter of major banks' core banking activities are cloud hosted,² and 14% of banking workloads use public cloud or software as a service.³ Synergy Group Research estimate the public cloud infrastructure market at \$70bn for 2018 globally, up 48% year on year.⁴

Cloud computing can spur innovation.⁵ It provides flexible and agile infrastructure and reduces barriers to entry for smaller players who might not be able to invest in their own solutions.⁶ Combined with digital business services, it offers ready-made platforms for early-stage companies, including fintechs to cut their time (and cost) to market.

McKinsey & Company estimate that 40%–90% of banks' workloads globally could be hosted on public cloud or use software as a service in a decade (**Figure 7**). Finastra has found that 30% of financial institutions surveyed in the UK and 33% in the US have moved towards payments or collaboration in the cloud, behind Singapore with 42%.⁷

Banks primarily use the cloud for customer relationship management, human resources and financial accounting.⁸ But a growing number could expand to consumer payments, credit scoring and asset management.⁹ And increasingly, financial firms' technology vendors are dependent on the cloud, creating reliance in the supply chain.

Many fintechs and nearly all major technology providers to banks and insurers are hosted to some degree on the cloud.¹⁰ Therefore policies will need to reflect that the financial system already indirectly relies on the cloud. If the UK wants to stay ahead in international finance with competitive financial firms that are on a level playing field to new business models, it will need to revise and shape new cloud usage guidelines.

The cloud could enhance cyber-resilience, especially for smaller financial firms with fewer technology resources. Cyber-attacks are becoming more common and sophisticated (see Chapter 8). But fieldwork for the review suggests that even the best-resourced financial firms invest less in cyber-defences than cloud providers, which have:¹¹

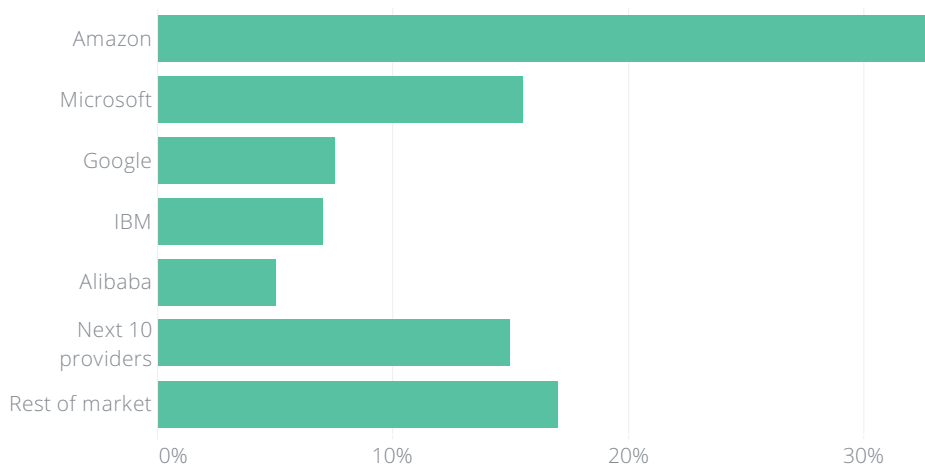
- Leading security capabilities.
- Diversified storage and multiple back-ups limiting the potential for wholesale outages.
- Cutting edge tools to protect against distributed denial-of-service attacks (DDoS).
- Automated network-wide updates reducing the risk of outdated software.

While the benefits of cloud are increasingly clear, the cloud services market is dominated by a few large firms.¹² Two providers, AWS and Microsoft, account for nearly half of all revenues from public cloud infrastructure. This brings scale and efficiency, but also concerns about dependence on a small number of critical suppliers, as shown by **Figure 1**.

There are some important trade-offs to make. But the benefits to customers and firms of moving from their own practically private cloud storage to public cloud at scale is persuasive.

Figure 1: Public cloud is big business

Cloud infrastructure services market share 2018 Q4 (IaaS, PaaS, hosted private cloud)



Source: Synergy Research Group.

Identity in a digital world

Better electronic identification will be essential for UK households and firms to benefit from the digital economy. Customers and businesses need to prove who they are many times a day for a whole host of purchases and transactions, using a range of identity attributes (**Figure 2**). Most financial firms consulted bemoaned the cost and inefficiency of identity verification. Digital IDs could make this process seamless, providing the convenience of integration into platforms and e-commerce.

A digital ID could also help reduce cyber-crime.¹³ UK banks spend £5bn fighting cyber-crime and online fraud annually, according to UK Finance.¹⁴ Not having a national digital ID strategy may result in increased fraud, higher costs of finance and more exclusion than in other markets. Secure digital identification would allow financial firms to better identify and authenticate customers, reducing fraud and facilitating compliance with “know your customer” (KYC) and anti-money laundering (AML) requirements.¹⁵

Figure 2: A number of different “attributes” can uniquely identify an individual or entity

	For individuals	For legal entities	For assets
Inherent (intrinsic to and individual)	Date of birth Fingerprint	Industry Business status	Nature of the asset Asset issuer
Accumulated (gathered/developed over time)	Health records Preferences and behaviours	Business record Tax record	Ownership history Transaction history
Assigned (attached to the entity)	National identifier number E-mail address	Legal Entity Identifiers (“LEIs”) Legal jurisdiction Directors	Identifying numbers Custodianship

Source: [McWaters, J, Robson, C \(2016\) “A Blueprint for Digital Identity The Role of Financial Institutions in Building Digital Identity”, World Economic Forum.](#)

Figure 3: Digital identification is established through several layers

Each layer of identity of serves a different purpose, and suffers from a distinct set of problems in today’s identity landscape

Goals		Problems
Providing efficient, effective and seamless services to users	Service Delivery	Inefficient or unsuited service delivery
Provisioning what services users are entitled to access based on their attributes	Authorisation	Complex authorisation rules and relationships
Providing mechanisms for exchanging attributes between parties	Attribute exchange	Insecure and privacy compromising attribute exchange
Providing mechanisms for linking users to attributes	Authentication	Weak or inconvenient authentication
Capturing and storing user attributes	Attribute collection	Inaccurate or insufficient attribute collection
Developing standards to govern system operation	Standards	Lack of co-ordination and consistency

Source: [McWaters, J, Robson, C \(2016\) “A Blueprint for Digital Identity The Role of Financial Institutions in Building Digital Identity”, World Economic Forum.](#)

Traditionally, identity has been established based on physical interactions and documents. A digital identity could offer a means of electronic verification, providing a wider range of services in real time (**Box 1**). But transactions require documents of varying standard and quality — for example for authorising payments and verifying credit histories (see **Figure 3** for an illustration of the different layers of identification).¹⁶

Many good ideas have been suggested from the private sector to address the UK’s lack of a national digital ID. For instance, Monzo suggested the UK issue an even cheaper provisional driving licence with no driving privileges — as done in New South Wales — to less advantaged groups to help move them online, which can also be used to open a bank account. Another idea was to install mobile-readable chips in driving licences and passports to help financial firms verify customers.

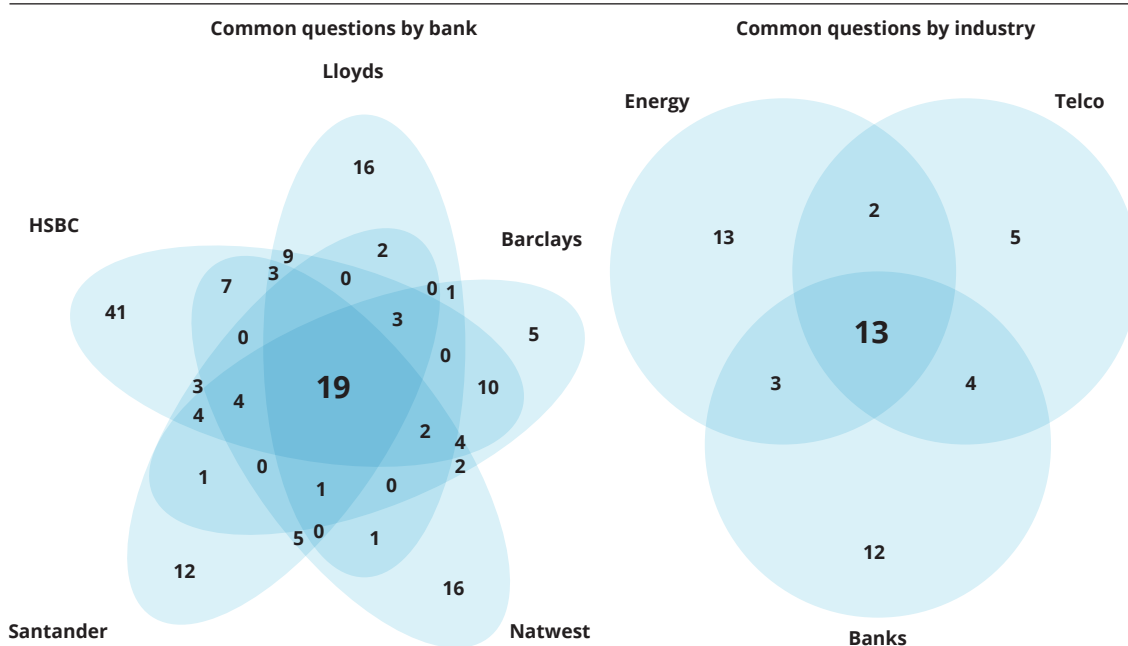
The experts consulted said a private digital ID solution was more likely to succeed in the UK than a public only one. They stressed that access to sources such as the Passport Office and the Driver and Vehicle Licensing Agency (DVLA) would be useful. The field work has suggested that information from Companies House could be too but may be of lower value as the information is self-certified and can be up to nine months out of date. Access to tax records would also be valuable.

A successful digital ID solution needs certain characteristics. First, those who use identity providers will need to trust their accuracy, reliability and safety.¹⁷ Second, digital identification must meet liability requirements for financial services and other firms who use the information. And third, it should be embedded in a user-friendly interface for customers that encourages take-up and use.

Better digital identification could overhaul cumbersome verification processes and expand access to finance.¹⁸ Small and medium-sized enterprises (SMEs) have to provide a large amount of information to financial firms, encountering fragmented and inconsistent processes across providers (see **Figure 4**). This creates a barrier to accessing finance, increases costs and limits productivity.

Organisations use different data sets to make their proprietary decisions, which makes it difficult to harmonise requirements without reducing lending to the simplest common factor. Many lenders are trying to improve the quality of their decisions through blending in even more datasets. Having a clear way to digitally identify an entity would help this process. Assigning Legal Entity Identifiers (LEIs) can further help firms to provide identification.¹⁹ Similarly, APIs can help with exchanging different attributes for authorisation.²⁰

Figure 4: SMEs face multiple questions when opening an account in the UK



Source: Whitechapel Think Tank/UK Finance.

Box 1: Digital identification across the world

Across the globe, countries have taken different approaches to establishing digital ID schemes.

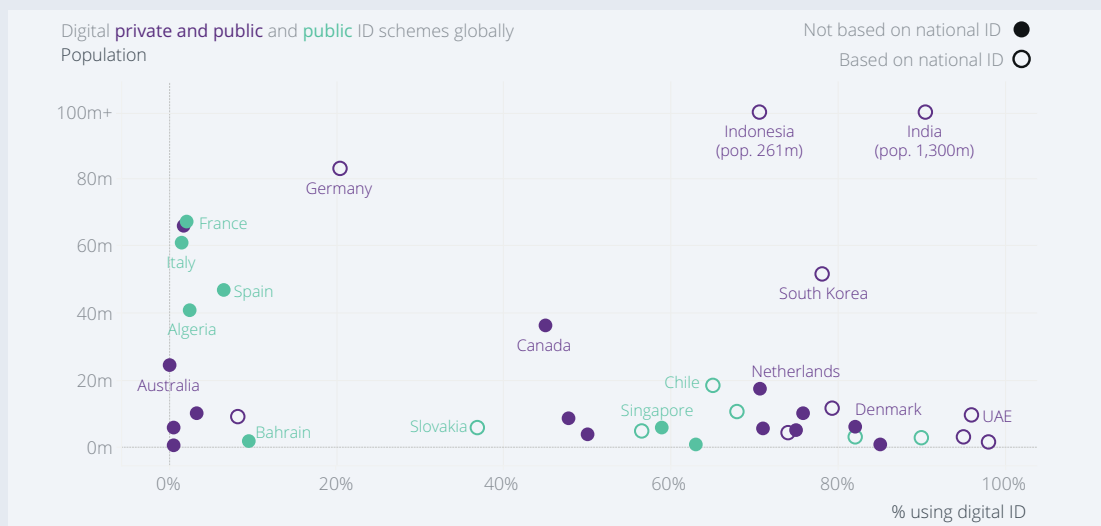
India's Aadhaar is a unique biometric ID (UID) given to each individual. Citizens must have it to access social benefits such as healthcare.¹ More than 99% of the adult population is enrolled in the mandatory programme, launched by the government in 2016.

Sweden's BankID is an electronic ID allowing companies, banks, and the government to authenticate and transact with individuals online.² It was developed by a consortium of banks in

2003 and is now used across a range of sectors. Similar public-private partnerships exist in Norway and Denmark.

UK digital ID schemes underwhelm. In 2014, the government launched the voluntary Verify scheme.³ It is primarily used for accessing government services online. It has had low adoption (<5% of adults) and seen significant criticism from the National Audit Office.⁴ By 2020, the scheme had expected to have over 20m users but only has 3.4m today. This is in contrast to countries such as the Netherlands which has over 70% usage of voluntary schemes (Figure 5).

Figure 5: The most successful digital ID schemes are built on national ID systems



Source: McKinsey & Company press search.

- 1 Case study: Aadhaar — India, Embracing Innovation in Government: Global Trends 2018, OECD, (2018).
- 2 See <https://www.bankid.com/en/>.
- 3 See www.gov.uk/government/publications/introducing-govuk-verify/introducing-govuk-verify.
- 4 Investigation into Verify, National Audit Office (NAO), (2019).

Investing in the future

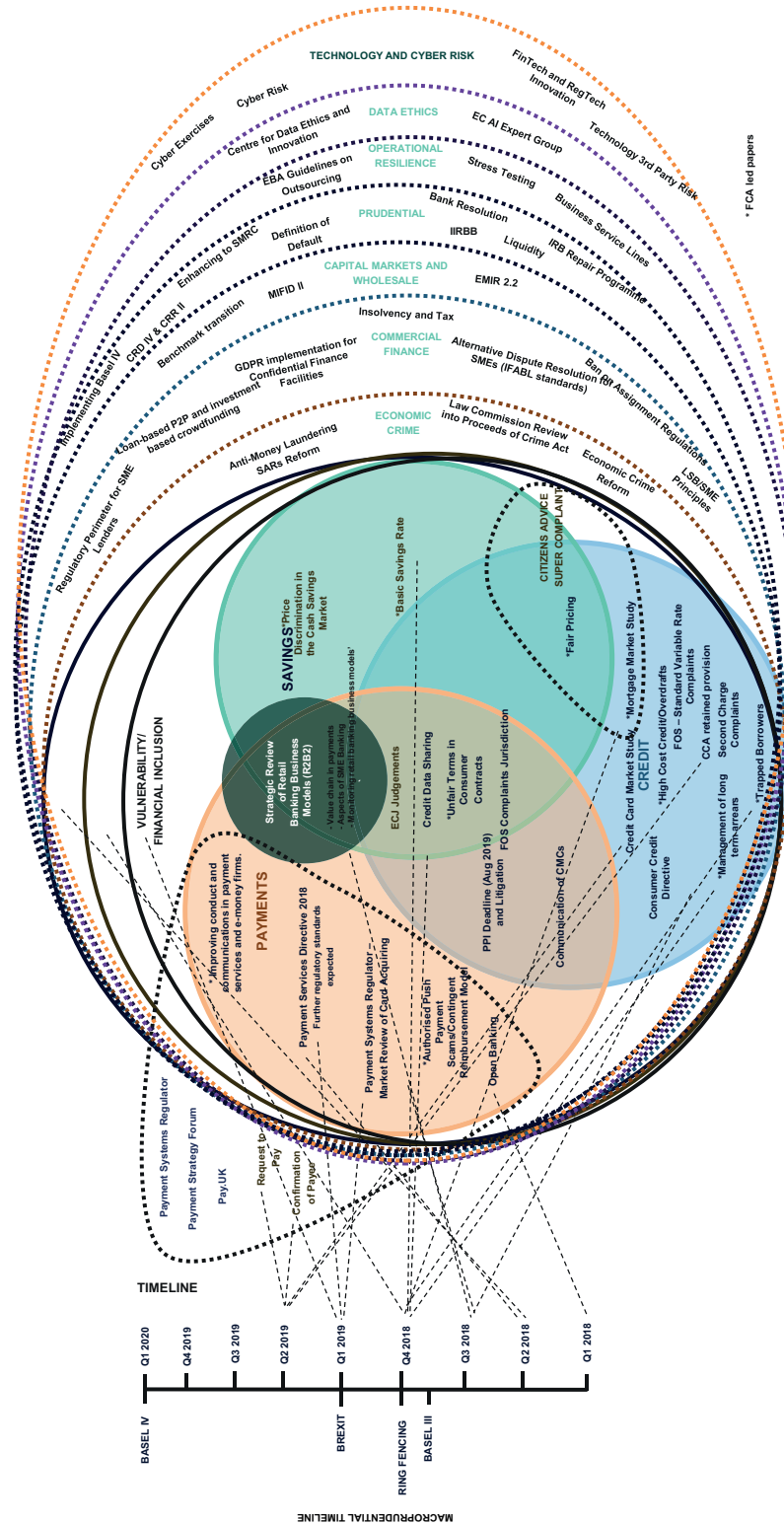
Firms must be able to make strategic investments in their technology infrastructure. This will ensure the efficiency, responsiveness and security of financial services in a digital age.

Uncoordinated and overlapping regulatory demands may hold back innovation and encourage tactical fixes rather than strategic solutions to technology challenges. Most financial services firms highlighted how coinciding regulatory timetables and the intensity of such projects added to complexity, costs and limited innovation. This is partly due to regulators failing to co-ordinate and in some cases not fully understanding the technology impacts of their initiatives. As importantly, national regulators do not always have control over the timescale and scope of regulation and legislation (see Chapter 9).

The flurry of regulatory demands with short deadlines may mean firms patch up existing legacy systems rather than invest in longer-term improvements. Regulators should co-operate more closely to avoid bunching and crowding out innovation at the expense of the operational resilience of the overall industry.

UK Finance have highlighted this complexity in **Figure 6** which shows a snapshot of regulatory demands.

Figure 6: Regulatory change is complex and overlapping — better co-ordination would help



Source: UK Finance, 16 April 2019.

LOOKING TO THE FUTURE

Providing the right central bank infrastructure

Public infrastructure can lower costs of production, give business the confidence to invest and enable them to use their resources more productively. It can also catalyse competition by providing a level playing field for firms to innovate and access the marketplace.

The Bank is an infrastructure provider. This includes hard infrastructure such as the Real-Time Gross Settlement system (RTGS). This infrastructure underpins payments and settlements that are vital to households and businesses — processing on average £650bn of value a day.²¹

The Bank was the first G20 central bank to give non-bank payment service providers (NBPSPs) access to settlement accounts in the payment system, thereby enabling competition.²² This first and foremost promotes financial stability by reducing dependence on a small number of banks and reducing credit exposures between those who are members and those who only have indirect access. But it also serves to support competition and innovation in a payments landscape that is seeing significant change.

The Bank is upgrading its infrastructure for a digital age by rebuilding the RTGS system.²³ It is future-proofing the system by:

- Exploring “plug and play” functionality with distributed ledger technology-based business models and synchronisation with other payment ledgers;²⁴
- Embracing global data standards through the use of the Legal Entity Identifiers (LEIs) which uniquely identify firms, and the ISO20022 payments messaging standard, which standardises transactions information; and
- Enabling members to apply data analytics to transaction data through an Application Programming Interface (API).

The economy and finance are changing rapidly. Data, platforms and e-commerce are re-shaping the economy. Climate change, demographics and the increasing integration of emerging markets into trade and commerce are creating new financial and investment needs (see Chapters 4–6). And the make-up of the financial system is changing as innovation occurs and new business models challenge incumbent institutions. From the growth in market-based finance to alternative lenders and new payment providers, the financial system is fast evolving (see Chapter 7).

The Bank should keep the infrastructure needs of a dynamic UK financial sector under review. Through its work on RTGS renewal the Bank has already shown leadership in understanding the infrastructure needs of a financial system that is innovating and changing. Given the expectation of continued change — as new payments providers emerge and if the traditional banking business model is “unbundled” — the Bank should continue to engage broadly to understand the implications of these developments for central bank policy and operations. This could include consideration of what level of access to the central bank payment systems infrastructure, and the Bank’s balance sheet, may be appropriate for fintechs and innovative business models.

Any review should be based on a thorough understanding of the business model of these companies and their implications for financial stability and monetary policy. Opening infrastructure to new types of business models is a major decision for the Bank. It would inevitably need to be preceded by a thorough exploration of whether there is a substantive case for access, and, crucially, what safeguards would need to be in place for this to happen safely, including an appropriate regulatory framework for those companies (see Chapter 7).

Removing barriers to cloud adoption

The adoption of cloud technology depends on many factors, including what choices regulators make. A significant part of the demand will likely come from software that users can subscribe to and access online rather than download (software as a service — or SaaS).²⁵

Financial institutions have been slower at adopting the public cloud than other industries. This can be explained by cautious regulators, management teams taking time to gain trust and see use cases and the cost of migrating systems.²⁶ Nearly half (43%) of UK firms surveyed by Finastra cite complex regulatory requirements as a key barrier to adopting new technologies, such as the cloud.²⁷

Firms want a clearer and more detailed conversation with regulators about which critical services they might outsource to the cloud. They also wish to know about requirements and what oversight they should expect from authorities. A lack of clear regulatory expectations will stifle adoption of cloud technology and the benefits it could bring. UK Finance have worked with the wider industry and cloud providers on a series of practices that might enable cloud computing at scale in finance (**Box 2**).²⁸

A range of plausible scenarios may describe how cloud use will evolve in financial services over the coming decade with a range of plausible outcomes for cloud adoption (**Figure 7**). The scale of adoption and the level of market concentration versus diversity of service providers will pose different risks for firms and regulators.

In a scenario of gradual change, concerns about the cloud prevail and firms' migration remains slow. The existing service providers consolidate their position and continue to dominate the market.

In an alternative scenario, many financial institutions migrate to the cloud and existing service providers maintain their market share. This would involve financial institutions "buying in" to the benefits of cloud infrastructure and regulators permitting increased use. It would require safeguards for the dependence on a few providers of cloud services.

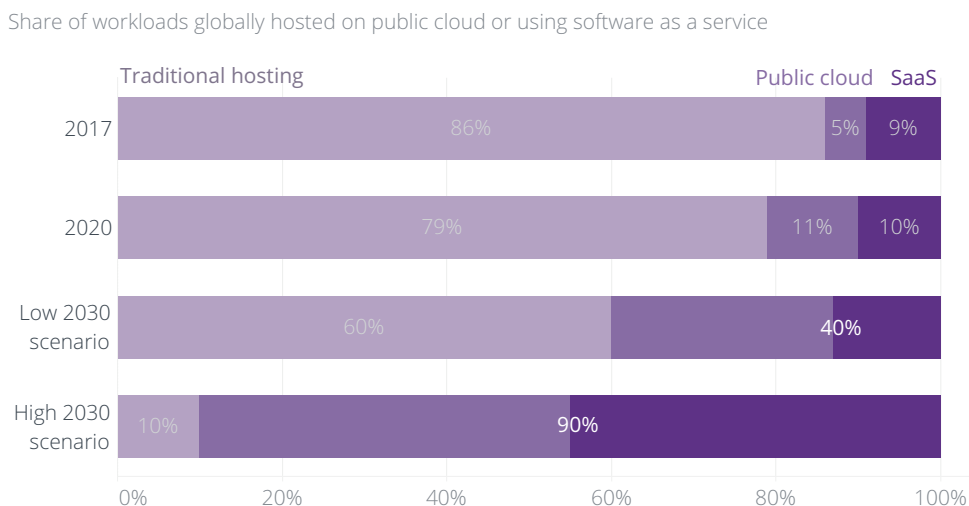
Market structures might also shift with a wider range of providers emerging alongside broader adoption. This could be accompanied by greater layers of interoperability in cloud infrastructures, aiding the migration of more systems and easier switching between providers. This might reduce concentration risk but poses new questions about maintaining oversight of many providers.

Enabling digital identification

Several countries have had success in implementing digital ID schemes that the UK could learn from. Policy objectives and design choices vary between countries, but these case studies can provide valuable information.

Australia has established a federated model where private (government-accredited) firms provide identification services under the Trusted Digital Identity Framework (**Box 3**).²⁹

Figure 7: Cloud usage could boom given the right conditions



Source: McKinsey & Company, McKinsey Enterprise Cloud Infrastructure Survey v2.0, McKinsey ITaaS survey 2017, IDC, Gartner newsroom, expert interviews. Based on retail banking financial markets cloud survey.

Illustrative low adoption scenario: Banks continue to replace applications at a rate of ~5%pa except for legacy core of ~20% of applications. New applications are 66% SaaS, 33% public cloud.

Illustrative high adoption scenario: Banks migrate all legacy applications en masse to 50% public cloud, 50% SaaS, except for legacy core of ~10% of applications.

Box 2: UK Finance best practice in cloud usage

- UK Finance’s suggestions for best practice consist of 44 controls. These are mapped to a range of domains, which they consider should be included in all risk frameworks, and 11 underlying risks.
- The cited risks are focused on the viability and resilience of the provider and controlling access to customer data. They also concern oversight by risk and internal audit functions, data governance, IT security of the provider and vendor lock-in.

Audit assurance and compliance	Assuring customer institution that the provider has appropriate business continuity and operational resilience measures
Encryption key management	The processes, and their management, used to keep customer data secure and segregated from other tenants
Governance	The provider’s internal policies and governance and how they may affect customer data
Identity and access management	Assuring that the appropriate controls can or will be in place to ensure the security of customer data
Lifecycle management	The lifecycle of data and how it is deleted/removed from the provider
Security controls on physical infrastructure and facilities	The physical security of the datacentres where client data and/or systems are hosted
Security of cloud networks and connections	The virtual security of the cloud infrastructure and its connections with other systems, whether customers or third parties
Security provisions for cloud applications	The virtual security of the cloud applications
Workforce security and access management	How the staff of the provider have been trained to ensure the security of customers’ data

Source: UK Finance, “Cloud Computing Controls Framework: A Procurement Framework for Public Cloud Computing Services”, 2019.

Box 3: The Australian Trusted Digital Identity Framework

The Australian Trusted Digital Identity Framework (TDIF) governs the platform Govpass.¹ The government developed it in consultation with industry. It allows people to choose their identity provider and access a range of public and private sector services.

TDIF is a set of rules and standards that accredited members of the digital identity federation must follow. It concerns:²

- handling personal information;
- access and use of identity services;
- security and fraud protection; and
- system management and maintenance.

1 See www.dta.gov.au/blogs/creating-govpass-digital-identity.

2 See www.dta.gov.au/our-projects/digital-identity/join-identity-federation/accreditation-and-onboarding/trusted-digital-identity-framework.

3 See www.dvs.gov.au/Pages/default.aspx.

Govpass identity providers must be accredited to pull information from government sources. The system operates independently from other government or private sector systems to ensure data privacy.

A user registers by selecting a provider to verify their identity. Their documents are then processed through the government's document verification service (DVS).³ It may verify the user's identity by matching the uploaded photo against an image on one of their government records such as a passport photo. This is the Face Verification Service (FVS).

Estonia has a near-universally adopted national digital ID scheme. About 98% of its population have an ID card, containing an electronic chip that allows them to sign documents digitally, access medical records and even vote.³⁰ The system is based on two principles:

- a. A national register which provides a single unique identifier for all citizens and residents.
- b. Identity cards providing legally binding identity verification and electronic signing.

Establishing viable means of digital identification in the UK will be of vital importance going forward.

IMPLICATIONS FOR THE BANK

Building the right public infrastructure

The Bank should keep its hard and soft infrastructure under review, including areas where access to its services, rules and regulations can support innovation and the creation of new products and services. This may involve evaluating how broadening access to central bank infrastructure to a wider class of financial firms may benefit innovation and enable competition, while still ensuring monetary and financial stability.

Enabling safe use of the cloud

The cloud is becoming a strategic necessity. Firms' senior executives repeatedly said it will be central to their business models and the benefits are only achievable at scale. To benefit from cloud technology, firms and regulators need to work together to manage the risks as reliance on third-party suppliers rises as they may become critical to financial sector infrastructure.³¹ This could heighten the risk of disruption to essential financial services in the event of operational outages or cyber-attacks. Firms will need to uphold the highest standards of risk management and operational resilience. Authorities should work with them to keep the system safe.

The Bank's Financial Policy Committee (FPC) should continue to keep a close watch on the changing use of cloud technology and what this means for financial stability. It has already reviewed cloud infrastructure across the financial sector.³² And as adoption grows, the FPC will need to be ever more vigilant to emerging vulnerabilities. Eventually, this may necessitate changing the boundaries of financial regulation to include aspects of cloud service providers' operations in the Bank's direct oversight.³³

As fintechs and incumbent financial institutions move services onto cloud platforms, major cloud providers may become systemically important. This means they might be of concern to the financial system as a whole. The small number of service providers could risk becoming a single point of failure.

Concentration risk raises the question of whether regulation of cloud providers should go beyond reliance on guidance for firms' risk management of outsourcing arrangements. Supervisory powers might have to be extended if supervising "through" regulated firms is no longer deemed sufficient. Regulators may have to engage with service providers directly to ensure they meet supervisory expectations. Alternatively, cloud providers could become regulated public utilities, creating a "certified cloud".

There may be analogies with central counterparties (CCPs). When mandatory central clearing of standardised derivatives through CCPs was introduced, policymakers recognised that they were creating concentrated nodes, which despite this risk would make the overall system safer.³⁴ Similar trade-offs may apply when considering the implications of cloud-hosted services for financial stability.

The Prudential Regulation Authority (PRA) will also need ongoing assurance that firms are managing risks from the cloud as it becomes increasingly central to their business models.³⁵ Cloud use has been an area of particular focus, including assessing firm's governance and management of risks from third-party relationships. It also includes evaluating specific topics such as managing service level agreements and fall-back arrangements.

As cloud use grows, the PRA must ensure its information sources, supervisory skills and approach keeps pace. It should also consider whether it needs new powers such as giving supervisors sufficient access to cloud service providers to monitor risks appropriately.

The FPC and PRA will need to weigh up the benefits of cloud technologies for operational and cyber-resilience against the risks that might be posed. They should enable greater adoption of the cloud through improved guidance and by communicating their expectations of risk management and operational resilience more clearly. This will give additional clarity and confidence to firms when deciding whether and how to use these technologies and will encourage good risk management practices.

The Bank may also wish to explore its stance on cloud computing for its own systems, some of which are already cloud hosted.

Highlighting the potential of digital identification

There is consensus that an effective digital identification system is needed to help the UK benefit from a digital economy and financial system. But a variety of complexities and challenges need to be resolved for a successful system to emerge.

The experts consulted deemed voluntary schemes based on private sector solutions the most likely to succeed. But this requires access to public information. It also points to the need for public-private collaboration. Complex and sensitive questions of privacy, consent, and data security through appropriate levels of encryption will have to be resolved. As will questions about liability in the event of breaches of privacy or fair use.

Digital identification could boost the effectiveness of finance and may enhance access to finance for households and businesses, reduce transaction costs, improve operational efficiency for financial institutions and reduce financial crime. All of these features would support the Bank's mission to promote the good of the people of the UK through monetary and financial stability.

It is not for the Bank to deliver a system of digital identification. But given the fit with the Bank's objectives, it should make the case for the benefits. The Bank could share its view on advantages and blocks, drawing on its unique vantage point at the centre of the UK financial system.

Promoting operational resilience through enhanced regulatory co-ordination

The Bank's objective is to maintain and promote stability by ensuring the resilience of the firms, markets and infrastructure that make up the financial system. This is to secure the continuity of essential financial services.

In an increasingly digital financial system, operational resilience is becoming as important as financial resilience.³⁶ Disruption to critical financial services may come from operational and technology events rather than from the financial distress of an institution. That means the resilience and effective management of operational and, in particular, technology infrastructure is paramount.

The Bank and the financial system have much to gain from better co-ordination of regulatory initiatives. Co-ordinating deadlines will reduce the risk of crowding out longer-term investment and ease pinch points that could exacerbate the peril of systems and technology migrations.

RECOMMENDATIONS

<p>2.1 Build an innovative payment infrastructure to enable alternative payment methods</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • Opening up wider access to central bank infrastructure could enable private sector innovation and competition. The Bank was the first G20 central bank to open up access to its payment system to non-bank payment service providers. • As financial data becomes ever richer, the Bank may wish to consider whether APIs and other data tools can allow members of the payment system to securely access and analyse the payments data they generate.
	<p>What can the Bank (and others) do? The Bank should:</p> <ul style="list-style-type: none"> • Consider how alternative providers might access the Bank's infrastructure including balance sheet and payment systems, and the appropriate package of obligations which come with these rights. This will need to dovetail with new payments regulation to ensure any new members are appropriately capitalised and supervised. Careful thought would also need to be given to the implications for monetary and financial stability of any further extension. • Create an API to allow improved information retrieval and sharing from payment systems.
<p>2.2 Champion trusted digital identification</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • Stakeholders repeatedly said verifying customer identity is excessively costly and cumbersome for the financial sector. UK Finance have highlighted that this causes delays and adds to the costs of finance for SMEs and consumers. It also impacts financial inclusion and creates a further barrier to competition. • Most stakeholders don't believe a fully-fledged (biometric or other) digital ID scheme would gain support in the UK, which has been scarred by the failed attempt of a national ID card. • There are opportunities to create protocols for selected public and private entities to share identification data safely with each other. These could include the Passport Office, Driver and Vehicle Licensing Agency, the Land Registry and private firms such as banks, telcos and utilities (see Chapter 3 on data standards).
	<p>What can the Bank (and others) do? The Bank should:</p> <ul style="list-style-type: none"> • Engage with the financial sector to establish its requirements for a digital ID, including discerning the features that would: <ul style="list-style-type: none"> - help reduce fraud in financial transactions; - reduce costs of on-boarding new customers and anti-money laundering and Know Your Customer processes; and - expand access to those excluded from the financial system. • Champion these requirements in broader engagement with public and private sector participants. The government should consider the merits of secure and efficient information gateways to trusted official sources, so the private sector can improve the effectiveness of identification verification.

2.3 Embrace safe cloud usage

Why does the Bank need to act?

- Cloud computing has emerged as a critical enabler for firms' efforts to meet rapidly evolving customer expectations, reduce risks, improve cyber-security and efficiency. Cloud service providers are able to offer outsourced storage and processing at a fraction of the cost of in-house data centres due to their large scale.
- Cloud service providers spend much more on cyber-security than traditional financial services firms. Their scale and capabilities mean they are likely to be able to maintain leading cyber-security standards. Failing to empower the use of the cloud may create its own operational resilience risks.
- The Bank needs to clearly articulate its assessment of cloud use in the financial sector, and the financial stability and safety and soundness considerations it presents. It should reach a judgement on whether the cyber-resilience benefits of cloud providers outweigh the potential risks associated with critical operational dependencies.
- This will give the market the certainty it needs to use cloud computing, and other hosted services, in a safe and resilient way. It will allow firms to create the infrastructure to make the most of big data and advanced analytics. This is likely to include updated guidelines and standards for cloud usage. Business continuity and interoperability solutions merit even greater consideration to mitigate risk from a single point of failure.

What can the Bank (and others) do?

The Bank should:

- Work with the private sector to help firms realise the benefits of public cloud usage without compromising resilience by:
 - understanding and mapping concentration risks and interoperability, as well as building expertise within the Bank;
 - testing operational resilience, including to cyber-risk;
 - setting standards and guidelines for cloud usage; and
 - collaborating with international regulators on a longer-term approach to cloud oversight.

<p>2.4 Support an “air traffic control” of major projects</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • Banks and insurers highlight that regulatory fragmentation imposes increased cost to the industry, and so customers, and creates risks to operational resilience. • In addition to already squeezed investment budgets, the multitude of at times duplicative regulatory data requests may have held back firms from adopting innovative solutions.
	<p>What can the Bank (and others) do?</p> <p>The Bank should:</p> <ul style="list-style-type: none"> • Argue for a new forum with all major regulatory bodies to map and identify critical junctures for ongoing and new regulatory projects. These include: The Payment Systems Regulator, the Financial Conduct Authority, the Open Banking Implementation Entity and the Competition and Markets Authority. While respecting each institution’s statutory duties, sharing information on the timing and impact of major projects would reduce risk to operational resilience. It would also limit the risk of crowding out innovation through the bunching of regulatory initiatives. Indirectly, it may build a richer roadmap of tech transformation for financial infrastructure.

ENDNOTES

- 1 McKinsey & Company research.
- 2 [Financial regulation — 20 years after the Global Financial Crisis, speech given by Ravi Menon, Managing Director of the Monetary Authority of Singapore, Symposium on Asian Banking and Finance, June 2018.](#)
- 3 McKinsey & Company research.
- 4 See www.srgresearch.com/articles/fourth-quarter-growth-cloud-services-tops-banner-year-cloud-providers.
- 5 See www.ibm.com/blogs/cloud-computing/2017/05/17/cloud-drives-enterprise-innovation/.
- 6 See www.salesforce.com/uk/blog/2015/11/why-move-to-the-cloud-10-benefits-of-cloud-computing.html.
- 7 Finastra, FTI Consulting Survey, 2019.
- 8 [Cloud Computing in Banking. What banks need to know when considering a move to the cloud, Capgemini, \(2017\).](#)
- 9 [FinTech and market structure in financial services: Market developments and potential financial stability implications, Financial Stability Board \(FSB\), 2019.](#)
- 10 See <https://aws.amazon.com/solutions/case-studies/monzo/>.
- 11 [Cloud Computing in the Financial Sector, Part 3: Cloud Service Providers \(CSPs\), Institute of International Finance \(IIF\), 2019.](#)
- 12 See www.srgresearch.com/articles/fourth-quarter-growth-cloud-services-tops-banner-year-cloud-providers.
- 13 See <http://ide.mit.edu/news-blog/blog/digital-identity-key-privacy-and-security-digital-world>.
- 14 [Staying ahead of cyber crime, UK Finance, KPMG, \(2018\).](#)
- 15 [How digital identities which meet government standards could be used as part of UK banks' customer on-boarding and KYC requirements, Open Identity Exchange White Paper, \(2017\).](#)
- 16 [Digital Identity: On the Threshold of a Digital Identity Revolution, World Economic Forum \(WEF\) White Paper, \(2018\).](#)
- 17 [A Blueprint for Digital Identity: The Role of Financial Institutions in Building Digital Identity, World Economic Forum \(WEF\), \(2016\).](#)
- 18 [Digital Identification: A Key to Inclusive Growth, McKinsey Global Institute, \(2019\).](#)
- 19 See www.gleif.org/en/about-lei/introducing-the-legal-entity-identifier-lei.
- 20 See <https://bbvaopen4u.com/en/actualidad/new-digital-identity-thanks-apis>.
- 21 See www.bankofengland.co.uk/payment-and-settlement/payment-and-settlement-statistics.
- 22 [A platform for innovation, speech given by Mark Carney, Innovate Finance Global Summit, April 2019.](#)
- 23 See www.bankofengland.co.uk/payment-and-settlement/rtgs-renewal-programme.
- 24 See www.bankofengland.co.uk/payment-and-settlement/rtgs-renewal-programme/rtgs-renewal-programme-news-events-and-milestones.
- 25 See <https://searchcloudcomputing.techtarget.com/definition/Software-as-a-Service>.
- 26 [Cloud Computing in the Financial Sector, Part 2: Barriers to Adoption, Insitute of International Finance \(IIF\), \(2018\).](#)
- 27 Finastra, FTI Consulting Survey, 2019.
- 28 [Cloud Computing Controls Framework: A Procurement Framework for Public Cloud Computing Services, UK Finance, \(2019\).](#)
- 29 See www.dta.gov.au/our-projects/digital-identity.
- 30 See <https://e-estonia.com/solutions/e-identity/id-card/>.
- 31 [Managing third party risk in financial services organizations: A resilience-based approach, Haller et al., Carnegie Mellon University, \(2016\).](#)
- 32 [Record of the Financial Policy Committee Meetings on 20 and 27 November 2018, Bank of England, \(2018\).](#)
- 33 [Building the UK financial sector's operational resilience, Prudential Regulation \(PRA\) DP01/18, Financial Conduct Authority \(FCA\) DP18/04, \(2018\).](#)
- 34 [Central counterparties: what are they, why do they matter and how does the Bank supervise them?, Bank of England, \(2013\).](#)
- 35 [Regulating and supervising the clouds: emerging prudential approaches for insurance companies, FSI Insights on policy implementation No 13, Bank for International Settlements \(BIS\), \(2018\).](#)
- 36 [Operational resilience — a progress report, speech given by Nick Strange, 21st Annual Operational Risk Europe Conference, May 2019.](#)

3 SUPPORT THE DATA ECONOMY THROUGH STANDARDS AND PROTOCOLS

THE OUTCOME WE SEEK

Data standards and protocols which enable households and businesses to access better, more customised financial services and to enable competition. Wider sharing and use of data are accompanied by improvements in security, and a clearer sense of data privacy, legitimate use and liability.

- Data standards and protocols are the bedrock of a robust and dynamic financial system. They can enable innovation and competition and reduce the cost of finance. But privacy, security, liability and trust will be of ever greater prominence.
- Automated decision-making based on machine learning is one of the most important trends in technology today and will become widespread in financial services. Ensuring artificial intelligence (AI) is used responsibly will be an important task.
- Financial services' use of data is already highly regulated, but businesses, policymakers and regulation have to keep pace with new techniques and alternative data sets. The responsible, explainable and ethical use of machine learning/AI will be important to achieve.

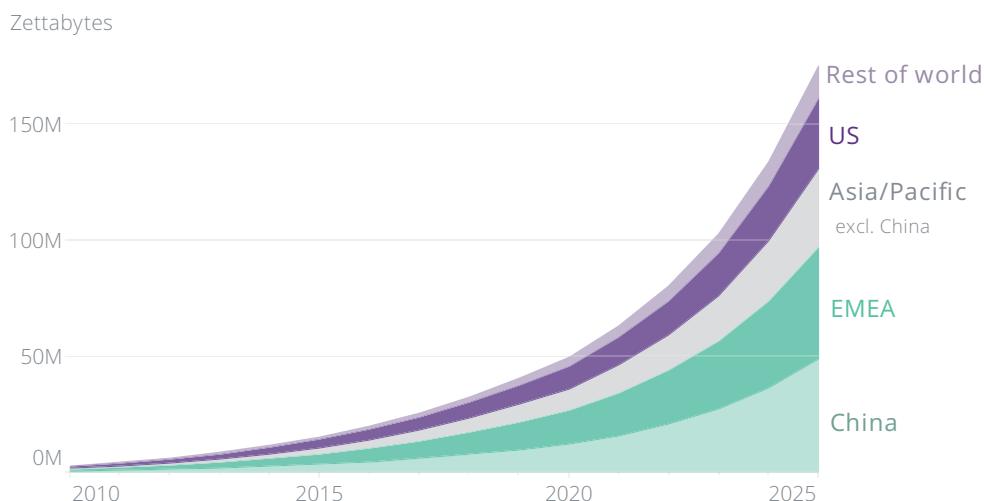
KEY DEVELOPMENTS

The power of data and analytics

Advanced analytics and the emergence of artificial intelligence could transform how customers experience finance and the agility, efficiency and resilience of financial firms. But risks must be managed. Data and analytics could broaden access and increase customisation. They could also improve pricing of financial products for customers. But reaping these benefits will require the trust and consent of customers.

The volume of data has increased exponentially in the digital economy and will accelerate over the next decade (**Figure 1**). Over four billion people use the internet and more than 40 billion devices are connected globally.¹ Each creates a trail of data with every action, adding 2.5 quintillion bytes every day.² It is estimated that more data would have been created in 2017 than in the past 5,000 years combined.³

Figure 1: The growth of data around the world



Source: IDC White Paper, sponsored by Seagate, Data Age 2025: The Digitization of the World from Edge to Core, November 2018.

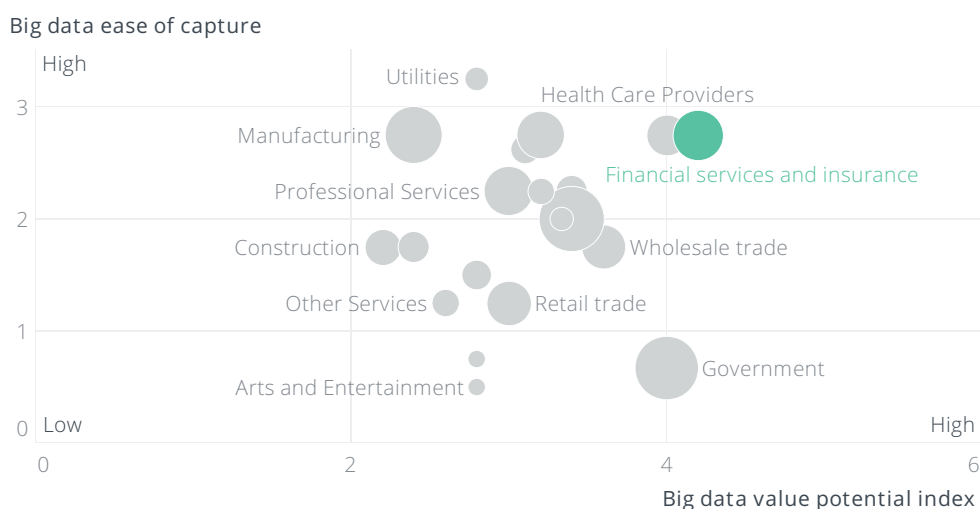
When harnessed properly, data has an enormous value.⁴ One estimate suggests that big data and the internet of things are already contributing more than £73bn to the UK economy yearly, or just over 4% of GDP.⁵ Other research suggests that firms which adopt data-driven decision-making are 5%–6% more productive.⁶ And these benefits can accrue to virtually every sector in the economy.

Data has always been the cornerstone of finance — from primitive ledgers to today's hyper-connected fast markets. McKinsey & Company outline the relatively high benefits from big data in finance compared to other sectors in **Figure 2**. The Centre for Economics and Business Research (CEBR) estimates that big data creates a £7bn benefit to retail and investment banking and insurance industries each year.⁷ And the future lies in smart use of data to improve consumer outcomes and generate enterprise value for financial services companies.

Data standards could bring several benefits to many different areas:

- Innovations in retail payments built on data standards and protocols can enhance the understanding of customer shopping habits and transform the checkout experience.
- Access to novel data sets could allow more tailored and accurate decisions about lending, opening new borrowing opportunities for customers and small businesses.
- Big data can help provide an in-depth understanding of business models for credit assessment.
- Transferring data through APIs could give households and businesses better information about and access to financial products.
- Data standards, such as the Legal Entity Identifier (LEI) and the ISO20022 payment message, can support innovation in, and greater connectivity across, wholesale payment systems, thereby cutting the costs of doing business across borders.

Figure 2: Big data and advanced analytics will shape every part of the economy — but financial services stands out



Source: *Beyond the buzz: Harnessing machine learning in payments*, McKinsey & Company, (2016).

Determined by industry average of transaction intensity, amount of data per firm, variability in performance, customer and supplier intensity, and turbulence.

Artificial intelligence and machine learning

Artificial intelligence (AI) and machine learning (ML) have existed since the 1960s.⁸ However, the recent growth in processing power and explosion of data available to “learn from” mean innovative analytical tools become vastly more important.

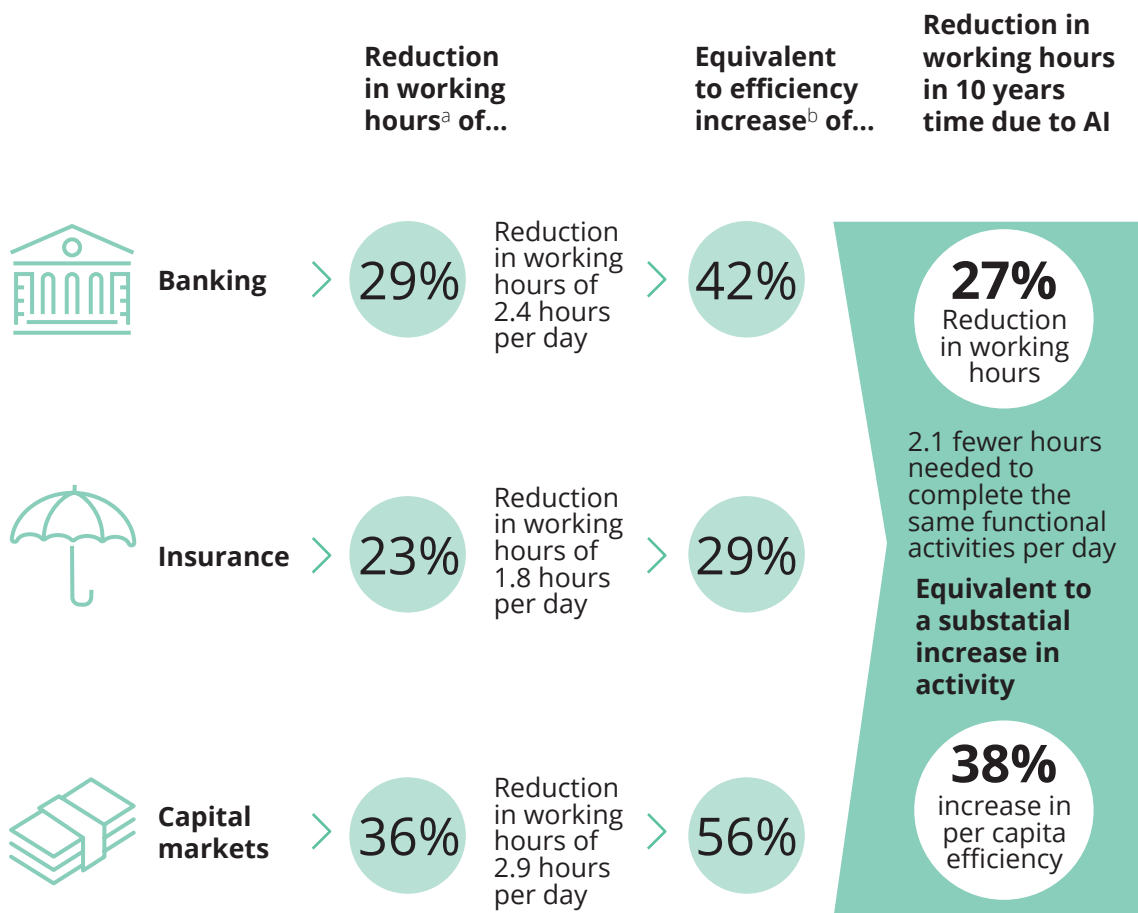
Machine learning can facilitate faster, more efficient and more personalised financial services at a lower cost. Financial firms can gain insights from customer data on everyday transactions, spending habits and preferences like never before, especially when supplemented by data from social media platforms, wearables and location devices. AI could improve the safety and soundness of firms, too, by making risk management more effective and reducing fraud. AI is already being used to understand and predict developments in financial markets, analyse risk scenarios, identify fraud and to monitor transactions.

The potential efficiency gains from AI are high. McKinsey & Company estimate AI and machine learning could provide a substantive uplift in financial performance for banks.⁹ A case study on China's financial sector by Boston Consulting Group (BCG) estimates that it will generate a 38% productivity increase within 10 years equivalent to a 27% reduction in hours worked (BCG, **Figure 3**). This said, it could come at the cost of jobs, as the Bank of England's ("the Bank") chief economist Andy Haldane and others have argued.¹⁰

The US and China are world leaders in the development and adoption of AI.¹¹ The UK should consider how it can stay at the forefront.¹²

Figure 3: Increases in efficiency in China's financial sector due to AI

AI could significantly raise efficiency in the financial sector



Sources: Boston Consulting Group Model for the impact of AI on the Employment Market in the Financial Sector by 2027; WIND; National Bureau of Statistics; China Banking Regulatory Commission; Insurance Association of China; China Securities Industry Association.

a Reduced working hours refers to activities that could be carried out using existing AI technologies in positions that have not been replaced by AI by 2027 (where less than two thirds of working hours have been replaced by AI); the estimate of reduced working hours is based on the status of AI in 2017, and is calculated based on the compound growth rate of employment from 2003–14 in the banking, insurance and capital markets, and the reduction in the total number of working hours of the total number of employees in 2027.

b The increase in efficiency refers to the increased efficiency from the reduction in working hours after applying AI.

The value of data standards

Standards can democratise data.¹³ Fragmented data in different formats from disparate sources is difficult and expensive to use, limiting its potential.¹⁴ When it is organised and described according to widely recognised standards, it's easier to access, share and use. People, other than the creators can also use the data, which means it can benefit a larger share of society and the economy.

In finance, data standards enable more transparency in markets, boost efficiency by slashing costs and give faster and more certain settlement. This cuts transaction costs and frees liquidity and capital for more productive uses. An example is the international data standard ISO20022 for payments which the Bank is adopting in its new RTGS system.¹⁵ It can help speed up cross-border payments by reducing frictions in payment messaging.

The UK has pioneered standards creating the first ever national standards body in 1901.¹⁶ Standards can encourage innovation and improve outcomes for customers. A widely adopted data standard gives an incentive to innovate.¹⁷ When the value of data can be utilised by a wider array of businesses, the gains for customers begin to multiply. Firms that are able to build a clearer picture of their customers can better anticipate their needs and offer keener pricing.¹⁸ Standards also enable data to be shared rather than being captive to one provider. Data portability enabled by standards could empower customers to take control of their data, use it for their benefit, and shop around for the proposition that best meets their needs.

Standards can improve risk monitoring.¹⁹ It is widely recognised that the lack of a common standards during the financial crisis made it difficult for firms to aggregate and understand their exposures in derivative markets.²⁰ The creation and promotion of the LEI as a unique identifier for firms has been a key part of the post-crisis regulatory framework and opens up a number of possibilities for the financial system and real economy. The LEI is also mandated for certain transactions in the Bank's new RTGS payment system.²¹

Finally, standards could drive greater resilience through better transparency, comparability, surveillance and oversight. This includes the transfer of critical functions in the event of distress or failure of a firm. And they can support interoperable infrastructure, enabling the development of platforms and other competitive market places.

Ethical standards for the sharing and data and use of AI/ML

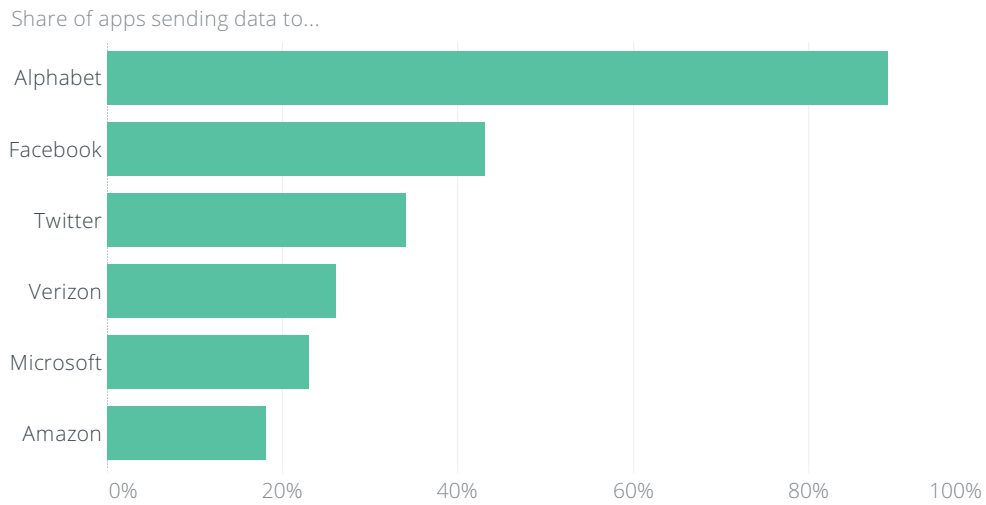
Standards will also have to be developed for the ethical use of data and analytics in order to promote trust.²² Consumers are not always aware when they consent to their data being shared and used.²³ And they are likely to have imperfect awareness of what they have agreed to. For example, research has shown that it would take the average online user 76 days to review all the terms and conditions they consent to in a year.²⁴

Additionally, privacy concerns could create a confidence backlash that would stifle the possibilities of data and analytics. Customer data is often shared between providers and across platforms. The median app on mobile phones transfers data to 10 third parties (**Figure 4**).²⁵ This raises concerns about the potential for data misuse. Cambridge Analytica's use of data from 87 million Facebook profiles in 2018 provoked a public backlash.²⁶ It put big technology firms' use of personal data under closer scrutiny.

Customers are increasingly concerned by and aware of the use of AI to make decisions that will affect them. Surveys show that banks enjoy relatively more trust today than firms in other sectors to manage personal data (**Figure 5**). And yet even in a trusted sector, AI techniques are unlikely to be entirely transparent or understood. This could lead to unexpected outcomes and an erosion of trust.²⁷ As such, firms need to be accountable for the decisions made by AI and able to explain their outcomes to customers.

Furthermore, while more precise and efficient risk assessment and pricing through AI will benefit users of finance, a minority may find themselves excluded. This could for example happen if new data or analytical techniques in health insurance revealed risk characteristics previously not fully appreciated, leading to cover being withdrawn from customers.

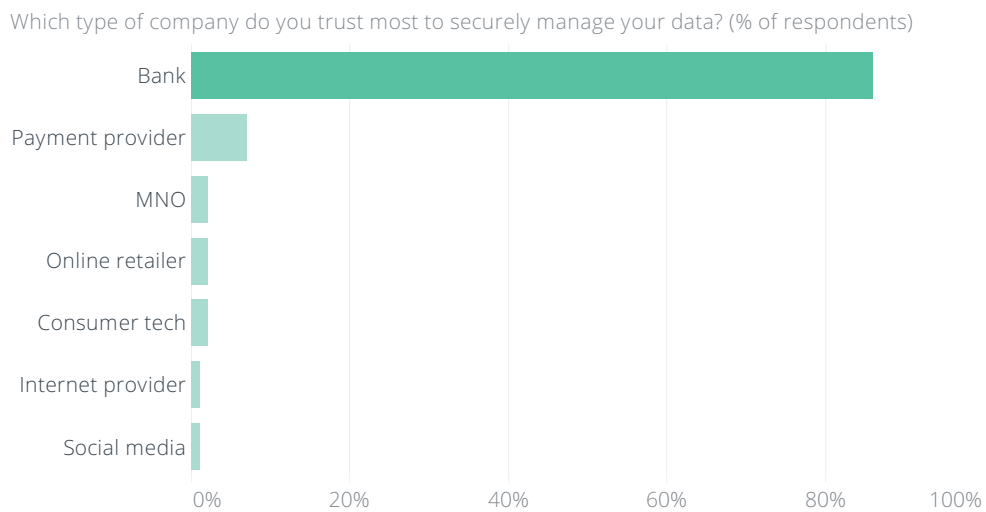
Figure 4: Data sharing with third parties



Source: Reuben Binns, Ulrik Lyngs, Max Van Kleek, Jun Zhao, Timothy Libert, Nigel Shadbolt. 2018. [Third Party Tracking in the Mobile Ecosystem](#).

The sample represents almost 1 million android apps.

Figure 5: Data and trust



Source: Boston Consulting Group, Capterra survey.

Establishing expectations for the acceptable use of data and AI

UK laws provide a baseline of what is permissible and prohibited for access and use of data.²⁸ For example, GDPR covers rights and responsibilities around the safeguarding, sharing and use of data, and specific provisions on automated processing such as AI.²⁹

Guidance and codes can support legislation and regulation. They can also make practitioners confident in using new technologies, where, new use cases emerge every day and conventions may not yet be clear.

Companies should behave responsibly, ethically and within the law. But codes and guidance can foster a dialogue about emerging practices, highlight issues and ensure best practice is shared. This helps clarify grey areas, sets expectations and builds confidence in using new technologies (see **Figure 6**).

Figure 6: Three levers to ensure good AI governance

	Description	Frequency of updating	Examples
Legal basis	Enshrine high-level principles	Updated infrequently	FSMA, UK Companies Act
Regulatory rules and expectations	Specify meaning of legislation in light of technological and other developments	Updated as the need arises	SM&CR, EBA guidelines (eg on outsourcing)
Industry standards	Add more clarity on what it means in practice	Regularly updated	FEMR, FMSB, Technology specific (eg ISO/IEC 19941 Cloud)

Source: Bank of England.

Three areas in particular can support the resilient and fair use of AI: data governance, model validation frameworks and accountability regimes:³⁰

- Quality control for data inputs into AI models.
Controlling the quality of model inputs is key to ensuring good outcomes. Data used to train models can replicate existing biases. So the data inputs should be well understood in model development.
- Best-in-class model validation frameworks.³¹
Existing frameworks must be adjusted to account for AI. Several promising methods have emerged to aid testing and “explainability” of AI models. Spreading best practice will promote quality control and reduce errors. This could be done through bodies akin to the Fixed Income, Currencies and Commodities (FICC) Markets Standards Board (FMSB).
- Clear expectations around governance and accountability for the use of AI.
In the financial sector, AI should be subject to the same standards of accountability, oversight, governance and risk management as other activities. But additional specific guidance and expectation-setting may be helpful.

Platform finance for small and medium-sized enterprises (SMEs) and individuals

The experience of China shows how data and technology can be used by platforms to provide access to finance. Ant Financial uses an array of data to offer credit to those that have been previously underserved by finance.³² For example, its “sesame” credit score includes individuals’ social media interactions and businesses’ sales and ratings on the Alibaba marketplace (see Chapter 1).³³

Examples from around the world show the potential of platform finance. Based on sales and ratings data, Amazon is now able to extend trade credit to businesses selling on its marketplace.³⁴ PayPal is extending credit to online customers at the point of sale, using their transaction history.³⁵ And the accounting software provider Xero’s agreement with RBS enables them to on-board customers using their account data.³⁶

Open Banking and greater use of APIs to share data across the financial system offer a glimpse of what might be possible with the right platforms, protocols and standards. For example, SMEs could benefit from being able to compile their data from different vendors to build a comprehensive, digital business profile.³⁷ They could then use their data to seek the most appropriate forms of finance at the best possible prices.

Quicker identification would speed up onboarding processes and allow SMEs to switch providers more easily. A deeper financial history, especially for young companies, could unlock working capital, invoice and trade finance.

Better access to government information would make this truly transformative. SMEs could demonstrate their credentials and verify their directors' identity by sharing accounts filed at Companies House, linked to data from the Passport Office and the Driver and Vehicle Licensing Agency (DVLA). Sharing tax data held at HMRC could provide a further step in offering a rich description of their business model.

A shared data platform could also benefit gig economy workers.³⁸ Utilities statements, DVLA and passport data could quickly prove their address and identity. Transaction and savings data could help build up their credit score. This would widen access at potentially more competitive prices for anything from consumer loans to mortgages.

Meeting the needs of small businesses and workers in the gig economy

The nature of work is changing with a larger proportion of the population in self-employment, flexible working or multiple jobs. In the UK, three million people worked in the gig economy over the past year, and nearly a third of British workers are self-employed.³⁹ In the US, 90% of new jobs created in the past decade were in the gig economy according to PayPal.⁴⁰

Work through platforms such as Uber, Deliveroo or TaskRabbit can produce irregular incomes, which does not fit well with traditional lending models. Gig workers who are generating regular incomes may be doing so without permanent contracts.

Lenders should lend responsibly and prudently, but conventional measures of creditworthiness may not give a full picture of the financial prospects of the self-employed and those in flexible employment. Innovators are trying to respond. Their use of novel data sets can also help SME finance.

The nearly six million SMEs in the UK are an important driver of growth. They account for 60% of all private sector employment⁴¹ and 70% of all new jobs since 2010.⁴²

These small firms report barriers to accessing finance that can stifle investment in their business.⁴³ More than two thirds of SMEs would rather grow slowly than borrow to grow faster.⁴⁴ And 6 in 10 would-be-borrowers end up using personal funds instead of borrowing.

More than half of SMEs only apply to one provider when seeking a loan.⁴⁵ A quarter of their applications are rejected.⁴⁶ And a similar figure don't approach other providers because of the "hassle" or time associated with applying for finance, particularly at short notice.

The costs of verifying the identity of these companies and understanding their businesses are a significant barrier. This includes confirming the identity of the company, its directors and officers, and its business model and risk profile.

New data and analytical techniques can reduce these barriers. This might help explain the success of alternative lenders in recent years. Fintechs around the world are finding ways to streamline onboarding and verification of SMEs through new forms of data.⁴⁷ And others are using it to enrich credit scoring and open up lending to previously underserved businesses.⁴⁸ Over half of SME owners are now aware of alternatives to bank lending, in part due to HM Treasury's credit referral scheme.⁴⁹

LOOKING TO THE FUTURE

Machine learning and AI are likely to become widely applied over the coming decade. There are many reasons to be optimistic about better fraud protection, more personalised finance and cheaper and more efficient services thanks to data and AI. But there are also many legal, ethical, economic and social challenges. Some topics which firms and financial regulators will need to consider include:

- Artificial stupidity: how to guard against mistakes such as learning from incomplete data sets (otherwise known as sample bias)?
- Racist robots: how to eliminate AI bias?
- What if platforms that aren't covered by financial regulation misuse or lose data? Who is liable? How can they recover?

- Security: how to keep AI systems safe from data manipulation?
- Singularity: how to stay in control of a complex and intelligent system?
- What is the legal status of algorithms?

Many of these issues will go well beyond finance. But the ethical use of data should be an important topic for firms and regulators. Some have started working with industry on this. The Monetary Authority of Singapore for example has published a set of principles around the use of AI, which address some key risks.⁵⁰ Stakeholders confirmed that industry welcomed this interesting initiative. This could be a useful model which could be adapted and developed for the UK.

Box 1: Singapore's FEAT principles

In November 2018, the Monetary Authority of Singapore (MAS) co-created a set of principles with industry on the ethical use of AI in financial services.¹ They decided upon four principles: fair, ethical, accountable and transparent. They aim to promote public trust in the use of AI and data analytics by providing general guidance for programmers on design choices and for senior executives on oversight.

One concern the principles seek to address is discrimination. MAS highlights that AI could lead to differential treatment of groups in new ways and "at greater scale and faster speed".

So AI should only use attributes to discriminate between people if this "can be justified" and that data and models should be regularly reviewed for bias.

Another concern is around transparency and accountability. AI decisions could "significantly affect data subjects" and so need to be "approved by the appropriate internal authority". Firms should be prepared to explain decisions to people who are affected. Finally, any decisions made by AI should be aligned with the firm's general ethics principles.

1 www.mas.gov.sg/News-and-Publications/Media-Releases/2018/MAS-introduces-new-FEAT-Principles-to-promote-responsible-use-of-AI-and-data-analytics.aspx.

IMPLICATIONS FOR THE BANK

Data standards can benefit the effectiveness and resilience of finance. So the Bank should keep identifying areas where it can encourage the adoption and embedding of robust data standards.

It should have a keen eye on potential market failures where policy interventions to mandate or encourage data standards may be needed. This is reflected in its work on regulatory data taxonomies in the European Banking Authority, the European Occupation and Pensions Authority, the Financial Stability Board and the Basel Committee on Banking Supervision. And its participation in the Committee on Payments and Market Infrastructure, as well as the engagement with private sector organisations.

Significant efforts towards ensuring greater data protection have already been made, most notably through the EU's General Data Protection Regulation (GDPR). But with constantly changing business models and innovation, authorities are only starting to set boundaries for data use and sharing.

The UK Government has set up a Centre for Data Ethics and Innovation which seeks to establish general principles and a code of conduct for data use.⁵¹ The Bank should take a keen interest in how this is embedded in the financial sector and should share its perspectives.

It should also evaluate its domestic rules around the governance of AI, including through the Senior Managers Regime (SMR).

Looking to the future, the Bank should help make sure that data and ethical standards are applied across the financial sector to enhance competition and avoid concentration. Only then can it make sure the financial system is resilient and ready for a future where it continues to provide the best financial outcomes for UK households and businesses. And it will need to work closely with other regulators, especially the Information Commissioner's Office, as the use of data and advanced analytics grows.

RECOMMENDATIONS

3.1 Promote the responsible use of machine learning and AI

Why does the Bank need to act?

- Ethical implications of the data economy are evolving rapidly. And the UK financial services industry is employing AI and data analytics on an increasing scale. It will be important to encourage transparent, responsible and accountable use of these technologies to maintain trust in the financial system.
- Customers need to understand how they have been assessed and rated for risk evaluation and pricing by AI. This is so they can be assured they have had a fair outcome, but also to avoid moral hazards in areas such as credit scoring and underwriting. This may also create positive incentives for consumers to manage their risk profiles.
- Policymakers will want assurance that models are explainable and fair. And as models evolve, they may want greater clarity on issues such as how personal data is used and how consent to use data is given and withdrawn. Where decisions are made by AI or machine learning, a “right of appeal” process is needed.
- It would make sense to establish industry standards or regulatory guidance for the use of AI in financial services. Other jurisdictions, especially the Monetary Authority of Singapore, have co-created a set of guiding principles with the industry. The UK Government has also recently established a Centre for Data Ethics and Innovation.

What can the Bank (and others) do?

The Bank should:

- Establish a public-private financial sector working group with the Financial Conduct Authority to:
 - monitor developments in the use of machine learning to understand possible micro and macroprudential implications of widespread adoption;
 - develop principles, and share best practice, for the responsible, explainable and accountable use of machine learning in finance;
 - explore the intersection with current rules (including Senior Managers Regime) and where old rules need updating; and
 - feed into the Centre for Data Ethics and Innovation’s work on maximising the benefits of artificial intelligence and managing the risks in finance.
- A wholesale working group (or subgroup) should also involve or could be championed by the Fixed Income, Currencies and Commodities Markets Standards Board.

3.2 Support better credit files for SMEs

Why does the Bank need to act?

- As working patterns become more flexible, parts of the real economy are at risk of exclusion by traditional credit risk assessment.
- Alternative data sources could help build richer credit scores. This might include current account transaction data, regular savings behaviour, or even social media to enhance the accuracy of existing scores and achieve better risk separation. It could make many of today's credit invisibles visible. Historically, these data sources have not been accessible — and some would require the public sector to adopt their model of providing access to data.
- UK SMEs' access to a variety of affordable finance could improve. Identification and sharing business and financial information are key pinch points. This is in part because of KYC/anti-money laundering requirements.
- HM Treasury ran a successful Rent Recognition Challenge to enable private and social renters to share a record of their rent payments to build their credit scores and improve access to credit. This may provide lessons for the future.

What can the Bank (and others) do?

The Bank should:

- Use its knowledge of LEIs in finance to support wider adoption.
- Contribute analysis on the value of better credit files for small and medium-sized enterprises and individuals. This could include considering permissioned access to high-level company tax data. The Treasury may wish to establish a competition for private innovators to help build better credit files for the gig and sharing economy.

ENDNOTES

- 1 See www.statista.com/statistics/617136/digital-population-worldwide/.
- 2 See www.socialmediatoday.com/news/how-much-data-is-generated-every-minute-infographic-1/525692/.
- 3 See <https://appdeveloperomagazine.com/more-data-will-be-created-in-2017-than-the-previous-5,000-years-of-humanity/>.
- 4 [The economic value of data: discussion paper](#), HM Treasury (2018).
- 5 See www.dataiq.co.uk/articles/articles/uks-data-economy-worth-ps73-billion-potential-greater.
- 6 BCG research.
- 7 [The Value of Big Data and the Internet of Things to the UK Economy](#), Centre for Economic and Business Research (CEBR), SAS, (2016).
- 8 [The new physics of financial services: understanding how artificial intelligence is transforming the financial ecosystem](#), World Economic Forum (WEF), Deloitte, (2018).
- 9 McKinsey & Company research.
- 10 [Artificial intelligence and machine learning in financial services: market developments and financial stability implications](#), Financial Stability Board (FSB), (2017).
- 11 See www.mckinsey.com/featured-insights/artificial-intelligence/kai-fu-lees-perspectives-on-two-global-leaders-in-artificial-intelligence-china-and-the-united-states.
- 12 [AI sector deal](#), Policy paper, Department for Digital, Culture, Media & Sport (DCMS), (2019).
- 13 [The democratization of data science](#), Harvard Business Review, (2018).
- 14 See www.cio.co.uk/it-strategy/data-fragmentation-challenges-restrict-business-flexibility-3431866/.
- 15 See www.bankofengland.co.uk/payment-and-settlement/rtps-renewal-programme/consultation-on-a-new-messaging-standard-for-uk-payments-iso20022.
- 16 [Regulation, ethics and standards in wholesale financial markets](#), Mark Yallop, ICMA ERCC Conference, 27 September 2016.
- 17 [The economic value of data: discussion paper](#), HM Treasury (2018).
- 18 [Made-to-order: the rise of mass personalisation](#), The Deloitte Consumer Review, Deloitte, (2015).
- 19 Office of Financial Research Annual Report 2012.
- 20 See www.treasury.gov/initiatives/wsr/ofr/Documents/Promoting-Data-Standards.pdf.
- 21 [Implementation and effects of the G20 financial regulatory reforms](#), 3rd Annual Report, Financial Stability Board (FSB), (2017).
- 22 [Building digital trust: the role of data ethics in the digital age](#), Accenture, (2016).
- 23 See <https://iapp.org/news/a/what-misconceptions-do-consumers-have-about-privacy/>.
- 24 See www.bbc.co.uk/news/technology-22772321.
- 25 [Third party tracking in the mobile ecosystem](#), Binns et al., University of Oxford, (2018).
- 26 See www.bbc.co.uk/news/topics/c81zyn0888lt/facebook-cambridge-analytica-scandal.
- 27 See www.forbes.com/sites/bernardmarr/2018/11/19/is-artificial-intelligence-dangerous-6-ai-risks-everyone-should-know-about/#122bf53e2404.
- 28 See www.forbes.com/sites/bernardmarr/2018/11/19/is-artificial-intelligence-dangerous-6-ai-risks-everyone-should-know-about/#122bf53e2404.
- 29 [Guide to the General Data Protection Regulation \(GDPR\)](#), UK Government, (2018).
- 30 [Notes from the AI Frontier. Modeling the impact of AI on the world economy](#), Discussion Paper, McKinsey & Company, (2018).
- 31 See www.forbes.com/sites/insights-intelai/2019/03/27/wrestling-with-ai-governance-around-the-world/#47c1f54a1766.
- 32 See www.economist.com/finance-and-economics/2017/02/25/in-fintech-china-shows-the-way.
- 33 See www.ft.com/content/ba163b00-fd4d-11e8-ac00-57a2a826423e.
- 34 See www.cnbc.com/2017/06/08/amazon-loaned-1-billion-to-merchants-to-boost-sales-on-its-marketplace.html.
- 35 See www.paypal.com/uk/smarthelp/article/what-is-paypal-credit-faq2887.
- 36 See www.xero.com/blog/2014/08/rbs-natwest-direct-feeds-update/.
- 37 See www.ukfinance.org.uk/news-and-insight/blogs/benefits-open-banking-smes.
- 38 See www.ipse.co.uk/ipse-news/news-listing/how-data-can-help-workers-in-the-gig-economy.html.
- 39 [Labour market economic commentary: May 2019](#), Office for National Statistics (ONS), (2019).
- 40 See www.paypal.com/stories/us/evolving-financial-services-to-meet-needs-of-the-global-workforce.
- 41 See www.fsb.org.uk/media-centre/small-business-statistics.
- 42 See <https://smallbusiness.co.uk/smes-driving-employment-levels-2539643/>.
- 43 [Enhancing the contributions of SMEs in a global and digitalised economy](#), OECD, (2017).
- 44 [SME Finance Monitor, Q4 2018](#), BVA BDRC, (2019).
- 45 [Retail banking market investigation](#), CMA (2016).
- 46 [SME Finance Monitor, Q4 2018](#), BVA BDRC, (2019).
- 47 See www.bankingtech.com/2018/09/the-future-of-client-onboarding/.
- 48 [On the rise of the FinTechs — credit scoring using digital footprints](#), Berg et al., FDIC, (2018).
- 49 [Bank referral scheme: official statistics](#), HM Treasury, (2018).
- 50 [Principles to promote Fairness, Ethics, Accountability and Transparency \(FEAT\) in the Use of Artificial Intelligence and Data Analytics in Singapore's Financial Sector](#), Monetary Authority of Singapore (MAS), (2018).
- 51 See www.gov.uk/government/groups/centre-for-data-ethics-and-innovation-cdei.

4 CHAMPION GLOBAL STANDARDS FOR FINANCE

THE OUTCOME WE SEEK

An open, effective and integrated global financial system that supports trade, commerce and investment. Global standards are embraced to maintain resilience and avoid fragmentation.

- Emerging markets will likely play an ever greater role in the international economy and global financial system as they continue to grow (faster than advanced countries) and open up their economies.
- As the largest international financial centre, the UK has an important role to play in helping finance the needs of a green and global economy.
- The Bank oversees the stability and effectiveness of the UK financial systems.
- To achieve this, the Bank needs to work intensively with others to create, develop and implement the global standards and deep supervisory co-operation that are crucial to ensuring open and resilient international financial flows.

KEY DEVELOPMENTS

As a global financial centre, the UK has an opportunity to share in the growth of the global economy as well as help mobilise international finance to support the transition to a green economy. But this means ensuring that the conditions are in place for safe, resilient and open international financial flows. At a minimum, this will require ongoing strong global financial standards and deep supervisory co-operation. It will also require emerging markets to carefully sequence their opening up to foreign investors. They will need structures and policy frameworks to mitigate risks to financial stability.

Political changes around the world are likely to impact the global economy and financial system in the decade ahead. This includes the UK's exit from the EU which will be critical context against which policymakers in the UK, including the Bank, will need to make decisions going forward. Irrespective of the outcome of "Brexit", there are numerous areas where the Bank can collaborate internationally to contribute to an effective and safe global financial system.

This is critical, as over the next decade, emerging market economies (emerging markets) will likely play a more central role in the global financial system as they continue to grow and open. By 2030, China could be the world's biggest economy and India the third largest, with their combined output accounting for more than a quarter of global GDP (at market prices).¹

London as an international financial centre and its importance to the UK economy

The UK financial sector is a driver of national prosperity. It employs over 1 million people² and contributes £60bn in exports.³

The UK financial sector is both a national asset and a global public good. London accounts for over 40% of global FX and interest rate derivative volumes, and more international banking business is booked here than anywhere else.⁴ UK banks' foreign lending is the third highest in the world, of which three quarters is lending to non-EU countries.⁵

The UK financial sector is also the second largest asset management and fourth largest global insurance centre.⁶ And UK financial institutions, especially non-banks, play an important role in international capital markets. As of end-2017, UK-resident investors held US\$3.4 trillion foreign portfolio investments, equivalent to 140% of UK GDP.⁷ Two thirds were invested in debt and equity instruments issued by non-EU countries.

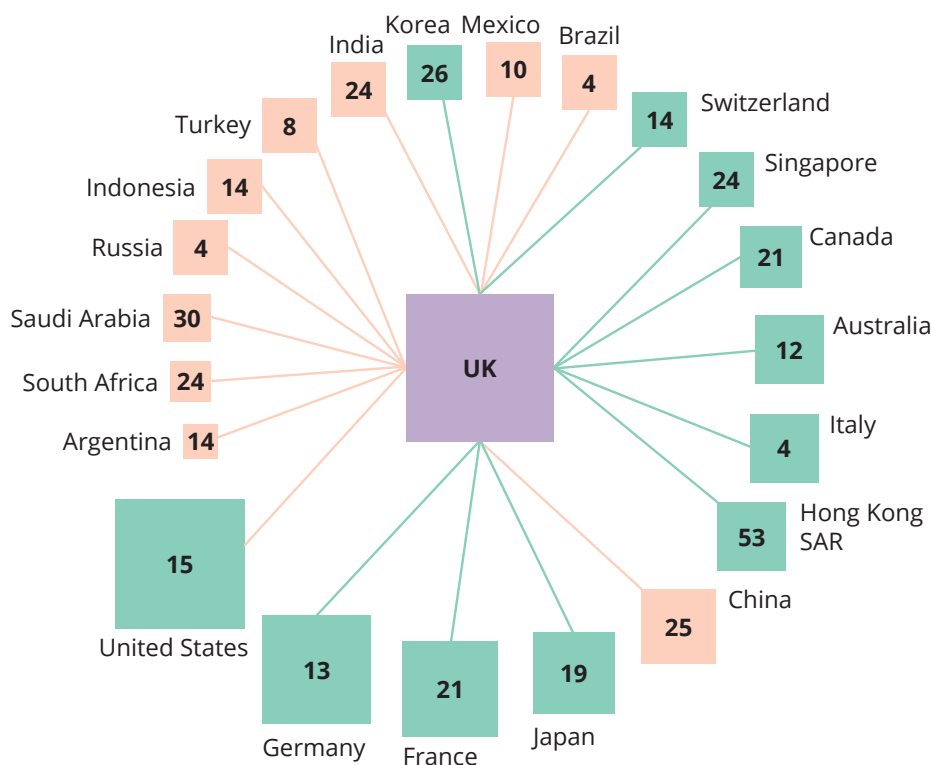
Growth in emerging market economies

Over the past 25 years, emerging markets' share of global economic activity has risen from 16.5% to 40%.⁸ In purchasing power parity (PPP) terms emerging markets' share of world GDP has risen from 40% to 60%.⁹ Their share of global trade has also increased from one fifth to one third.¹⁰ But developments in the global financial system have lagged behind those in the real economy. Financial assets and savings pools are still mainly concentrated in advanced economies.¹¹

A number of large emerging markets, such as China and India, remain relatively closed to foreign investment.¹² The composition of their external financing is focused on foreign direct investment rather than debt or portfolio equity flows. As they develop and deepen their financial sectors and open to foreign investors, they will need to ensure they focus on the effectiveness and integrity of their markets.

London as a global financial centre is open and connected to the global economy. This has significantly contributed to the UK's prosperity, but the interconnectedness also brings risks. UK financial institutions remain relatively focused on advanced economy clients. Other than China, currently most foreign financing of UK banks is provided to other advanced countries. **Figure 1** shows UK banks' claims on individual major countries as a share of all foreign banks' claims on these markets.

Figure 1: Global network of UK-HQ banks' claims



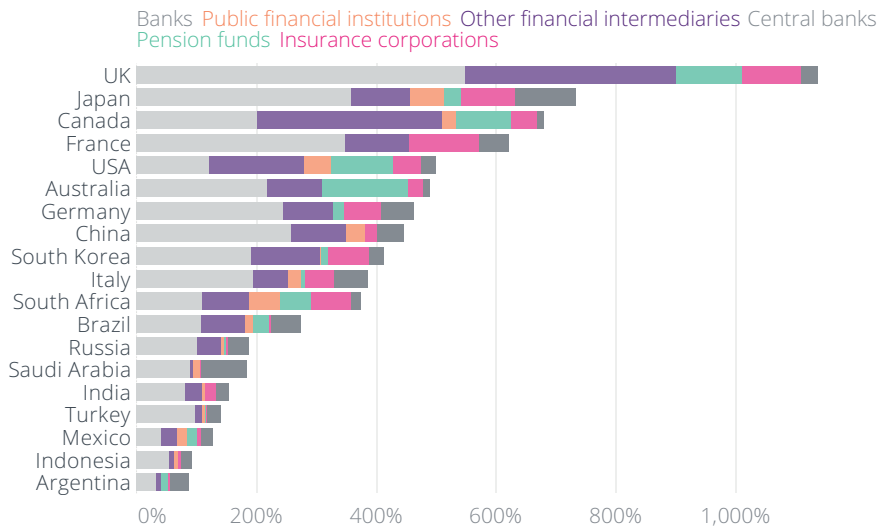
Source: BIS.

Note: 2017. Width of the arrows reflects UK banks' relative claims. Size of the boxes reflects that market's share of the total global claims of all foreign banks. The numbers in the boxes are UK banks' share of each market, end-2017. The colour coding of the boxes are green for advanced countries and pink for EMs.

In the future, emerging markets will likely play a significantly bigger role in the global economy and finance. If the composition of finance extended by UK banks were to change and tilt more towards EMs, this would have important implications for financial stability. Relative to the overall economy, the UK has the biggest financial centre of any large country (**Figure 2**), standing at over 10 times GDP. So it will be crucial to enhance existing approaches to maintaining financial stability to meet new challenges as the range of counterparties and opportunities expands.

The high degree of openness leaves the UK susceptible to financial stability threats from abroad. For example, more than one half of UK banks' total exposures are overseas rather than from the domestic economy.

Figure 2: Size of G20 financial systems as a percentage of GDP



Source: Global Monitoring Report on Non-Bank Financial Intermediation 2018, Financial Stability Board, 2019.

Note: Year-end 2017.

Emerging market debt

Emerging market government and corporate debt (owed to both domestic residents and foreigners) has gone up nearly 10 times in the past two decades — from US\$6 trillion at end of 1995 to US\$55 trillion as at end of 2018.¹³ The share of locally denominated debt for the top 21 emerging markets by size has grown from 76% in 2005 to 87% in 2018, as domestic debt markets have deepened.¹⁴

Local currency government bonds can contribute to a variety of policy objectives. Countries have to repay their debts in the same currency they borrow in. This exposes them to foreign exchange risk and the risk of changes in foreign countries' interest rates. Locally denominated bonds can help to meet emerging economies' financing needs while reducing currency mismatch and contributing to financial deepening.

Even though local currency bond markets have deepened over the past two decades, including since the global financial crisis, the growth in debt held by non-residents ("external debt") has been mainly denominated in US dollars.¹⁵ This leaves emerging markets vulnerable to appreciation in the US dollar.

Were local currency bonds to be issued more widely then the currency mismatch would migrate elsewhere in the financial system to the holders of these bonds. This would place ever greater importance on understanding the behaviour of the investors, and how their actions may affect the riskiness of capital flowing to emerging markets.

Growth in green finance

Green finance has seen significant growth in recent years.¹⁶ There is increasing focus on Environmental, Social and Governance (ESG) investing and sustainable finance among investors' client bases. Green finance is as an important element of financing the transition to a low-carbon economy (Chapter 5). While still a relatively small part of global bond issuance, the market for green bonds is growing at an accelerating pace with about US\$168 billion of issuance in 2018, quadrupling from 2015 (**Box 1**).

As a result of strong demand, green bonds have been more oversubscribed and, in some specific cases, have provided lower borrowing costs than their non-green equivalents.¹⁷ Therefore some argue evidence of a "Greenium" in debt pricing is emerging.

Box 1: Green bonds

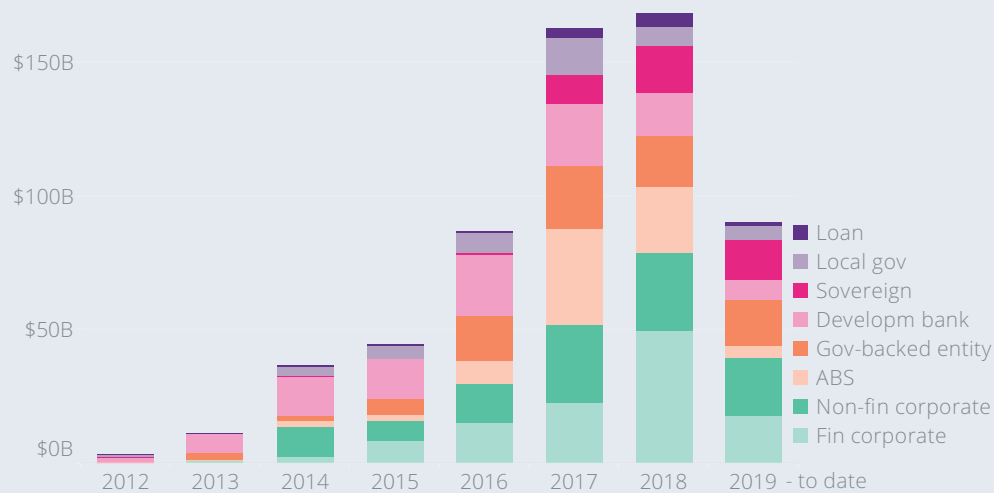
Finance that is climate-friendly does not always have a label, but there is an increasingly defined market for green finance. The market for financing environmentally aligned projects and companies has blossomed in recent years. The bond market is the most visible area of green finance.¹

The Green Bond Principles were established by the International Capital Markets Association (ICMA).² They provide a framework for issuing bonds whose proceeds are designated to support environmentally friendly objectives, while typically maintaining full recourse to the issuing company. The European Commission's Sustainable Finance Action Plan is developing a classification system for sustainable economic activities, a harmonised green bond standard and methodologies for low-carbon indices.³

Energy sector corporates, then banks and most recently sovereigns have picked up on green bond issuance, which was originally driven by supranational development banks.⁴ Energy production and efficiency remain the main areas for use of proceeds from green bonds. Green bonds from banks are typically used to finance mortgages on more energy efficient properties. The share of proceeds for transport and water projects has increased in recent years, largely driven by sovereign and supranational issuers.

Overall, the market has seen rapid growth with issuance of US\$168 billion in 2018, taking total cumulative issuance to approximately US\$500 billion (Figure 3). But it remains small compared to the financing needs that will arise for infrastructure investments globally.

Figure 3: Green bond issuance in recent years



Source: Climate Bonds Initiative.

1 www.sustainalytics.com/sustainable-finance/2019/03/06/trends-in-sustainable-finance-for-2019/
 2 www.icmagroup.org/green-social-and-sustainability-bonds/green-bond-principles-gbp/
 3 https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance_en
 4 [The Green Bond Market in Europe, Climate Bonds Initiative, 2018.](#)

LOOKING TO THE FUTURE

Emerging markets are expected to continue to grow and open

Emerging markets' share of the world economy could increase to around three quarters on a PPP basis by 2030 if trends continue.¹⁸ And further liberalisation of their capital accounts could lead to a marked increase in financial flows. Emerging markets' external financing as a proportion of GDP could roughly double over the next two decades.¹⁹ As suggested by recent trends, this would likely be accompanied by a diversification of EME financial inflows, moving towards markets rather than borrowing from overseas banks.

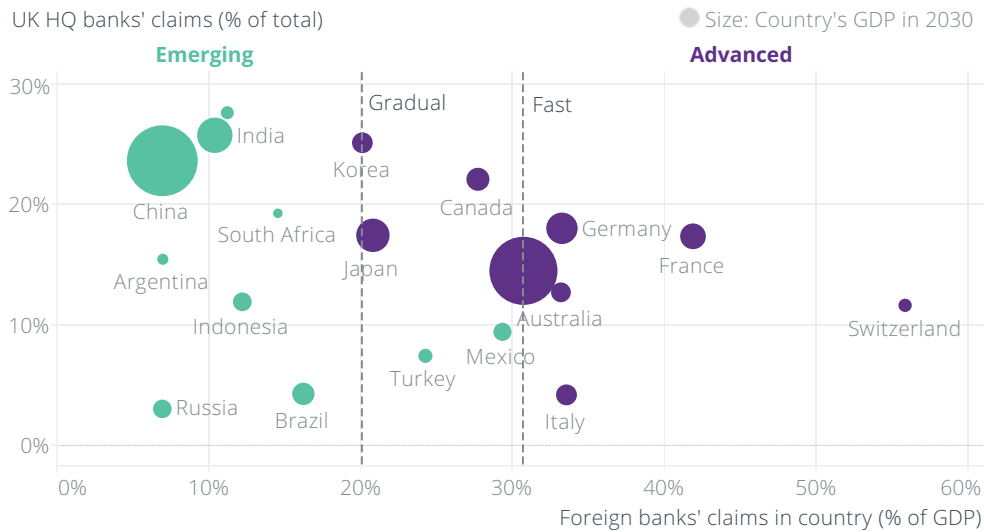
This would support EME growth by making it easier to finance domestic investment needs, which are likely to be substantial. Although wider adoption of protectionist or fragmenting measures may act as a countervailing force to greater integration.

The UK has an important role to play in financing the global economy

The prospect of a more broad-based global economy where economic and financial power is distributed more widely could benefit the UK. With a strong history of innovating to meet the needs of international clients, the UK also has an important role to mobilise finance for the low-carbon economy.

UK banks provide significant finance to advanced and emerging economies. **Figure 4** shows how much finance foreign banks provide to selected countries as a percentage of GDP and the UK's market share. The same applies to foreign portfolio investments in these countries. **Figure 5** presents selected countries' total foreign investment and the UK's share. The UK's exposures are high compared to its share of only 2.3% of the world economy.²⁰ If UK banks maintain their current foreign market share in many emerging markets, it could lead to strong business growth.

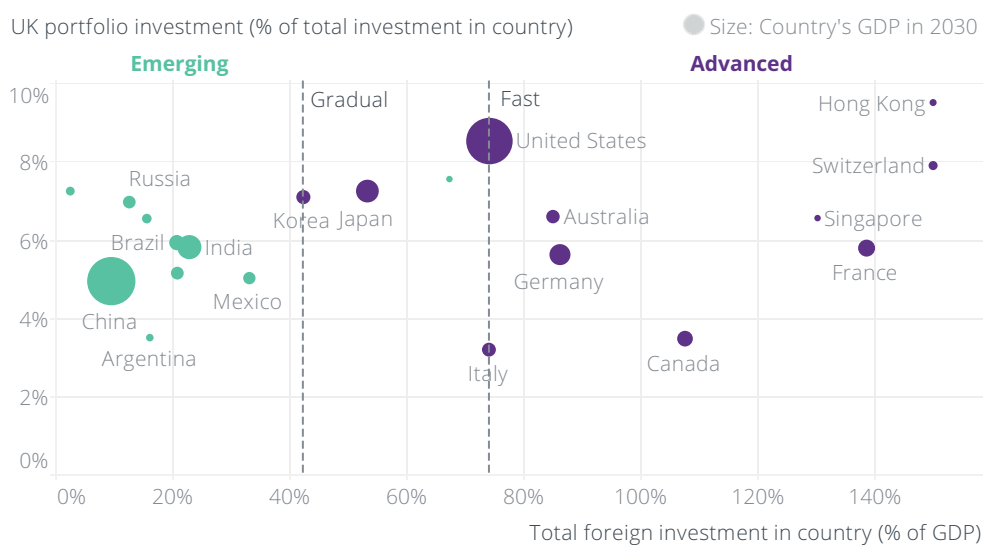
Figure 4: Total borrowing from foreign banks and UK market share, 2030



Sources: BIS Consolidated Banking Statistics, IMF WEO 2018 and Bank calculations.

Note: The size of the bubbles reflects the forecast of a country's GDP in 2030. Advanced countries in green, EMEs in purple. Gradual external liberalisation is to current South Korean levels, fast liberalisation is to current US levels.

Figure 5: Total portfolio investment liabilities to foreign investors and UK market share, 2030



Sources: BIS Consolidated Banking Statistics, IMF WEO 2018 and Bank calculations.

Note: The size of the bubbles reflects the forecast of a country's GDP in 2030. Advanced countries in green, EMEs in purple. Gradual external liberalisation is to current South Korean levels, fast liberalisation is to current US levels.

Different scenarios, where emerging markets see varying levels of liberalisation, can inform the implication of these trends. For example, EMEs could open up capital accounts to the levels currently experienced by South Korea. In this scenario, UK banks' claims on emerging markets could rise from 20% of UK GDP to around 60% in 2030. And UK residents' holdings of G20 emerging markets' portfolio debt and equity could rise from around 10% to 30% of UK GDP. **Figure 6** projects UK banks' claims on different countries under this scenario to 2030.

In a scenario of faster liberalisation, UK banks' claims could rise to almost 90% of UK GDP and portfolio investments to 55%. **Figure 7** shows that claims on emerging markets could overtake those of advanced economies in this scenario. UK portfolio investment in these — while also significantly increasing — would not yet reach the level of advanced economies.

An accelerated rate of liberalisation could considerably increase financial flows intermediated by UK institutions and the connectedness of the financial system to overseas economies. However, such liberalisation, would also leave emerging markets more exposed to external shocks which might "spill-back" to the UK with negative consequences for financial stability. In particular, capital flows are on average twice as volatile to emerging markets as they are to advanced economies.²¹

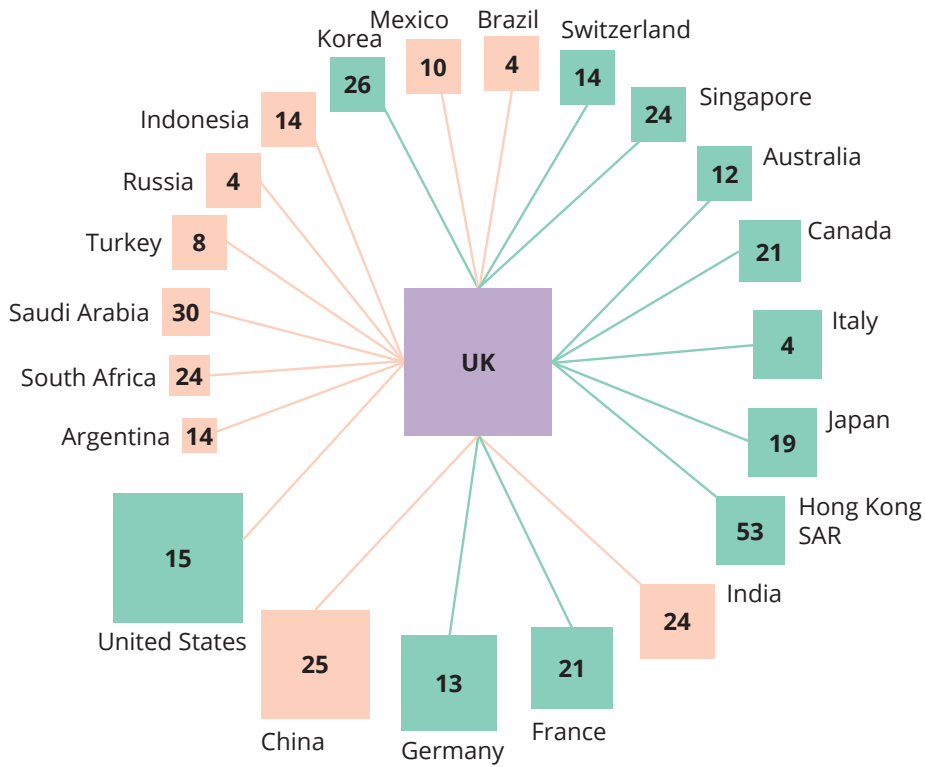
Green finance is on the rise

Green finance will likely become an increasingly important segment of global financial markets. In order to deliver the Paris Agreement commitment to limit global warming to well below 2°C compared to pre-industrial levels, carbon emissions would have to decline by 45% from 2010 to 2030 and reach net zero by 2050 (see Chapter 5).²² In practice, this would require 95% of electricity generation to be low carbon (eg from wind, solar, hydropower), 70% of cars electric and the entire building stock retrofitted with energy saving features.

This will require a significant investment in infrastructure, requiring private and public finance. The Organisation for Economic Co-operation and Development (OECD) estimates it could take more than US\$90 trillion in investment, or US\$6.9 trillion annually between 2016 and 2030 on average.²³

The UK's deep financial and derivatives markets such as renminbi clearing facilities and "Panda" (renminbi) and "Masala" (rupee) bonds could provide a platform for increased green debt issuance. London has been the centre of a series of landmark global green bond issuances, including China's first international issuance of a green bond, the Green Covered Bond.²⁴

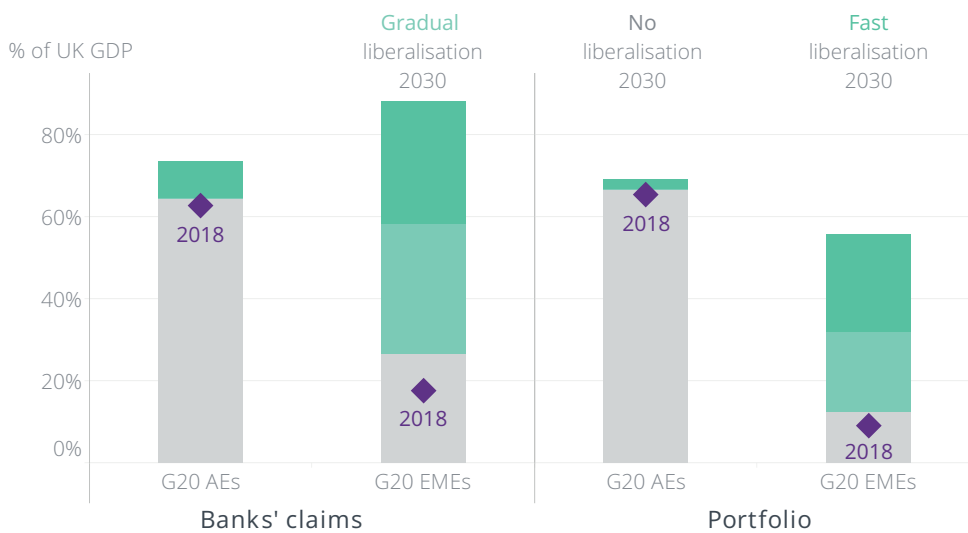
Figure 6: Global network of UK-HQ banks' claims, end-2030



Source: BIS.

Note: See Figure 1. Relative size of each market assumes that for EMEs total liabilities to foreign banks (per cent of own GDP) rise by 2030 to the current levels in South Korea but remain unchanged in advanced countries. GDP growth forecasts through to 2023 from IMF WEO October 2018. Growth 2024–30 assumed at same rate as the last period of the IMF forecast (2023).

Figure 7: UK holdings on the G20 advanced countries and EMEs under different scenarios (% of UK GDP)



Sources: IMF CPIS, BIS Consolidated Banking Statistics, WEO Forecast and Bank calculations.

Note: Gradual and fast liberalisation means foreign liabilities (per cent of GDP) rise by 2030 to the current levels in South Korea and the United States respectively. GDP growth forecasts through to 2023 from IMF WEO October 2018. Growth 2024–30 assumed at same rate as the last period of the IMF forecast (2023). UK is assumed to maintain its current foreign share of these markets.

IMPLICATIONS FOR THE BANK

Open international finance needs global standards and co-operation

The Bank is responsible for maintaining monetary and financial stability and promoting the safety and soundness of financial institutions. As such, it has a keen interest in the integrity and effectiveness of financial markets. In line with its mandate the Bank makes policy judgements and targeted interventions. It has a range of tools to protect financial stability at its disposal, including its annual stress-testing framework, setting an appropriate countercyclical capital buffer and the resolution regime for failing financial institutions.²⁵

The Bank closely monitors the shifts in the international economy and global financial system towards new and emerging market players. The openness of the UK economy means macroeconomic developments abroad can have “spillover” effects as emerging markets continue to open their economies and financial systems. Changes in the global financial system must be accompanied by a shift in how authorities deal with broader financial opening. Identifying new drivers of possible financial instability will be key to ensuring continued oversight and stability of the system.

This oversight is provided by a number of international financial institutions including the International Monetary Fund (IMF), the Bank for International Settlements (BIS), the Financial Stability Board (FSB) and a number of standard setting bodies. All are reviewing how their financial stability surveillance frameworks operate in light of the changing nature of risks.²⁶ There are also regular meetings of senior central bank and finance ministry officials from the major economies (G20, G7) to discuss issues affecting the international monetary and financial system.²⁷

The Bank engages in these international meetings by contributing to setting international regulatory and prudential standards, discussing macroeconomic and financial issues and, where required, co-ordinating policies. These institutions and meetings help to maintain an open and stable global financial system.

Global financial standards

Financial openness is good for sustainable global growth. But this openness needs to be safeguarded by a set of solid foundations. This means having strong global financial standards. The global financial crisis revealed a system that needed fundamental repair. The UK has been at the centre of G20 reforms to create a global financial system that is safer, simpler and fairer in the aftermath of the global financial crisis of 2008 (see Chapter 9).²⁸ This included repair of the banking sector and a fundamental shift from a system of largely intransparent bilateral trades to central clearing of standardised derivatives through a strong, centralised infrastructure.

But, finance, the economies, and threats to stability also constantly evolve. It is not sufficient to simply focus on the problems of the past to ensure they do not reoccur. Global standards, the institutions in which they are designed, and the authorities of which they are comprised must be forward looking, dynamic and ever vigilant to new threats. The UK, as host to a major international financial centre should be at the forefront of efforts to spot new risks, develop standards and promote close supervisory and regulatory co-operation.

Standards are also only as good as their implementation in practice. Therefore the FSB and the IMF regularly assess and transparently report on implementation. This helps to maintain trust in each other's policies. It also provides opportunities for authorities to defer to each other to harmonise regulation and avoid global financial fragmentation.

An additional requirement for markets to be effective is the development of an institutionalised framework of standards that go beyond the traditional reach of legal and regulatory frameworks to tackle the behavioural, social and other causes of misbehaviour in markets. These can be developed through initiatives by the public (as, for example, the FX Global Code)²⁹ or the private sector (as is being attempted through the Fixed Income, Currencies and Commodities Markets Standards Board)³⁰ or a collaboration between the public bodies and the industry.

Going forward, International co-ordination will be ever more important to avoid national approaches generating new sources of fragmentation and arbitrage as new issues merit policy action. This includes convening industry stakeholders to harmonise data standards and improving the quality of financial information.

The financial crisis exposed the failure of firms and public authorities to accurately identify exposures to troubled institutions, which significantly impacted the ability to react to events as they unfolded. Since then, international efforts to improve the availability of information on markets and firms include: the FSB's Common Data Templates reporting standards, reference data such as the Legal Entity Identifier (LEI) and defined data elements for OTC derivatives trades.³¹ These include the CPMI and IOSCO's Critical Data Elements (CDE).

Authorities will have to collaborate closely to manage the increasing data flows across borders. Current requirements for data localisation support national policy objectives, such as law enforcement, national security and personal data protection.³² But they may also be used as a tool for economic protectionism. Data sharing should occur wherever possible to ensure international finance can serve the global digital economy.

Careful capital account liberalisation

Further EME opening, especially to market-based finance, needs to be managed well to minimise risks and maximise the opportunities. Over the past 20 years, portfolio flows to emerging markets have been nearly four times as volatile as foreign direct investment (FDI) flows.³³ Emerging markets will need certain structures and safeguards to reduce their vulnerability to potentially damaging capital flow volatility: (i) sound macroeconomic and prudential policies (ii) deeper domestic financial markets and (iii) better monitoring of capital flows.

When countries are confronted by volatile capital flows, the first line of defence should be sound domestic macro and macro prudential policies. In certain cases, they could consider using temporary policies that directly affect capital flows ("capital flow management measures") although such policies should not be used to maintain undervalued exchange rates.

A deepening and broadening of domestic financial markets can also help countries better absorb capital inflows and enable an efficient allocation of funds to productive uses in the real economy. This includes local currency debt. A more diversified domestic investor and instrument base including institutional investors and simple and transparent securitisation markets further reduce risks.

The traditional advice to emerging markets on capital flow volatility has been to "keep your own house in order" by reforming domestic institutional frameworks and so stabilising capital flow "pull" factors.³⁴ Emerging markets have made good progress here. This has protected against external forces outside of their control — capital flow push factors. But push shocks have been amplified by underlying changes in the global financial system, including the structural shift from bank to market-based finance.³⁵

Much of the increase in emerging markets' external debt since the global financial crisis has come from portfolio debt, which is volatile.³⁶ In addition, market-based cross-border capital often comes from non-bank financial companies. These usually fall outside the regulatory scope. There is a need for an increased understanding and ability to manage such flows.

A final backstop, to avoid currency crises, is provided by the Global Financial Safety Net (GFSN) — consisting of IMF loans, regional financial arrangements and bilateral swap lines.³⁷ There is a risk that financing of the IMF — the only truly multilateral lender of last resort to the global financial system — could decline over the next decade while demands on it increase.³⁸ Given the likely growth of emerging markets, global gross external liabilities could double in dollar terms by 2030.³⁹

Deep supervisory co-operation

Deep supervisory co-operation will be an important element of strong international co-operation. The Bank has a long history of building and maintaining relationships with overseas supervisory authorities. Supervisory colleges such as crisis management forums and established resolution mechanisms play a valuable role in the supervision of internationally active financial institutions.⁴⁰ And they will continue to be a key element in fostering international co-ordination.

Going forward, they will have to engender even greater collaboration to increase information sharing to manage cross-border challenges to financial stability. The UK is home to four and hosts more than 26 globally systemically important banks. So the Bank already participates in major supervisory colleges which are key to achieving this goal.

Green standards

The Bank may also wish to take a more active role in promoting greater international co-operation on implementing standards for green finance. At present, standards for what constitutes “green finance” are high-level, fragmented and voluntary. There has been a proliferation of private sector entities providing green labels, each with their own taxonomies, frameworks and methodologies.

Loosely constructed, unenforceable standards and definitions can lead to “greenwashing”, especially when coupled with economic incentives. This would mislead investors, undermine confidence in the market and hinder the growth of green finance.

A number of developments could be helpful to support the growth of this market including: clear, granular standards of what is classified as green and brown; robust and harmonised certification and verification methods; transparency on the use of proceeds and independent audit mechanisms and; consistent rating methodologies on the “green-ness” of bonds.

RECOMMENDATIONS

<p>4.1 Champion global standards</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> Over the next decade emerging market economies will play a more central role in the global economy and global financial system. They are also likely to continue to open up their capital accounts. This brings significant opportunities but also new risks to financial stability, both in the UK and globally.
	<p>What can the Bank (and others) do? The Bank should:</p> <ul style="list-style-type: none"> Promote strong public sector standards and deep supervisory co-operation, including through maintaining and optimising influence in forums such as the Financial Stability Board, the Basel Committee on Banking Supervision and the International Monetary Fund. Convene and catalyse private sector standards through discussions on road blocks to more effective finance, particularly in post-trade and deepening supervisory co-operation. A good place to start would be the swap and collateral markets along the lines of the International Swaps and Derivatives Association common domain protocols. The Fixed Income, Currencies and Commodities Markets Standards Board can play a useful role on this.
<p>4.2 Engage on the evolving needs of emerging markets</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> As emerging market economies continue to grow the UK as a global financial centre has an opportunity to share in the growth of emerging markets. It may also help meet the investment needs that will be required for a transition to a low-carbon economy given its strong history of innovating to serve international clients.
	<p>What can the Bank (and others) do? The Bank should:</p> <ul style="list-style-type: none"> Continue to engage internationally to explore ways in which the UK, as a global financial centre can use its expertise to meet the needs of international markets. This includes through providing green finance, greater insurance for cyber-risk and offshore local currency bonds.

4.3 Engage with future of financial services initiatives

Why does the Bank need to act?

- The confluence of a number of factors may lead the current or any future government to wish to explore the competitiveness and shape of the UK financial sector in the decade ahead — similar to the Darling-Bischoff report from 2009.⁴¹
- Brexit poses numerous challenges to businesses and the financial system. It has driven many firms to re-evaluate the UK as their choice for future jobs and investment.
- Fintech is a significant opportunity for the UK economy and the jobs of tomorrow. In addition, after a decade of regulatory reform nears its end, it is important to re-assess whether rules work as intended, are as efficient as possible and don't create unintended consequences. The recent reviews in the US of financial regulation also contain many useful ideas for modest recalibrations to make the system more efficient.

What can the Bank (and others) do?

The Bank should:

- Contribute within the scope of its mandate, if the Treasury wants to explore pro-growth changes to financial services regulation and other policies to be a competitive vibrant centre of financial services and be a leader in fintech, not least as Brexit choices become clearer.

ENDNOTES

- 1 International Monetary Fund, World Economic Outlook Database, October 2018.
- 2 www.statista.com/statistics/298370/uk-financial-sector-total-financial-services-employment/.
- 3 www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/datasets/3tradeinservicesthepinkbook2016.
- 4 *Staying Connected*, speech given by Mark Carney, Markets Forum, May 2018.
- 5 www.bis.org/statistics/b1.pdf.
- 6 *New Economy, New Finance, New Bank*, speech given by Mark Carney, The Mansion House, June 2018.
- 7 <http://data.imf.org/?sk=B981B4E3-4E58-467E-9B90-9DF0C3367363&slid=1424963554286>.
- 8 International Monetary Fund, World Economic Outlook Database, October 2018.
- 9 *Pull, Push, Pipes: Sustainable Capital Flows for a New World Order*, speech given by Mark Carney, Institute of International Finance Spring Membership Meeting, June 2019.
- 10 International Monetary Fund, World Economic Outlook Database, October 2018.
- 11 <https://datacatalog.worldbank.org/dataset/world-development-indicators>.
- 12 http://web.pdx.edu/~ito/Chinn-Ito_website.htm.
- 13 IIF Global Debt Monitor Database.
- 14 IIF Global Debt Monitor Database.
- 15 www.ecb.europa.eu/pub/economic-bulletin/focus/2018/html/ecb.ebbox201808_01.en.html.
- 16 *Sustainable Finance Progress Report*, UNEP, (2019).
- 17 *Climate Bonds Initiative, Green Bond Pricing in the Primary Market January-June 2019*.
- 18 Based on IMF projections 2019–23 of GDP at market prices from the World Economic Outlook, October 2018 and assuming growth rates 2024–30 remain at 2023 levels.
- 19 *Pull, Push, Pipes: Sustainable Capital Flows for a New World Order*, speech given by Mark Carney, Institute of International Finance Spring Membership Meeting, June 2019.
- 20 www.statista.com/statistics/270452/united-kingdoms-share-of-global-gross-domestic-product-gdp/.
- 21 IMF IFS and Bank calculations.
- 22 *Global Warming of 1.5°C*, IPCC, (2018).
- 23 *Green Finance and Investment: Mobilising resources for sustainable development and climate action in developing countries*, OECD, (2017).
- 24 www.lseg.com/resources/media-centre/press-releases/icbc-london-lists-1-58bn-equivalent-green-bond-london-stock-exchange-green-bond-segment.
- 25 www.bankofengland.co.uk/financial-stability.
- 26 See for example: www.imf.org/en/About/Factsheets/IMF-Surveillance.
- 27 <https://g20.org/en/>.
- 28 *Prudential bank regulation: present and future*, speech given by Vicky Saporta, Westminster Business Forum, 4 July 2018.
- 29 www.globalfxc.org/fx_global_code.htm.
- 30 <https://fmsb.com/>.
- 31 *Data Standardization: A Call To Action*, Regulatory Policy Insights, JP Morgan Chase, (2018).
- 32 *Data Flows Across Borders: Overcoming Data Localization Restrictions*, Institute of International Finance (IIF), (2019).
- 33 IMF IFS and Bank calculations.
- 34 *Pull, Push, Pipes: Sustainable Capital Flows for a New World Order*, speech given by Mark Carney, Institute of International Finance Spring Membership Meeting, June 2019.
- 35 *Transforming Shadow Banking into Resilient Market-based Finance*, FSB, 2015.
- 36 *Pull, Push, Pipes: Sustainable Capital Flows for a New World Order*, speech given by Mark Carney, Institute of International Finance Spring Membership Meeting, June 2019.
- 37 *Stitching together the global financial safety net*, Bank of England Financial Stability Paper No. 36, Denbee et al (2016).
- 38 *Pull, Push, Pipes: Sustainable Capital Flows for a New World Order*, speech given by Mark Carney, Institute of International Finance Spring Membership Meeting, June 2019.
- 39 IMF IIF for gross external liabilities, IMF WEO for GDP growth, World Bank for population projections and Bank calculation.
- 40 www.bankofengland.co.uk/prudential-regulation/policy.
- 41 *UK international financial services — the future: A report from UK based financial services leaders to the Government*, (2009).

5 PROMOTE THE SMOOTH TRANSITION TO A LOW-CARBON ECONOMY

THE OUTCOME WE SEEK

A smooth transition to a low-carbon economy through mainstreaming climate-related disclosures, launching climate stress tests and promoting climate risk management.

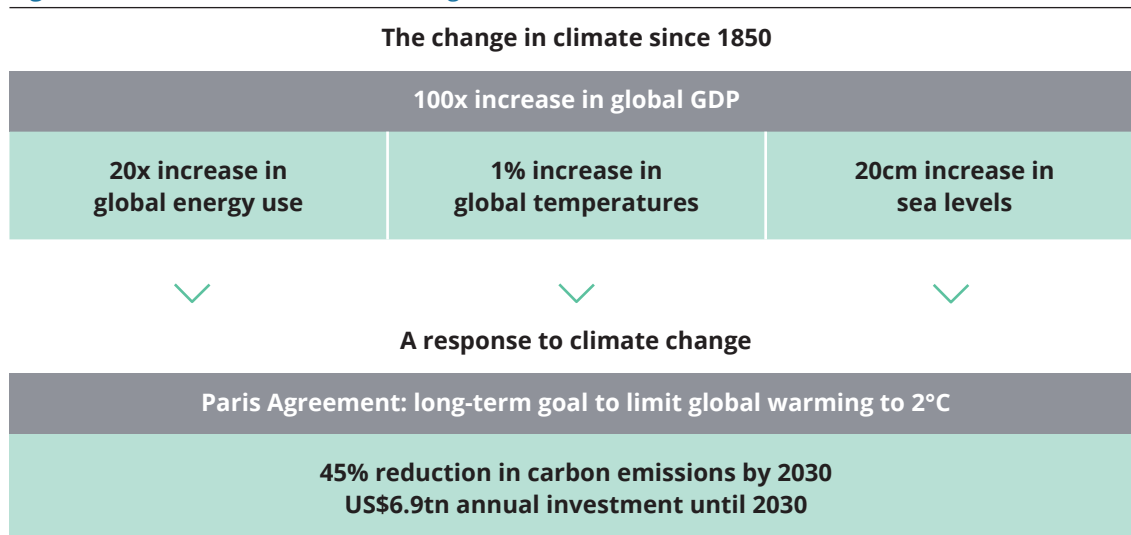
- Climate change poses risks to financial stability and threats and opportunities for firms. An earlier and smoother adjustment to a low-carbon economy can help mitigate this.
- Achieving the Paris Agreement's 2°C target requires huge investment in infrastructure that can only be made possible by mobilising public and private finance.
- Better disclosure of climate-related risks is necessary to steer investment towards initiatives that reduce the world's dependency on fossil fuels and promote investment in energy efficiency.

KEY DEVELOPMENTS

Industrialisation has brought an exponential increase in global growth and prosperity since 1850.¹ Yet the benefits have come at a significant cost to the environment.

Energy usage has gone up 20 times. We're seeing the highest rate of atmospheric CO₂ for hundreds of thousands of years. Surface temperatures have increased by 1°C and sea levels are 20cm higher. Unchecked, this trend will present grave threats to the environment, the economy and financial stability (**Figure 1**).

Figure 1: Industrialisation has had a negative effect on the environment



Source: [Annex to the Ladybird Expert Guide on Climate Change](#), HRH The Prince of Wales et al., British Antarctic Survey. Data compiled from a wide range of sources, Bank (2018).

To mitigate this impending climate tragedy, decisive action is needed. In 2015, 197 governments met in Paris and formed the Paris Agreement.² They committed to keep warming to well below 2°C and to strive to limiting it to no more than 1.5°C (**Box 1**).³

Achieving the 2°C goal of the Paris Agreement will require significant public policy interventions, changes in individual lifestyles, and companies adapting their business models and investment choices. This presents an unprecedented collective action problem with many risks and opportunities that will shape the new economy. Finance, both public and private, will be needed to fund the transition.

Box 1: The 2015 Paris Agreement

The Paris Agreement was built on various principles including:

- Emissions peaking: The need for greenhouse gas emissions to peak as soon as possible and to then undertake “rapid reductions”.¹ This includes recognising emerging economies will need longer to adjust and that developed economies are expected to make greater and faster reductions.
- Mitigation: Each country has prepared a binding national climate action plan on emissions reduction.² While the sum of these national plans would not be sufficient to limit warming to below 2°C, they provide clarity and a path going forward.
- Adaptation: Increasing the resilience of economies and infrastructure to climate change. Governments have committed to “adaptation planning”, including communicating and co-ordinating their priorities.

- Climate finance, technology and capacity building: Developed countries have committed to mobilise US\$100bn of public finance each year by 2025.³ This is to support developing countries create a Green Climate Fund and facilitate the transfer of “climate-safe technologies”.
- Transparency and global stocktake: Robust transparency measures, an international emissions accounting framework and a global stocktake on progress every five years.

The Paris Agreement came into force in November 2016, and 185 of the 197 parties have ratified it in their national legislation.⁴

In 2018, the Intergovernmental Panel on Climate Change (IPCC) concluded that countries needed to take unprecedented action to limit temperatures to 1.5°C above pre-industrial levels within the next decade.⁵

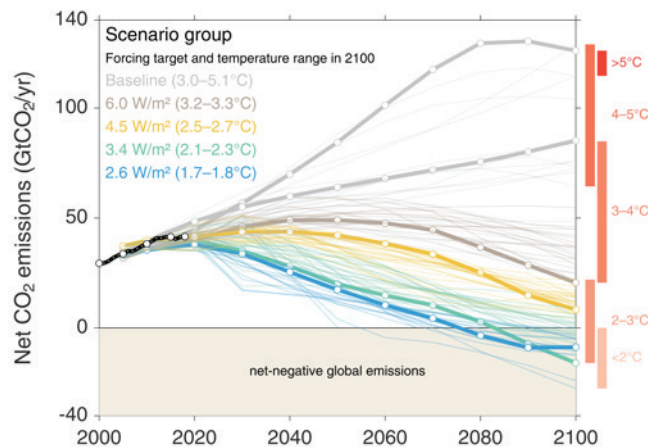
- 1 See www.ec.europa.eu/clima/policies/international/negotiations/paris_en.
- 2 See www.unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement.
- 3 See www.unfccc.int/news/finale-cop21.
- 4 See www.unfccc.int/process/the-paris-agreement/status-of-ratification.
- 5 Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments, IPCC, (2018).

LOOKING TO THE FUTURE

A low-carbon economy is an economic and environmental imperative.

The case for action is compelling (**Figure 2**). For the economy, failure to act could be catastrophic with the potential for more extreme weather events, widespread resource degradation and shortages. It could cause damage to land, property and physical capital. And it may lead to volatile migration flows and disruption to supply chains.

Figure 2: CO₂ emissions curves could vary widely



Source: Global Carbon Project. Data: SSP Database (IIASA)/GCP.

The economic impact of more frequent and extreme weather events is devastating for advanced and emerging economies alike. Extreme weather events totalled US\$160bn of losses globally in 2018 according to one estimate.⁴ Where these losses are not insured, as often is the case in emerging economies, they directly damage the financial wellbeing of citizens and businesses.

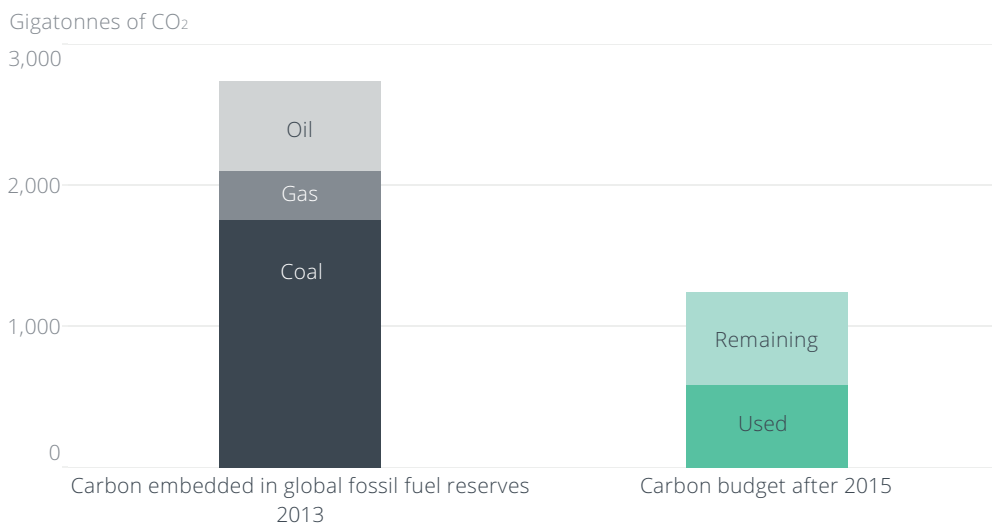
Risks to financial stability

It is increasingly recognised that climate change can pose risks to financial stability and the safety and soundness of financial firms, particularly through two channels:

1. **Physical risks** are caused by damage to assets including property, land and infrastructure from climate and weather-related events.⁵ These can for example be heatwaves, droughts, floods and rises in sea level. The events can cause financial losses, increased insurance claims and impairment to asset values and borrower creditworthiness. Insured weather-related losses have risen from US\$10bn a year in the 1980s to US\$45bn in this decade.⁶
2. **Transition risk** can occur from the adjustment to a lower-carbon economy. Changes in climate policy, technology or market sentiment could prompt a reassessment of the price of many assets as changing costs and opportunities become apparent.⁷ The timing and speed of this repricing is uncertain. It could impact financial stability, particularly if such risks are not reflected in current valuations.

Given the historic reliance on fossil fuels much focus has been on the issue of so-called unburnable carbon (**Figure 3**). This is the embedded valuation of fossil fuel reserves that under new emissions targets may never be allowed to be used.⁸ But in practice this issue goes well beyond fossil fuels, given the scale of the realignment required to support the transition to a low-carbon economy. It is relevant to every sector of the economy. One estimate puts the potential value of the global stock of manageable assets that are at risk between US\$4.2tn and US\$43tn until the end of the century.⁹

Figure 3: The carbon embedded in global fossil fuel reserves is more than double the 2°C carbon budget



Source: Heede and Oreskes, 2016. Rogali et al., 2016.

Note: Carbon budget estimates are uncertain and depend on a number of factors, including the probability with which warming is kept below 2°C; the contribution to warming from non-CO₂ emissions; and uncertainties in climate processes and feedback.

There is growing consensus that an earlier and smoother adjustment to a low-carbon economy will allow risks to financial stability and threats to financial firms to be better managed. However, this requires effective transparency and information from companies and governments on their strategy and progress.

Financing the transition

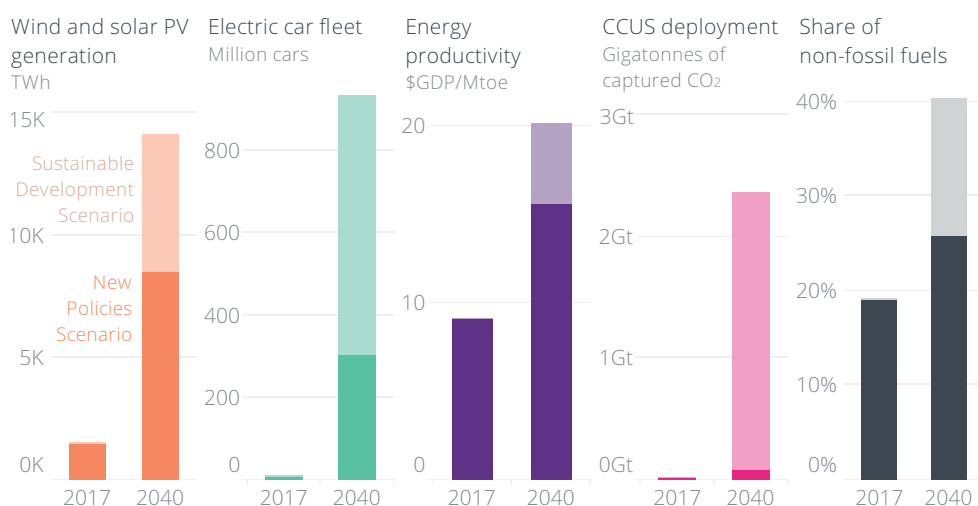
The transition to a low-carbon economy requires support from the financial sector. It must mobilise private finance for projects and infrastructure that reduce carbon emissions.

To achieve the Paris Agreement, carbon emissions must decline by 45% until 2030 from 2010 levels and reach net zero by 2050.¹⁰ To meet this goal, 95% of electricity generation will need to be low-carbon according to the International Energy Agency. Seventy per cent of cars will need to be electric. And the entire building stock in the UK must be fitted with energy saving features to reduce CO₂ emissions from housing by 80%.¹¹

This assumes tremendous investment in infrastructure that requires private and public finance. The Organisation for Economic Co-operation and Development (OECD) estimates it could take more than US\$90tn in investment in total between 2016 and 2030.¹² This is almost five times the annual GDP of the USA.

Capital will especially need to be redirected from carbon-intensive projects to initiatives that reduce the world's dependency on fossil fuels (**Figure 4**). And emerging economies will need to spend the most. While this demands a striking financial mobilisation and capital reallocation, it also presents opportunities for the financial sector to develop new products and services.

Figure 4: The need for low-carbon energy will increase significantly



Source: World Energy Outlook 2018, International Energy Agency.

The pathway forward — barriers and frictions to be addressed

Policy responses are needed to resolve barriers and ease frictions for an earlier and smoother adjustment to a low-carbon economy and to mobilise investment. Some of the most significant barriers include:

Lack of understanding and awareness

The market's perception of the relative rates of return on carbon-intensive assets and those funding emission reductions in part reflects a lack of understanding of the financial risks from climate change.¹³ Firms still need to recognise that climate change-related risks should be seen as part of financial risk management. Instead they are often regarded through a narrow lens such as corporate social responsibility. The timespan for corporate lending of three to five years may be too short to warrant greater consideration of climate factors.

Information shortages

The lack of understanding comes with an information shortage. Financial markets are not sufficiently aware of the risks of ignoring climate change. This is partly because recipients of finance do not disclose enough information for an appraisal of the risks. It is compounded by the absence of standardised measures of carbon intensity for specific assets.

Tragedy of the horizon

In a 2015 speech, the Governor of the Bank of England, Mark Carney, coined the term “the tragedy of the horizon”.¹⁴ It describes how financial markets can be too focused on short-run profit maximisation to consider the long-term impact. This can be driven by many factors including: risk appetite, investment horizons, and the need to match investment and funding profiles. Overall, this can result in the negative effects of climate change being seen as relevant only well beyond normal business planning horizons.

Disclosure — breaking down barriers to better informed investment

Asset allocators and institutional investors are seeking to integrate environmental factors into their investment processes. Demand is growing. In 2018, US\$760bn of investment flowed into sustainable funds across the US and Europe, up from US\$453bn in 2013.¹⁵ In the US alone, more than 100 new sustainable mutual funds were launched between 2015 and 2017.

But markets need more and better information to work properly. In particular, investors need companies to produce more consistent and comparable information mainstreamed in company reporting.

Better disclosure is especially important with institutional investors looking to alternative investments and longer-term infrastructure projects for returns because of low interest rates. The economies of scale that passive investing offers are also leading to “barbell” asset allocations, meaning core index portfolios accompanied by high conviction satellite asset allocations.

Climate-related disclosures can be particularly challenging. Measuring and assessing long-term trends, and the interactions between climate science, public policy, economics and financial markets is complex. Making sense of the potential impact of climate change and the strategic response is also difficult due to interconnected global supply chains and a multitude of intersecting legal, regulatory and operating environments.

One feature of climate disclosures has been the number of fragmented schemes, well-intentioned but lacking comparability and consistency. 7 in 10 asset managers say the lack of high-quality information is the biggest challenge in adopting sustainable principles.¹⁶ And the growth in, potentially piecemeal, disclosure schemes may slow adoption.

The International Trade Centre reports at least 230 corporate sustainability standards initiatives in over 80 sectors.¹⁷ There are nearly 400 initiatives with varying status, scope, methodologies and ambition.¹⁸ Over 90% of FTSE 100 companies and more than 80% of Fortune 500 companies are members of one of these schemes.

In response, the G20 finance ministers and central bank governors asked the Financial Stability Board to consider this issue. The FSB established the Task Force on Climate-related Financial Disclosures (TCFD) in 2015 (**Box 2**). Its G20 member states account for over 85% of global emissions.

Box 2: FSB Task Force on Climate-related Financial Disclosures

In 2015, G20 finance ministers and central bank governors asked the Financial Stability Board (FSB) to convene public and private sector participants¹ to review how the financial sector can take account of climate-related issues.

The review identified the need for better information to support informed investment, lending, and insurance underwriting decisions and to improve understanding and analysis of climate-related risks and opportunities. The FSB established the industry-led Task Force on Climate-related Financial Disclosures (TCFD) to identify which information was needed. It published voluntary, consistent, climate-related financial disclosures that would be useful to investors, lenders, and insurance underwriters in understanding material risks in 2017.²

The TCFD's recommendations span governance, strategy, risk management and metrics and targets. They were designed to be applicable to both financial and non-financial institutions

across sectors and geographies.

The recommendations were based on several key features including: (i) they should be adoptable by all organisations, (ii) provide useful, forward-looking information on financial impacts, (iii) bring the “future nature of issues into the present through scenario analysis”, (iv) present a strong focus on both the risks and opportunities of the transition to a low-carbon economy.³

The TCFD is supported by over 700 global companies with a market capitalisation of more than US\$9tn and is endorsed by financial institutions managing over US\$110tn in assets.⁴ This includes three quarters of the globally systemic banks, eight of the top 10 global asset managers, and leading insurers and pensions managers from across the globe.⁵ Twenty-three per cent of UK companies are expected to report in line with TCFD recommendations in 2019.⁶

TCFD recommendations

Governance	Strategy	Risk management	Metrics and targets
Disclose the organisation's governance around climate-related risks and opportunities	Disclose the actual and potential impacts of climate-related risks and opportunities on the organisation's businesses, strategy and financial planning where such information is material	Disclose how the organisation identifies, assesses and manages climate-related risks	Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material

1 See www.fsb.org/work-of-the-fsb/policy-development/additional-policy-areas/climate-related-financial-disclosures/.

2 Recommendations of the Task Force on Climate-related Financial Disclosures, FSB, (2017).

3 Task Force on Climate-related Financial Disclosures: Overview of Recommendations, FSB, (2017).

4 TCFD: 2019 Status Report, FSB, (2019).

5 A New Horizon, speech by Mark Carney, European Commission Confere: A global approach to sustainable finance, (2019).

6 See www.carbontrust.com/news/2019/01/two-thirds-of-major-uk-companies-to-incorporate-climate-change-risks-and-opportunities-in-this-year-s-annual-reporting/.

Broad adoption of the TCFD recommendations is based on supply and demand, which is helping to create a virtuous circle of disclosure. “Suppliers” of disclosures have emerged covering every geography and sector, from consumer goods to oil and gas majors, from auto manufacturers to technology companies. Alongside, investors are increasingly asking for, and using, TCFD information. The TCFD's status reports on implementation published in 2018 and 2019 generate encouraging evidence on uptake increasing from the first to the second round of reviewed company reports.

But the overall adoption is still low and disclosure can improve. Firms publish climate-related information in a variety of different reports, which often lack appropriate information about the financial implications of the cited climate risks. Additionally, disclosures vary across industries and regions which does not always ensure they are aligned with the TCFD recommendations.

More also needs to be done to enhance awareness. The TCFD has established a range of materials and support networks to help companies implement the recommendations, share experience and securing progressive improvements in their disclosures.

There may be a good case for making disclosures mandatory in the UK company reporting framework, as adoption broadens, quality improves and experience increases. This would ensure consistent and comparable practice and equip markets with the necessary information. As **Box 3** indicates, some countries have already made aspects of climate reporting mandatory.

Box 3: French energy transition law

In August 2015, France passed the Energy Transition for Green Growth Law.¹ Under Article 173, asset owners and managers have to report on how physical and transition risks impact their activities and assets. The law helps to create a co-ordinated framework for policy action by linking disclosure to the broader efforts to decarbonise the energy sector.

While most other jurisdictions have taken a voluntary disclosure approach, Article 173 creates a mandatory approach while giving firms leeway in how they disclose.² This can help the breadth of disclosure and make sure climate change is on the management team agenda.

1 [Article 173-VI: Understanding the French regulation on investor climate reporting. Forum pour l'investissement responsable. \(2016\).](#)

2 [French Energy Transition Law: Global Investor Briefing. UNEPFI Principles for Responsible Investment. \(2016\).](#)

Other incentives

It is worth adding that incentives are an important driver in addition to increased information. Many banks highlight that they are primarily regulated through risk-weighted assets, which are based on historical information and expert analysis. They do not always take account of longer-horizon forward-looking information such as climate change. And while adjusting the risk weights for exposure to “brown” assets might merit discussion, it would not be easy to operationalise, given the globally agreed approach to setting capital requirements. But some banks like ING are starting to measure and incorporate data on green commercial real estate in the Netherlands, which at the margin can help.¹⁹ This is a topic the Bank may wish to explore and advocate internationally.

IMPLICATIONS FOR THE BANK

The Bank does not have a statutory objective to set or implement environmental, energy or broader economic policy, which is rightfully for the Government. As such, it does not have the mission or mandate to set the course to a low-carbon economy. At all times, the Bank’s supervisory and operational decisions should be based on the economics and financial risk substance of the issues, governed by its mandate. And it should not use the policy tools at its disposal to incentivise specific “green” behaviours from market participants.

Consistent with its duties, the Bank must take steps to ensure systemic risks from climate change are addressed and the safety and soundness of regulated financial institutions upheld. This means making sure risks are properly managed. It requires a strategic approach to account for the distinctive features of climate risks. These features arise from the breadth of industries and geographies, the magnitude of the impact climate-related events can have on the economy and their foreseeable nature. Most importantly, short-term actions today are determining the size of future impacts.²⁰ So the uncertain time horizon of climate risks needs to be brought into traditional business planning cycles. **Box 4** outlines the work the Bank has already done to meet the need for strategic action.

Box 4: The Bank's response to the financial risks from climate change

The Bank has enhanced its understanding of physical and transition risks from climate change through detailed reviews of the impact on insurers and banks.¹ It considers that an early adjustment to a low-carbon economy will be lower risk. The costs and potential for threats to financial stability from transition risks can be reduced by pulling this process forward. Consistent, comparable and timely information, which allows a broad range of stakeholders to assess the risks and opportunities from the transition will catalyse this adjustment.

The Bank's mission as to micro-prudential regulation is to promote the safety and soundness, and the protection of benefits for insurance policyholders, of firms regulated by the Prudential Regulation Authority (PRA). A PRA survey established that financial risks from climate change tend to be beyond firms' usual planning horizon of roughly four years.² Even where these may crystallise in full over longer time, their effects are becoming apparent now. Almost three quarters of banks surveyed are starting to treat them as financial risks. The PRA has published supervisory expectations that firms manage the far-reaching and foreseeable risks from climate change as part of a strategic approach.³ These span governance, risk management, disclosure and the use of scenario analysis as a tool.

To advance the financial sector's approach to climate risks, the PRA and the Financial Conduct Authority (FCA) created the Climate Financial Risk Forum.⁴ Combining the expertise from a group of regulated firms, it aims to develop best practice approaches to identifying, mitigating, and managing these risks. The forum will also seek to support innovation for financial products and services in green finance.

The PRA's work informs the Financial Policy Committee's (FPC) efforts to identify, monitor and remove or reduce systemic risks to protect and increase the resilience of the UK's financial system. The FPC is exploring whether climate-related factors should be included in the biennial exploratory scenario (BES) stress test.

The Bank also recognises that climate change is a global issue that requires global solutions.⁵ It has worked with other regulators and central banks across the world to ensure consistent approaches to managing these risks. It is an active member of the Sustainable Insurance Forum and a founding member of the Network for Greening the Financial System.⁶ As part of these, it has convened conferences with over 100 attendees from different central banks, financial firms, academics, and NGOs to further the thinking on important issues such as the use of scenario analysis. It also supports global initiatives such as the G20's Sustainable Finance Study Group and the TCFD.

- 1 [The impact of climate change on the UK insurance sector: A Climate Change Adaptation Report by the Prudential Regulation Authority, \(2015\).](#)
- 2 See www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/report/transition-in-thinking-the-impact-of-climate-change-on-the-uk-banking-sector.pdf.
- 3 See www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/supervisory-statement/2019/ss319.pdf?la=en&hash=7BA9824BAC5FB313F42C00889D4E3A6104881C44.
- 4 See www.bankofengland.co.uk/news/2019/march/first-meeting-of-the-pra-and-fca-joint-climate-financial-risk-forum.
- 5 [Open letter on climate-related financial risks, Governor of Bank of England Mark Carney, Governor of Banque de France François Villeroy de Galhau and Chair of the Network for Greening the Financial Services Frank Elderson, \(2019\).](#)
- 6 See www.bankofengland.co.uk/climate-change.

RECOMMENDATIONS

<p>5.1 Advance the adoption of climate change disclosure</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • Better data can improve the analysis of the risks and opportunities of climate change. Disclosure plays an important role in allowing the market to assess exposures and determine a strategic response. The TCFD has outlined a voluntary disclosure framework to help investors and others understand how reporting organisations assess climate risks and opportunities. The Bank has been vocal supporters of the TCFD, recognising its role in enabling the private sector to assess these.
	<p>What can the Bank (and others) do? The Bank should:</p> <ul style="list-style-type: none"> • Encourage widespread adoption of the Task Force on Climate-related Financial Disclosures' (TCFD) recommendations. • Monitor climate-related disclosures among supervised firms. • Work with the Department for Business, Energy and Industrial Strategy and relevant authorities to explore the merits of making climate-related financial disclosures mandatory in mainstream financial disclosures, ideally within five years. • Consider climate disclosure for its own operations.
<p>5.2 Embed climate risk management</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • If firms are to assess and manage the risks from climate change adequately, they need a forward-looking, strategic approach. It must account for the long-term nature of climate risks and recognise the impact of today's decisions. Firms should incorporate the risk assessment of climate change into their risk management frameworks and governance structures. • Firms should also hold financial resources against these risks where they are material in line with the prudential capital regime. This will require them to look beyond their capital planning horizon towards the longer term where losses are likely to occur.
	<p>What can the Bank (and others) do? The Bank should:</p> <ul style="list-style-type: none"> • Ensure that the firms the Bank supervises are embedding scenario analysis in their risk management. • Engage internationally to develop templates for scenario analysis. • Facilitate the sharing of best practices in the management of climate-related financial risks. • Include a new climate-risk scenario for the Biennial Exploratory Scenario (BES).

ENDNOTES

- 1 [Annex to the Ladybird Expert Guide on Climate Change](#), HRH The Prince of Wales et al., British Antarctic Survey, Data compiled from a wide range of sources, (2018).
- 2 [The Paris Agreement](#), UNFCCC, (2015).
- 3 See www.unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf.
- 4 [The natural disasters of 2018 in figures](#), Munich Re, (2019).
- 5 [Enhancing banks' and insurers' approaches to managing the financial risks from climate change](#), PRA Supervisory Statement SS13/19, (2019).
- 6 [The Bank of England's response to climate change](#), Bank of England Quarterly Bulletin 2017 Q2, (2017).
- 7 [Transition in thinking: The impact of climate change on the UK banking sector](#), PRA, (2018).
- 8 [The Carbon Bubble: Climate Policy in a Fire-Sale Model of Deleveraging](#), Comerford et al., (2016).
- 9 [The cost of inaction: Recognising the value at risk from climate change](#), The Economist Intelligence Unit, (2015).
- 10 [Global Warming of 1.5°C](#), IPCC, (2018).
- 11 [UK housing: Fit for the future](#), Committee on Climate Change, (2019).
- 12 [Green Finance and Investment: Mobilising resources for sustainable development and climate action in developing countries](#), OECD, (2017).
- 13 See www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/report/transition-in-thinking-the-impact-of-climate-change-on-the-uk-banking-sector.pdf?la=en&hash=A0C99529978C94AC8E1C6B4CE1EECD8C05CBF40D.
- 14 [Breaking the Tragedy of the Horizon - climate change and financial stability](#), speech given by Mark Carney, Lloyd's of London, 29 September 2015.
- 15 [Sustainability: The future of investing](#), Blackrock Global Insights, (2019).
- 16 [Sustainable Signals: Growth and Opportunity in Asset Management](#), Morgan Stanley Institute for Sustainable Investing, (2019).
- 17 See www.intracen.org/itc/market-info-tools/voluntary-standards/standardsmap/.
- 18 [Climate change: The investment perspective](#), EY, (2016).
- 19 See www.ing.com/Newsroom/All-news/ING-will-only-finance-green-office-buildings-in-the-Netherlands-after-2017.htm.
- 20 [A call for action: Climate change as a source of financial risk](#), Network for Greening the Financial Services (NGFS), (2019).

6 ADAPT TO THE NEEDS OF A CHANGING DEMOGRAPHIC

THE OUTCOME WE SEEK

Individuals are empowered to save in an efficient and convenient way across a wide range of investments. This provides a secure income stream in retirement and supports the flow of long-term finance for the economy.

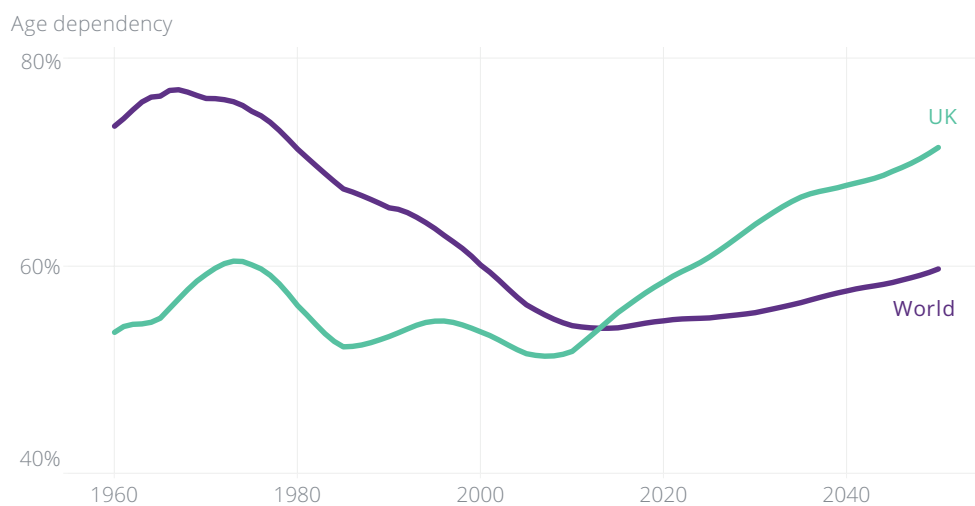
- Individuals are living longer and increasingly have to provide for old age, as traditional state and corporate pension schemes have been transformed.
- As our population ages, it is becoming clear that policy changes will be needed to facilitate greater security in retirement.
- Finance will also need to support major changes in demographics and working patterns as well as the evolving needs of savers and borrowers.

KEY DEVELOPMENTS

Ageing society

People are living longer in the UK. By 2030, more than a fifth of the population may be above 65.¹ This could rise to over a quarter in 2050, depending on levels of immigration and advances in healthcare.² As a result, ill health and disability are rising.³ People are also having fewer children, while the working age population is in decline, putting pressure on funding provisions for old age (**Figure 1**). This said, individuals may also be working for longer in the future, offsetting some of the pressure. Advances in technology and productivity could help further.

Figure 1: We are getting older
Age dependency ratio



Source: World Bank.

Note: Age dependency ratio is the ratio of dependents — people younger than 15 or older than 64 — to the working-age population — those ages 15-64. Data are shown as the proportion of dependents per 100 working-age population.

People have to save more to reflect longer retirement periods and costs of long-term care, which are likely to rise. They need access to savings products to accumulate wealth — and products to help ensure a steady income in retirement, “decumulation”.

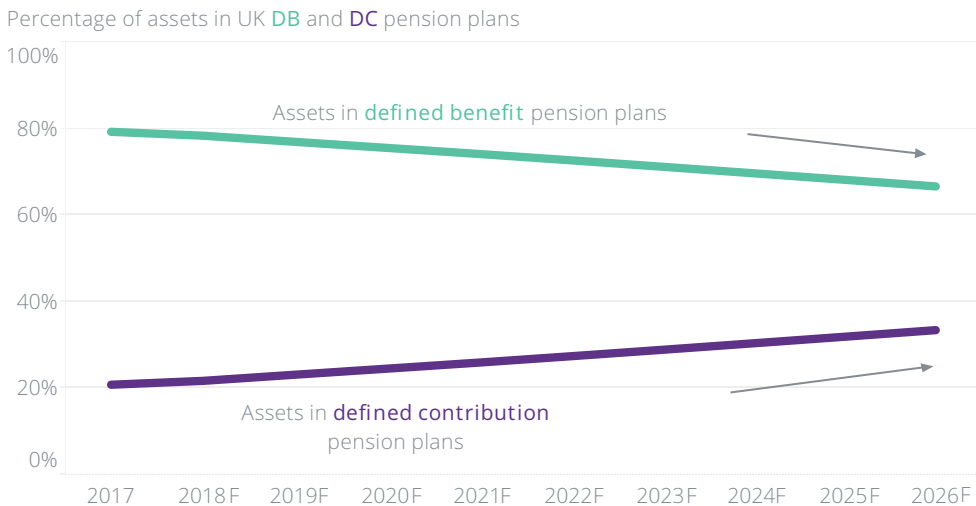
Greater longevity and tax changes mean many firms have switched from defined benefit (DB) to defined contribution (DC) pension schemes in recent years.⁴ But DC schemes provide less certainty over retirement income. Contribution rates to occupational DC schemes are typically lower than for DB schemes. Oliver Wyman suggest that the share of pensions in DC schemes will significantly increase in the next five years (**Figure 2**).

Low expected returns as interest rates remain low make certain mainstream retirement products less viable and appealing. Long-term income is largely backed by lower-risk fixed income assets, including government and corporate bonds. A decade of low yields has had a profound effect on retirement security, including greater liabilities for pension managers.

Many are not saving enough for their retirement. More than seven in 10 adults have no investments. Of those that do, only 35% have in excess of £10,000.⁵ A third of UK adults make no private pension provision. Yet, nearly half of people think they will have the same living standard or higher in retirement. Recent increases in flexible employment are likely to further increase the savings gap. Three million people worked in the “gig” economy in 2017. While flexible/gig economy employment offers a number of benefits to the individual, it does not include employer pension contributions.

Figure 2: UK assets in DC schemes will significantly rise in the next five years

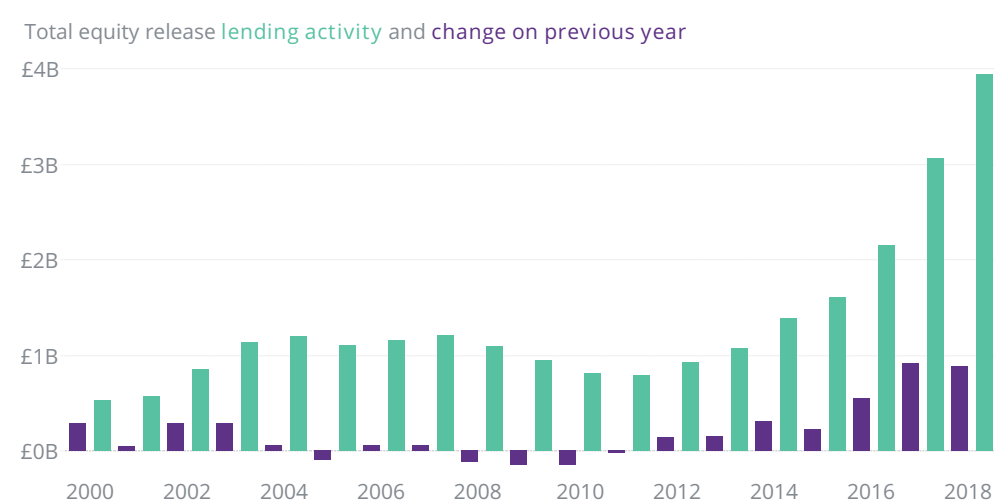
Percentage of assets in UK DB and DC pension plans



Source: Oliver Wyman.

Figure 3: Demand for equity release mortgages has increased to £4bn

Total equity release lending activity 2000–17



Source: Spring Report 2018, Equity Release Council.

Much of wealth in the UK is in housing — almost the equivalent to private pensions, according to the ONS.⁶ In recent years, equity release mortgages (ERMs) that offer an upfront lump-sum payment for a contingent claim on a property have become more common (**Figure 3**).⁷ They provide an income stream from property. An alternative is for individuals to sell their house and downsize. This may be the better option for many people.

LOOKING INTO THE FUTURE

Retirement security is one of the most important financial priorities. It is important that the UK retirement savings market can best accommodate the prospective changes in the need for savings, investment and retirement income. Industry, policymakers and consumer groups all have a role in ensuring that long-term savings products provide the combination of security, affordability, risk-sharing and flexibility that is appropriate to the long-term interests of individuals.

Figure 4: The UK fails to make it into the top 10 on the Natixis Global Retirement Index
Natixis Global Retirement Index (GRI)

Rank #	Country	Health Index	Finances in Retirement Index	Quality of life Index	Material wellbeing Index	Global retirement Index
1	Switzerland	87%	78%	92%	80%	84%
2	Iceland	85%	71%	88%	93%	84%
3	Norway	90%	60%	92%	87%	81%
4	Sweden	89%	67%	90%	71%	78%
5	New Zealand	85%	79%	90%	63%	78%
6	Australia	85%	78%	83%	66%	78%
7	Ireland	82%	71%	83%	73%	77%
8	Denmark	85%	59%	94%	74%	77%
9	Canada	87%	74%	83%	65%	77%
10	Netherlands	90%	58%	83%	80%	76%
11	Luxembourg	92%	62%	80%	73%	76%
12	Finland	81%	63%	93%	69%	75%
13	Germany	86%	57%	83%	79%	75%
14	Austria	86%	54%	87%	76%	74%
15	Czech Republic	72%	69%	75%	82%	74%
16	United States	86%	72%	77%	61%	73%
17	United Kingdom	83%	57%	83%	71%	73%
18	Belgium	83%	59%	80%	71%	73%
19	Israel	76%	71%	78%	63%	72%
20	Malta	77%	67%	69%	73%	71%

Source: Natixis Global Retirement Index 2018.

Demographic and economic trends signal that more needs to be done. The Natixis Global Retirement Index which ranks countries by their level of retirement security puts the UK 17th (**Figure 4**).⁸ Policymakers will have to:

1. Stimulate contributions to retirement savings.
2. Create efficiencies including through larger savings schemes to reduce the costs of investing and widen choice.
3. Ensure products provide a suitable income stream in retirement.
4. Encourage the industry to invest in infrastructure.

The government is already taking steps to encourage more saving. In 2012, it introduced automatic enrolment into employer pension schemes.⁹ This has contributed to a large increase in employees saving through workplace pensions from 47% in 2012 to 73% in 2017.¹⁰ This was accompanied by the introduction of pension freedoms dropping the requirement for individuals to purchase an annuity at retirement.¹¹ But frequent changes in tax treatment have also reduced incentives to save.

Technology can enable better access to and control over savings. A number of fintechs are using well-timed “nudges” to encourage saving among younger adults, including by illustrating their purchasing power in retirement. This gives them greater control over their financial outcomes. In addition, the government is working with the industry to develop an online dashboard for consumers to see an overview of their pensions in one place.¹²

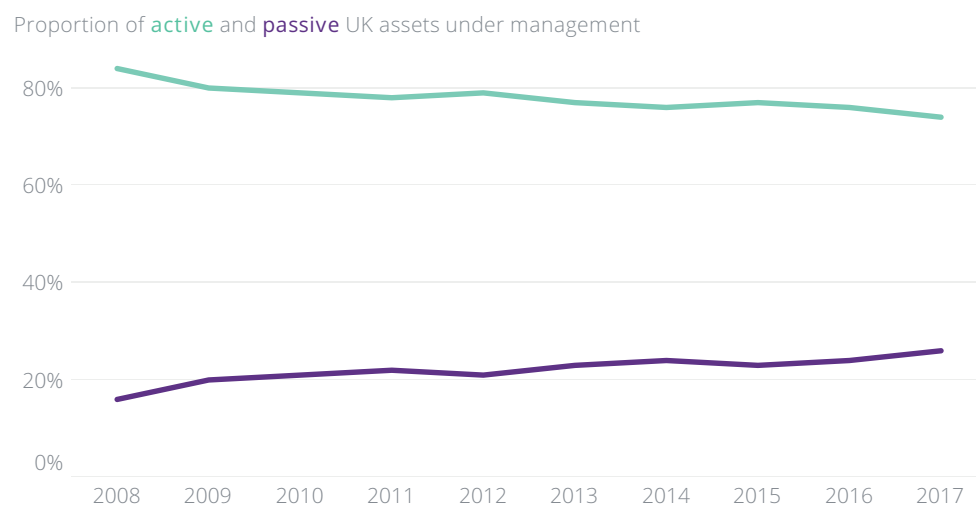
Several government initiatives to consolidate pension schemes are also under way to create greater economies of scale in savings. With current interest rates, it is imperative to reduce costs and maximise returns. The Department for Work and Pensions (DWP) is proposing to create collective DC schemes, enabling savers to pool money into a fund and share risks.¹³ These could take inspiration from models in Sweden, Australia and elsewhere.

The Australian Superannuation system is seen as a leading national retirement income system (**Box 1**).¹⁴ It provides incentives to save, efficiency in investment and viable decumulation products. It is formed of two pillars:

- *Compulsory superannuation*: This ensures a reasonable level of income is saved for retirement. It is set at 9.5%¹⁵ of salary (expected to rise to 12% by 2026) and taxed at a lower rate of 15%.¹⁶ Employers contribute to the scheme.
- *Voluntary contributions*: The scheme provides a tax-assisted means for self-contribution for retirement.

Figure 5: Passive investment is on the rise

Active and passive as proportion of total UK assets under management (2008–17)



Source: Asset Management in the UK 2017–2018, The Investment Association.

Box 1: The Australian Financial Systems Inquiry (the “Murray Review”)

The Australian Financial System Inquiry (the so-called “Murray Review”) was published in 2014.¹ The inquiry evaluated changing demographics and customer preferences and the role and impact of new technologies and market innovations. It also assessed changes in the way Australia sources and distributes capital through banks’ intermediation of savings, non-bank financial institutions, insurance companies, superannuation funds and capital markets.

The review presented 44 policy recommendations to future-proof the Australian financial system. A focus was on how to foster more effective risk-sharing between individuals to provide sustainable retirement incomes to the aging population. It also considered how investment choices would best promote the efficient allocation of capital in the economy and cost-effective services for individuals.

The Australian “super” system provides a holistic approach to encouraging greater savings.² It is funded through employer, personal and government contributions. Money deposited into the super fund is invested by the fund’s trustee. Upon retirement, it is usually converted into a pension.³ Funds can also offer a simple, low-cost default superannuation product called MySuper,

which improves simplicity and transparency and allows comparison.⁴

MySuper has rules for fund governance and transparency and restricts how advice is given and paid for. It provides a default investment option with a minimum level of insurance cover and a short list of allowable fee types.

The superannuation system plays an important role in providing long-term funding for economic activity in Australia. It has grown rapidly in the past 20 years, with assets standing at AUS\$2.7 trillion by 2018.⁵ Superannuation assets are generally expected to outgrow those of the banking system over the next few decades.⁶

This attests to the effectiveness of the scheme in:

- incentivising higher savings;
- creating efficiencies in investment;
- providing a suitable income stream in retirement; and
- funding long-term investment for the economy.

Changes to the UK pensions system might do well to target similar areas for reform.

1 [Financial System Inquiry: Final Report, Australian Government, \(2014\).](#)

2 See http://strongersuper.treasury.gov.au/content/publications/information_pack/downloads/information_pack.pdf.

3 See [www.ato.gov.au/super/self-managed-super-funds/paying-benefits/lump-sum-and-income-stream-\(pension\)/](http://www.ato.gov.au/super/self-managed-super-funds/paying-benefits/lump-sum-and-income-stream-(pension)/).

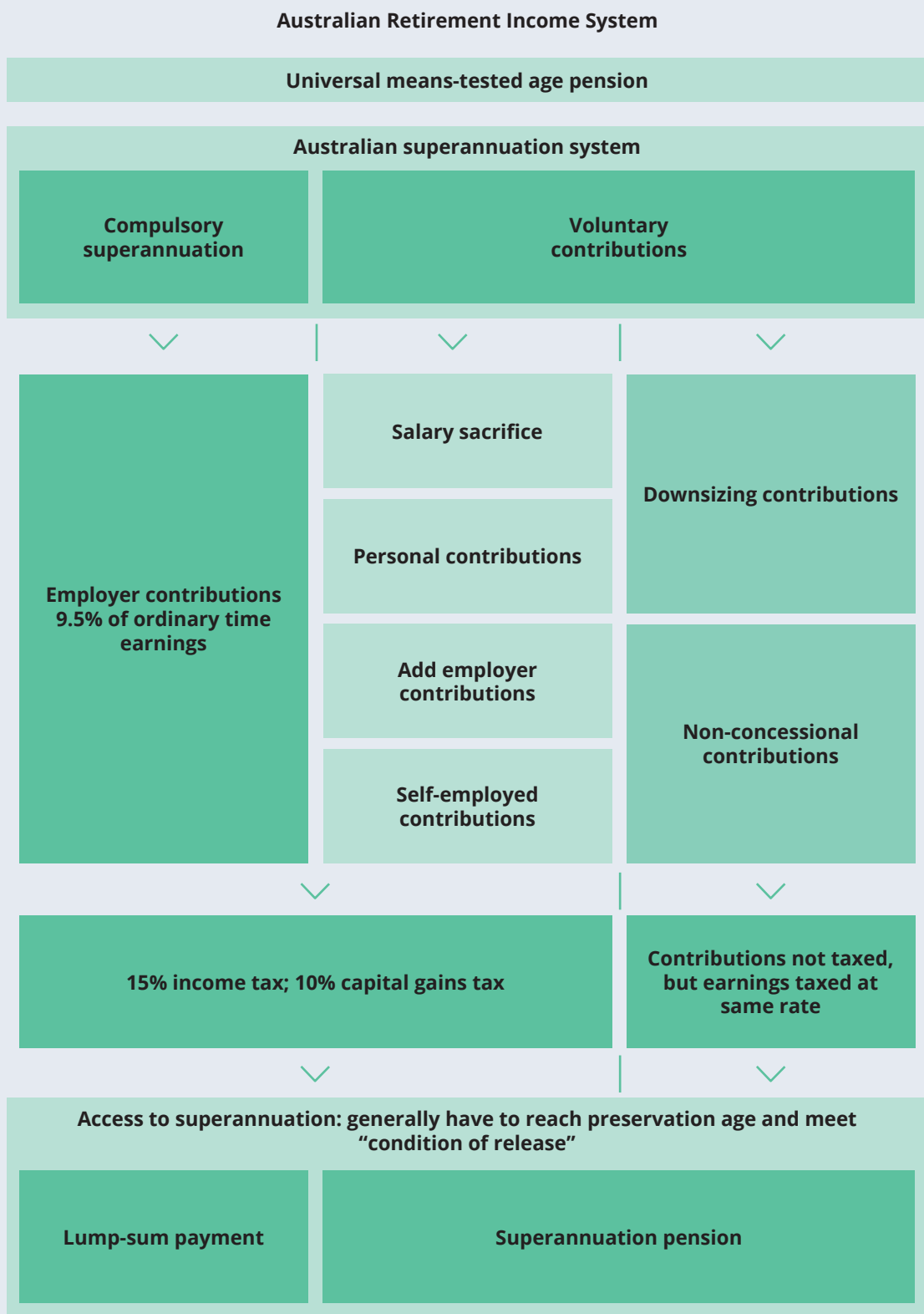
4 See http://strongersuper.treasury.gov.au/content/publications/information_pack/downloads/information_pack.pdf.

5 “Superannuation Statistics”, The Association of Superannuation Funds of Australia, (2017).

6 [Financial System Inquiry: Final Report, Australian Government, \(2014\).](#)

Box 1 continued: The Australian Financial Systems Inquiry (the “Murray Review”)

Figure 6: Illustrative view of Australia’s Superannuation System



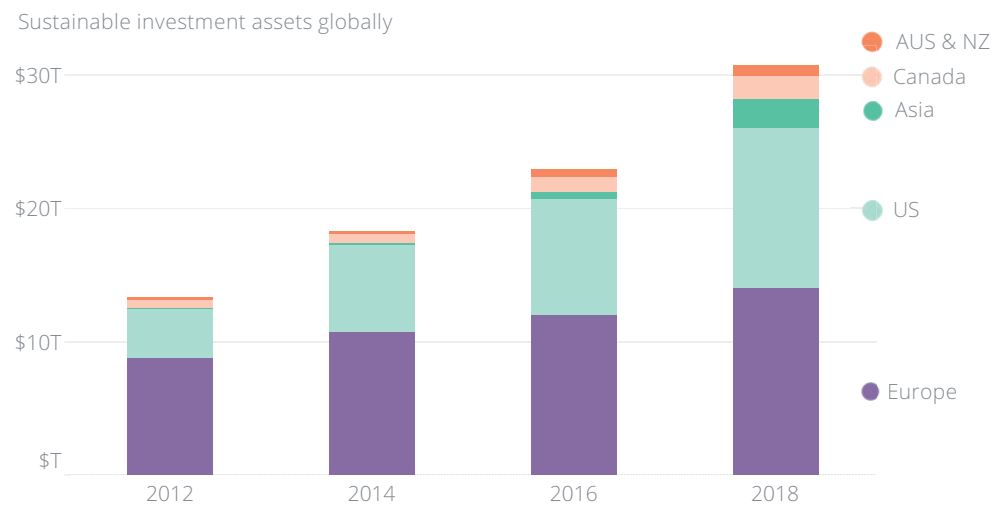
Sources: ASIC, Australian Government Productivity Commission and Oliver Wyman.

Shifting models

Insurers and asset managers are responding to client needs by using technology to improve efficiency, and returns, and to offer greater control and choice. Almost a quarter of UK-managed assets are passively managed, up 17% from a decade ago (**Figure 5**, excluding insurers). Index-tracking exchange traded funds have risen in recent years, providing lower-cost investment opportunities (**Box 2**).

There has furthermore been a shift to more sustainable finance and the integration of sustainable factors into decision-making. More than 6 in 10 institutional investors have changed their approach to voting or incorporated environmental, social and governance criteria in the past 12 months, according to Edelman.¹⁷ And sustainable investment assets globally have increased to more than US\$30 trillion from US\$13 trillion in 2012 (**Figure 7**).

Figure 7: Global ESG investment is on the rise
Sustainable investment assets globally (in \$trn)



Source: The Global Sustainable Investment Alliance, Oliver Wyman. The Global Sustainable Investment Alliance defines sustainable investing in terms of portfolio selection and management reflecting ESG factors, plus investments that are otherwise identified as being socially responsible.

Infrastructure and private assets

Demographic, economic and environmental factors all reinforce the need for infrastructure investment. This would benefit economic growth directly in the near term by boosting activity and indirectly over longer periods by supporting productivity. For example, the OECD estimates that the required infrastructure investment to deliver the Paris Agreement commitment to limit global warming to well below 2% compared to pre-industrial levels may be more than US\$90 trillion in investment, or US\$6.9 trillion annually between 2016 and 2030 on average (see Chapter 5).

Insurers and pension funds play a key role in intermediating savings and investing them in a variety of assets. With their long-term liabilities, pensions and long-term savings products are crucial for supplying long-term finance to the economy. UK insurers held assets totalling around £2 trillion (end-Q1, 2019), of which firms classified £115 billion, or 6%, as infrastructure investments.¹⁸

There is a trend in the insurance industry towards increasing investment in infrastructure. The Solvency II Matching Adjustment encourages long-term investment to back long-term annuities. Insurers have diversified their portfolio away from government and corporate bonds into other direct investments.¹⁹

For pension funds, there has been a movement to de-risk assets so employers have less volatility and uncertainty in their future funding obligations.²⁰ This has happened through off-loading liabilities to insurers and increased hedging against adverse movements in interest rates and inflation. There has also been a shift from higher-risk, higher-return equity to fixed income securities and other investments. In addition, DC pension schemes generally invest through traded funds. These are likely to be more liquid than DB schemes and so favour less investment in illiquid assets, such as infrastructure. More may be done to ensure retail investors can invest in industries of the future and longer-term assets which generate returns.

Box 2: Exchange-traded funds (ETFs)

ETFs have grown rapidly in recent years as technology has democratised access to stock and bond markets.

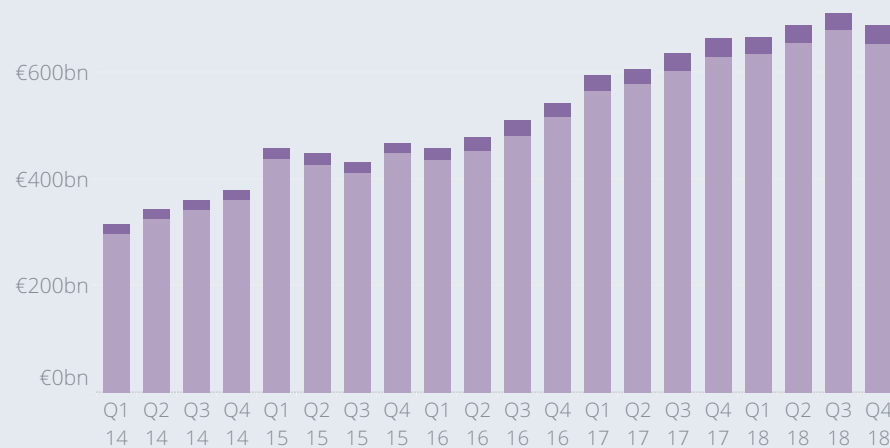
Global ETF assets totalled US\$4.8tn in 2018.¹ Since 2003, they have grown at an annual rate of 23.4%. The majority of growth in assets under management can be attributed to net inflows rather than capital appreciation.² This is driven by a number of factors such as the low cost compared to other investment vehicles, transparency about target tracking indices and pricing, and the promise of intra-day liquidity. Inflows into ETFs and mutual funds were heavily concentrated in those with lower expense ratios in 2017.³ In some countries, ETFs can also be tax efficient.⁴

In Europe, ETF assets totalled US\$761bn in 2018 with somewhat slower growth than in the US.⁵ Retail investors accounted for roughly 15%.⁶

The emergence of ETFs partly reflects a broader shift towards cheaper, passive investment styles that often seek to track a benchmark market index. Without the costs of investment decision-making, the management cost to the investors can be much lower. The Investment Company Institute estimates that index ETFs have an asset-weighted expense ratio of 0.21%,⁷ as compared to active funds which charge 0.76%. They provide a lower-cost investment vehicle that can provide individuals with greater returns in a low-rate environment.

Figure 8: Investment through ETFs has increased in Europe

ETC and ETF



Source: ETF Global Annual Review, Deutsche Bank Research, 2019. ETC: exchange-traded commodities.

- 1 ETF Global Annual Review, Deutsche Bank Research, (2019).
- 2 In *Turbulent Times*, European Institutions Turn to ETFs, Q1 2019, Greenwich Associates, (2019).
- 3 *The implications of passive investing for securities markets*, Sushko et al, Bank for International Settlements (BIS) Quarterly Review, (2018).
- 4 See www.morningstar.com/articles/914893/etfs-are-tax-efficient-but-is-that-sound-policy.html.
- 5 ETF Global Annual Review, Deutsche Bank Research, (2019).
- 6 See www.euroclear.com/newsandinsights/en/Format/Articles/RetailETFs.html.
- 7 *Trends in the Expenses and Fees of Funds, 2018*, Investment Company Institute Research Perspective, March 2019, Vol. 25, No. 1, (2018).

Demographic challenges beyond old age

It is worth noting that an ageing population is far from the only transition in society. Each generation faces particular financial challenges. The younger generations today are saddled with far more student debt than their parents and higher economic uncertainty, including through the rise in the gig and sharing economy among younger adults.²¹ The issue of intergenerational fairness has grown in importance,²² as older generations have enjoyed more secure pensions and a boom in house prices. A series of policy decisions may have further widened the gap between young and old.

The Financial Conduct Authority (FCA) have recently launched their work on intergenerational finance.²³ This is important in light of ever more pressing challenges for the financial services industry to better meet changing consumer needs. It will be key for the Bank to monitor the outcomes of this work and contribute to its objectives where it can provide expertise.

IMPLICATIONS FOR THE BANK

Setting or implementing pension policy is not part of the Bank's objective. It should not use its policy tools to encourage specific investment or savings choices from the market. But as part of its mandate of financial and monetary stability, it should continue to monitor developments in the savings rate.

In macroeconomic terms, an ageing population is likely to save more out of current income, which could depress consumer spending over the medium term, while the increase in savings may put downward pressure on long-term yields. These will be important considerations for the Bank's monetary policy and financial stability objectives.

Through the prudential supervision of insurance firms, the Bank ensures that firms hold adequate levels of financial resources to meet their liabilities. In accordance with the EU legislation relating to the prudential regulation of insurance and reinsurance undertakings, Solvency II, the Prudential Regulation Authority (the PRA):

- Requires a buffer of assets above the value of policyholder liabilities to absorb unexpected losses, including through market moves;
- Allows firms to apply a matching adjustment when valuing certain policyholder liabilities (subject to certain conditions), which can incentivise UK insurers to invest in assets with long-term fixed cash flows to match their annuity liabilities.²⁴

The Bank has shown keen interest in developments around pensions and insurance and monitors and contributes to government initiatives relating to its mandate. The DWP has recently consulted on the consolidation of legacy DB schemes.²⁵ The Bank has responded to the DWP's consultation.²⁶ It highlighted that DB consolidators face similar risks to those managed by insurance companies providing annuities, suggesting they may merit a similar regulatory approach.

The main objective of Solvency II is the protection of policyholders, but the regime also recognises that financial stability and fair and stable markets are other objectives of insurance and reinsurance regulation, which should be taken into account. The Solvency II regime does not aim to eliminate all risk. Similarly, the PRA's two primary objectives are to (i) promote the safety and soundness of all of the firms it regulates and (ii) (specific to its regulation of insurers) contribute to the protection of policyholders, balancing policyholder protection with broader economic considerations.

Insurers need to match their assets and liabilities to ensure that they are able to meet their liabilities as they fall due. This is particularly important in the case of annuity business and other policies with long-term guarantees, which can span many years. The Solvency II Matching Adjustment recognises that insurers with illiquid long-term liabilities (like annuities) may have matching illiquid bonds or other assets with similar cash flow characteristics; and by holding them in maturity they avoid exposure to the risk of changing spreads on those assets. In order to avoid changes of asset spreads from impacting on the amount of own funds of those undertakings, they are allowed to adjust the value of those liabilities to take into account an illiquidity premium. This may incentivise investment in long-term assets, yielding better returns.

The design of the risk margin under Solvency II merits ongoing review. For long-dated insurance risks such as longevity, the margin calculation is sensitive to interest rates. As a result, it is particularly high when rates are low, and particularly low when rates are high. Insurers have responded to current rates by reinsuring longevity risk, for example through offshore vehicles that may not offer the same security. This is undesirable because UK insurers may be over-exposed to offshore reinsurers.

Policymakers should continue to think about how to enable individuals to deal with increased longevity risks. The government's proposed collective DC schemes are a first step to pooling risk. The Bank should also review lifetime income products such as annuities. These mitigate longevity risk and alleviate challenges from managing withdrawals throughout retirement by providing a basic level of income security.

RECOMMENDATIONS

<p>6.1 Consider forces determining security in retirement</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • Policy changes need to facilitate a secure income in retirement as people live longer. As average life spans extend to 83, this means a third may reach the age of 93 and 5% will reach the age of 100. Budgeting for this is incredibly difficult. • Lifetime income products, such as annuities, can help mitigate longevity risk and alleviate challenges from managing withdrawals throughout retirement. Insurers may need to offer decumulation products combined with options to buy annuities if people live to a certain age. • Other markets provide greater ways mitigating and sharing longevity risk. For instance, in the Netherlands individuals bear systematic longevity risk under a collective arrangement but pool idiosyncratic longevity risk.²⁷
	<p>What can the Bank (and others) do? The Bank should:</p> <ul style="list-style-type: none"> • Consider what opportunities finance presents to share longevity risk. • Explore any regulatory impediments to security in retirement, starting with the treatment of risk-sharing products and products that help protect savers from outliving their savings if they live longer.
<p>6.2 Support wider investment choices</p>	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • Pension funds can hold on to very illiquid investments and should be a significant source of “patient capital”.²⁸ • Meanwhile, a growing number of innovative companies are staying in private capital markets for longer, when more risk-seeking investors in DC schemes may want to benefit from the new opportunities these provide.
	<p>What can the Bank (and others) do? The Bank should:</p> <ul style="list-style-type: none"> • Provide its expertise to help challenge firms and authorities to consider what financial products or protections gig and sharing economy employees may need and the implications for firms’ risk management. • Assess how firms are responding to the changing investment desires of younger demographics and whether they are strategically resilient to changing preferences. • Share expertise from climate-disclosure work to help investors develop principles for broader sustainability metrics.

ENDNOTES

- 1 [National population projection: 2016-based](#), Office for National Statistics (ONS), (2017).
- 2 [Overview of the UK population](#), November 2018, Office for National Statistics (ONS), (2017).
- 3 [Living longer: caring in later working life](#), Office for National Statistics (ONS), (2019).
- 4 [Occupational Pensions Schemes Survey, UK: 2017](#), Office for National Statistics (ONS), (2018).
- 5 [The financial lives of consumers across the UK: Key findings from the FCA's Financial Lives Survey 2017](#), FCA, (2018).
- 6 [Wealth in Great Britain Wave 5: 2014 to 2016](#), Office for National Statistics (ONS), (2018).
- 7 See www.ft.com/content/2e33921c-5546-11e9-a3db-1fe89bedc16e.
- 8 [2018 Global Retirement Index](#), Natixis, (2018).
- 9 See <https://www.workplacepensions.gov.uk/employee/>.
- 10 [Employee workplace pensions in the UK: 2018 provisional and 2017 revised results](#), Office for National Statistics (ONS), (2019).
- 11 See www.gov.uk/government/news/over-92-billion-released-by-pension-freedoms.
- 12 See <https://pensionsdashboardproject.uk/>.
- 13 [Collective defined contribution pension scheme inquiry](#), House of Commons, (2018).
- 14 See www.ft.com/content/79be1a82-c3dd-11e7-b2bb-322b2cb39656.
- 15 See www.ato.gov.au/Business/Super-for-employers/How-much-to-pay/.
- 16 See www.moneysmart.gov.au/superannuation-and-retirement/how-super-works/tax-and-super.
- 17 See www.ft.com/content/c742edfa-30be-328e-8bd2-a7f8870171e4.
- 18 Solvency 2 data, Bank calculations.
- 19 [An annuity is a very serious business: Part Two](#), speech given by David Rule, Westminster and City Bulk Annuities Conference, (2019).
- 20 www.ppf.co.uk/sites/default/files/file-2018-12/the_purple_book_web_dec_18_2.pdf.
- 21 See <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN01079>.
- 22 [Select Committee on Intergenerational Fairness and Provision Tackling intergenerational unfairness](#), Report of Session 2017-2019, UK Parliament, (2019).
- 23 [Intergenerational differences](#), Discussion Paper 19/2, FCA, (2019).
- 24 www.bankofengland.co.uk/-/media/boe/files/speech/2019/an-annuity-is-a-very-serious-business-part-two.pdf?la=en&hash=6BF86C21B2C85232A0A22D7D4D36344DF34B4610.
- 25 [Defined benefit pension scheme consolidation](#), Department for Work and Pensions (DWP) consultation, (2018).
- 26 [PRA response to DWP consultation paper: Defined benefit pension scheme consolidation](#), PRA, (2018).
- 27 [The economics of sharing macro-longevity risk](#), Working Paper No. 618, De Nederlandsche Bank, (2018).
- 28 [Patient Capital Review](#), HM Treasury, (2017).

7 SAFEGUARD THE FINANCIAL SYSTEM FROM EVOLVING RISKS

THE OUTCOME WE SEEK

A financial system that innovates to serve its customers better. It should be safeguarded by effective, and dynamic oversight and regulation that support innovation, prosperity and sustainable growth.

- Financial stability supports innovation, prosperity and sustainable growth. And as the financial system evolves and innovates; the Bank's approach to financial stability will need to keep pace.
- New entrants and "unbundling" of the financial services business model may change market structures. Open Banking gives consumers more control over their data. But authorities need to address concerns around liability and operational resilience.
- Market-based finance has brought welcome diversity and choice in funding options. But possible vulnerabilities around liquidity mismatches and investor behaviour need to be understood and managed, particularly following a decade of ultra-low interest rates.

KEY DEVELOPMENTS

Financial stability supports innovation, prosperity and sustainable growth

Financial stability is the reliable and resilient provision of critical financial services for households and the economy.¹ These financial services allow consumers and businesses to make and receive payments, borrow money to invest and grow, save for the future and manage and insure against risks. They support businesses in promoting economic activity, creating employment, and investing in their efficiency and productivity.

Financial crises are extremely costly and have long lasting effects. Research suggests they can cost as much as 75% of annual GDP, equivalent to about £21,000 per person in the UK.² The 2008 "Great Financial Crisis" led to the deepest recession in the UK since the Second World War, with one million more people unemployed, a 5% fall in wages below 2007 levels, and a complete halt in bank lending.

Financial stability supports fertile conditions for innovation.³ This is because stability gives consumers and entrepreneurs confidence to invest and experiment. When coupled with regulation aimed at protecting consumers, it can give businesses confidence to innovate and helps customers feel more secure in using new types of financial services.

Not all innovations are desirable or sustainable. For example, the "financial engineering" that preceded the crisis, was innovation that should have been constrained. It allowed risks to be parceled in highly leveraged, opaque and fragile structures with misaligned incentives that had catastrophic effects for financial stability.⁴ This serves to underline that innovation is essential but can bring new risks and also old risks in new forms.

Finance has continually evolved to meet changing needs of customers throughout its history. These changes have often helped finance become more accessible, effective and efficient. But they have also brought episodes of risk and instability. The Bank needs to keep pace to ensure that changes benefit users of finance, while not threatening stability.⁵

The rise of market-based finance

One of the defining changes over the past ten years, which will shape the future of finance and markets for now and in the coming years, is the reform of the financial system following the crisis and the rise of market-based finance.⁶

Common equity requirements and capital buffers for banks are now ten times higher than pre-crisis.⁷ “Too big to fail” banks are subject to resolution plans which means “bail-in” (of investors) rather than “bail out” (by taxpayers) is becoming a reality.⁸ Central counterparties (CCPs) have been created to untangle the complex and risky web of opaque over-the-counter derivatives transactions.⁹ And formerly toxic, and under-regulated, shadow banking has been transformed into resilient market-based finance through new regulations and rules.¹⁰

The Financial Stability Board (FSB) estimates that around 50% of the US\$382tn total global financial intermediation¹¹ now takes place outside the banking system. The global asset management industry has grown from around US\$50tn a decade ago¹² to US\$80tn in 2017.¹³ In the UK, over two thirds of the net finance raised publically by private non-financial corporations (PNFCs) since the crisis has been through capital markets, mostly through corporate bond issuance.¹⁴ Markets have also accounted for almost all of the increase in overseas lending to emerging markets since the crisis.

The diversity that market-based finance brings is welcome. It promotes choice and reduces the reliance on bank funding. And it can promote resilience where investors may be better able to absorb risks and changes in asset prices than banks.¹⁵ This is because, unlike banks, they do not generally use leverage or undertake maturity transformation. Capital markets may therefore be better able to fund certain types of activities like long-term infrastructure investment.

While market-based finance is an important risk sharing mechanism that can mobilise productive and resilient finance for the economy, it can also display vulnerabilities. This includes the potential for sudden changes in investor behavior in response to market developments, the possibility for surges of requests for redemption of money from funds which offer daily liquidity but are invested in less liquid assets, and “fire sales” which can transmit to markets more widely.¹⁶ This could result in a “sudden stop” in the flow of finance to the economy. Therefore, understanding structural vulnerabilities in market finance, and the evolving dynamics of investor behavior, and putting in place mechanisms to promote stability should remain a priority for authorities. This is particularly the case following a decade of ultra-low rates with a different structure of capital markets.

New Business models and “unbundling” value chains

Advances in technology, e-commerce and the growth of peer-to-peer networks are enabling new business models and greater diversity of players (**Figure 1**). For example, insurance telematics, wearable technology and home sensors provide real-time data about customer behavior and risk.¹⁷ This is positive by promoting choice, inclusion, and competition for customers. But it can also bring risks.

Figure 1: Diversity of new entrants in finance (selected providers)

Neo banks	Fin Techs	Tech Giants
N26	mint	Amazon pay
orange bank	Bankin’	Paypal
Atom	Linxo	Apple Pay
Fidor Bank	Lending Club	Android Pay
Monzo	Prosper	AliPay
WeBank	Funding Circle	WeChatPay
MyBank	iDeal	
Simple	adyen	
	Klarna	
	vpps	
	Venmo	

Source: Boston Consulting Group.

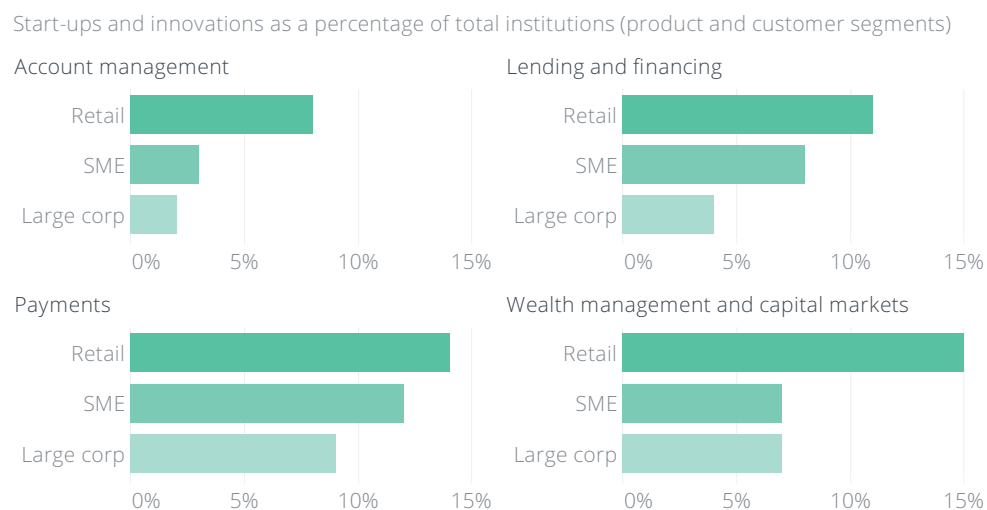
The increased competition from new entrants can have implications for the business models of “incumbent” financial services companies, who may experience reduced revenues or margins, and pressure to adapt their strategy and operations in response. For example, PWC estimate that “fintechs” are contesting nearly a quarter of banking revenues, and similar trends are expected in insurance and wealth management.¹⁸ The Bank of England’s 2017 “Biennial Exploratory Scenario” (BES) stress test explored the possible impacts of increased competition through new entrants on bank profitability and resilience.¹⁹

Big techs have also entered finance in recent years and many expect them to offer significant competition. They could use their global customer base and brand to attract customers and launch new propositions. Amazon, for example, provides payments, cash, lending, credit and prepaid cards.²⁰ In China, Ant Financial has the largest money market fund in the world.²¹ When considering these new competitors, authorities will be interested in understanding the implications for the structure of markets and viability of business models to ensure that financial firms remain safe and sound and financial stability is maintained.

New entrants are unbundling financial services and dividing them into their core activities.²² These include payments, settlement, safeguarding assets, savings, lending, insurance and investments. Unbundling can involve activities transferring to new players, including those who may be outside the “perimeter” of PRA regulation. It can also lead to narrower, more specialised business models that can bring efficiency and customer focus, but may be more vulnerable in downturns due to their focus on a relatively narrow set of clients and activities.

So far, unbundling has been most prominent in payments, consumer finance, wealth and asset management and lending to small and medium-sized enterprises (SMEs), where new entrants have been able to take significant market share (**Figure 2**). But in the future, it could also include products such as mortgages. The extent to which more profitable activities migrate, or how far competition compresses margins, will have implications for the viability of some business models.

Figure 2: Provision of financial services by fintechs in the UK



Sources: McKinsey & Company, Pitchbook, Crunchbase, Fintech Global, McKinsey Panorama Fintech Database. Number of start-ups and innovations as a percentage of database total.

Open Banking and new market structures

Open Banking, introduced in the UK in 2018, has required banks to give third parties access to current account information through direct application programming interfaces (APIs).²³ Third parties can initiate payments on their customers’ behalf (**Box 1**).

Box 1: Open Banking in the UK

The UK's Open Banking reforms were developed in response to a report issued by the Competition and Markets Authority (CMA) in 2016.¹ The report highlighted a lack of competition among established, larger banks for customers' business as well as difficulties for smaller and newer banks to compete.

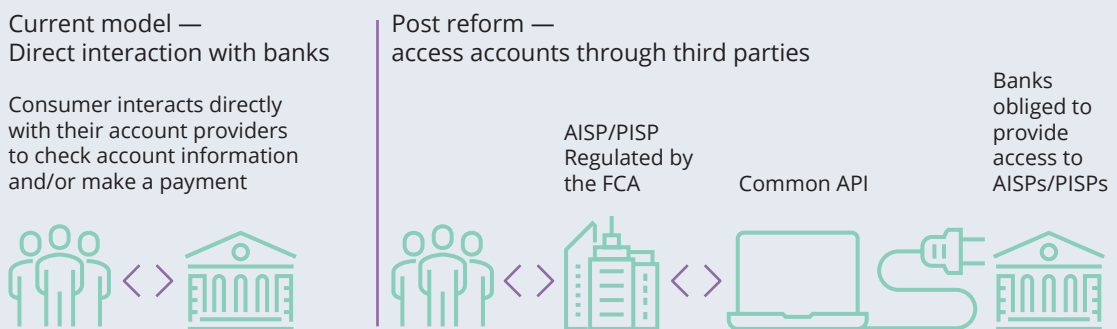
Open Banking requires the nine largest banks² to develop a common API and provide — at the request of customers — access to customer data. They also have to initiate payments in a standard format. It was adopted in January 2018.

Open Banking could change the relationship between banks and customers (**Figure 3**).

The CMA has set up the Open Banking Implementation Entity (OBIE) which determines the specifications for APIs, creates security and messaging standards and manages the Open Banking Directory. It also produces guidelines and manages disputes and complaints.

Eligible third parties which can access data shared by banks have to be authorised and regulated by the FCA and enrolled in the Open Banking Directory³. They include account information and payment service initiation providers (AISPs/PISPs) as well as banks and other third-party providers. 86 AISPs and 37 PISPs have been authorised by the FCA.

Figure 3: How Open Banking changes customers' relationships with banks



Source: FCA.

1 Retail banking market investigation: Final report, Competition & Markets Authority (CMA), (2016).

2 RBS, Lloyds, Barclays, HSBC, Santander, Nationwide, Danske Bank, Bank of Ireland and Allied Irish Bank. These were selected by the CMA based on their market share of retail current accounts in Great Britain and, separately, Northern Ireland.

3 See www.openbanking.org.uk/customers/regulated-providers/.

Open Banking can revolutionise how customers manage their finances and enable more choice and greater convenience.²⁴ But it also poses risks around fraud, security an unlevel playing field, costs and liability. As the UK is one of the first countries in the world to have launched it, the onus is on authorities to get it right or adapt fast. Teething issues will be inevitable.

Reflection on what can be learned from the experience with Open Banking so far is called for. For example, UK Finance estimates it has cost the nine major banks up to £1.5bn to create Open Banking.²⁵ Boston Consulting Group also argue that the design of Open Banking does not fulfil the most attractive use cases. Only 28% of adults were aware of the initiative half a year in according to a YouGov survey in August 2018.²⁶ Nervousness around data sharing may also be a barrier to adoption. Almost four out of five of those surveyed stated a concern around sharing their financial data with companies other than their bank.

Nearly 60% of retail banking transactions worldwide are now estimated to go through mobile and online channels.²⁷ So customers could benefit from the framework. Important considerations for policymakers will include:²⁸

- Understanding the implications for funding and liquidity in the banking system if deposits are moved more frequently;
- monitoring the system's ability to withstand outages as the volume of information requests and transactions executed through APIs and third-party providers increases;
- ensuring adequate mechanisms for collecting customer consent and addressing complaints in the event of data breaches; and
- reviewing how liability between banks and third parties is split (under current rules banks compensate customers for unauthorised transactions by third parties, which they can subsequently reclaim from providers).²⁹

When considering these, the experience of other jurisdictions in opening up financial data through similar initiatives might inform future policy choices (**Box 2**).

Box 2: Opening up account information around the world

Jurisdictions around the world are opening up customer data (**Figure 4**). In Europe, the revised Payment Services Directive (PSD2) requires banks to share both payments data and the ability to transact (read and write privileges) with third parties.¹ In contrast, Australia has limited the scope of its framework to read access.² In addition, it requires more industries such as telecom companies and utility providers to share their customer data. This is part of the Consumer Data Right strategy, which has a much broader competition objective.³

What data and processes to open, to whom and under what rules has significant implications for the impact of Open Banking type initiatives. Greater scope, increases opportunities, but also create complexity. Furthermore, the level of security standards and data sharing

infrastructure affect operational resilience. So called "screen scraping", may expose customer data to greater vulnerabilities than data accessed through APIs, given it involves sharing identity credentials.⁴

Other countries that are exploring the establishment of an Open Banking framework include Japan and Canada.⁵ The US does not currently have a legislative framework for Open Banking. The US Treasury Department's recent report on fintech acknowledges the need to remove legal and regulatory uncertainties preventing financial services firms and data aggregators from establishing data-sharing agreements, but does not specify an Open Banking model.⁶ It highlights the benefits of a private solution to developing APIs. Such a private initiatives are also being explored in Singapore.⁷

1 [EU Payment services \(PSD 2\) — Directive \(EU\) 2015/2366](#).

2 See https://bankingblog.accenture.com/open-banking-framework-comes-to-australia?lang=en_US.

3 See <http://static.treasury.gov.au/uploads/sites/1/2018/02/180208-CDR-Fact-Sheet-1.pdf>.

4 See www.finextra.com/blogposting/16494/open-banking-vs-screen-scraping-looking-ahead-in-2019.

5 See www.lexology.com/library/detail.aspx?g=65efbc60-73b9-4f9a-beb5-ce7cee58b05f.

6 [A Financial System That Creates Economic Opportunities: Nonbank Financials, Fintech, and Innovation](#), US Department of the Treasury, (2018).

7 See www.dbs.com/newsroom/Reimagining_banking_DBS_launches_worlds_largest_banking_API_developer_platform.

Box 2 continued: Opening up account information around the world

Figure 4: How Open Banking changes customers' relationships with banks

	UK	EU ^a	Australia ^b	Hong Kong ^c
Initiative	CMA's Open Banking	Revised Payment Services Directive PSD2 (implemented individually by each member state)	National CDR initiative	HKMA's Open API Framework as part of "Smart Banking"
Implementation date	January 2018	January 2018	Phased implementation from June 2019	Phased implementation from January 2019
Scope of data	Personal and small businesses current accounts	All payment accounts (not just current accounts), including flexible savings, corporate (large and small) and credit card accounts	Current accounts, credit cards, personal and business loans, mortgages (to be phased in)	Product and service information (for comparison sites), account information in the future (timetable to be determined with industry)
Scope of application	Read and write access	Read and write access	Read access	Read access (limited to product information at first) and write access in the future (timetable to be determined with industry), banks can choose third parties to grant access to)
Scope of actors	Nine largest current banks	Banks and online payment providers	Banks, energy companies and telcos	Largest banks, others able to join in the future
Method of data sharing	API	Technology-neutral (API, screen scraping)	API	API
Governing rules	OBIE determines the specifications for APIs used, creates security and messaging standards, produces guidelines, manages disputes and complaints	EBA issues guidelines and recommendations to authorities and financial institutions	Office of the Australian Information Commissioner advises on and enforces privacy protections. Standards are based on the UK's OB standards	This is yet to be determined

a [EU Payment services \(PSD 2\) — Directive \(EU\) 2015/2366](#).

b See <http://static.treasury.gov.au/uploads/sites/1/2018/02/180208-CDR-Fact-Sheet-1.pdf>, www.capgemini.com/2018/06/open-banking-and-australias-emerging-financial-services-ecosystem/.

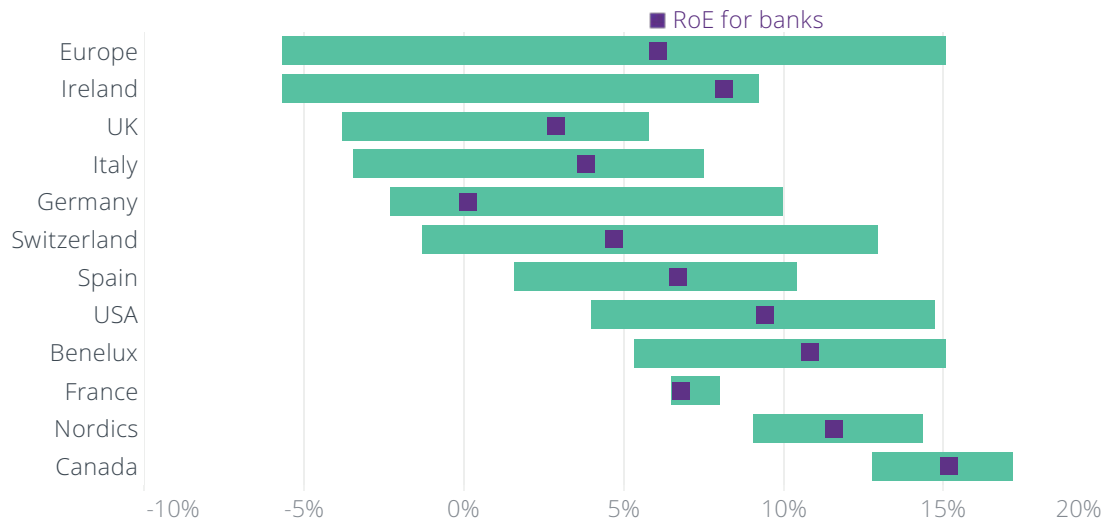
c See www.hkma.gov.hk/media/eng/doc/key-information/press-release/2018/20180718e5a2.pdf.

Hurdles to investment in resilience

While market structures and participants have changed in recent years, banks have faced a period of low profitability. **Figure 5** shows that the average return on equity (RoE) for UK banks has been lower in recent years than their European and US counterparts'.

Figure 5: Europe and North America Banks Return on Equity Dispersion

Average RoE within a country 2014-2018



Source: "Bank X" report, Citigroup.

One implication of low profitability is that there are fewer resources for investment in systems and technologies, which could lead to the patching-up and maintenance of aging legacy systems.³⁰ Such temporary solutions can increase operational vulnerabilities and increase cyber-risks.

Legacy IT infrastructure and physical distribution models are costly to maintain and update. This presents a strategic challenge as one response to low profitability is structural investment in new technology to reduce cost and make systems fit for the future (see Chapter 2).³¹ The costs of a transformational IT change are even higher. In a low margin world, scale becomes more important, putting particular pressure on challenger banks.

Evidence collected for this review suggests UK banks overall have lower innovation budgets than the global average. The weight of new rules and regulations, high compliance costs, lower returns and management decisions all seem to factor in, but no good data exists to explore this rigorously. For example, UK banks spent about half of their change-the-bank (CTB) budgets on mandatory initiatives such as those required by regulation in 2017 according to Oliver Wyman.³² This compares to 35% for the overall group and is significantly higher than for US banks. Supporting UK banks as they seek to make investments in technology will help boost the resilience and competitiveness of a key sector of the economy. Given the focus on the UK's lagging productivity, zooming in on one of the UK's leading industries could help.

Finally, some banks highlighted as a regulatory barrier to investment in technology an uneven playing field between US, Swiss banks and EU banks. This is because investment in software is deducted from banks' capital base in the EU; but not in other countries, such as the US.³³ This can act as a disincentive in strategic investment in technology in the EU banking sector. It merits further consideration.

LOOKING TO THE FUTURE

The financial system needs to be able to innovate to meet customer demands and serve the economy reliably in good times and bad. The ability to do so rests on a fair, resilient and dynamic financial system which is able to serve households and businesses throughout the economic and business cycle, shaped by forward-looking and agile regulation. It also rests on firms being able to invest in their infrastructure.

How the system might evolve in the future will depend on different factors. To explore this, it is helpful to consider two key dimensions; first, the level of interest rates as a proxy for economic growth and second, the degree of competition and disruption to the mainstream banking business model from unbundling and challengers.

Evidently, reality is much more complex. And the range of business models of big or small banks cannot be captured by simple scenarios. But they may provide a useful thought experiment. The Bank may wish to develop indicators to identify the path along them.

Several scenarios may unfold as the pace of disruption and unbundling accelerates and entrants further unpick the traditional banking model. Below are highlighted just two.

Scenario 1 — Low rates/economic growth and low disruption

It is possible that competition and the entry of new actors in finance proceeds at a gradual pace. Opportunities to contest markets which are easier to enter, such as payments and SME lending may have largely been exploited. Other activities, such as custody and settlement could prove sticky with fewer chances to disrupt. It is possible some fintechs could adopt a partnership model, offering their services primarily through incumbent banks.

The degree of value chain unbundling and market disruption in such a scenario might be moderate with continued vertical integration of non-disrupted activities.

Return on equity could exceed the industry's cost of capital. In this scenario, banks might use technology to enhance their products, services and operations, allowing them to retain their customer relationships and core services. Risks to financial stability might be more modest in this situation as the pace of change would be lower, yet the benefits of competition and innovation may also reduce.

Scenario 2 — Low rates/economic growth and “high degree of disruption”:

New firms might consolidate their market position and aggressively contest markets, with value chains unbundling faster as a result. Greater access to data and growth in peer-to-peer systems allow fintechs to form new types of connections and dependencies. The core banking model may be increasingly focused on a narrower set of activities in which the funding advantages of banks are powerful, or where there are very high barriers to entry. In the most extreme form, the deposit-taking and credit provision services traditionally bundled in banks would be increasingly separated. Funding and lending might be undertaken in new market places.

Continued low rates mean the system may struggle to make their cost of capital. The majority of incumbents might become low-margin back-end utilities with nimble new entrants focused on customer acquisition. Smaller banks may be forced to merge to find scale. The industry could become more modularised with services provided primarily through market place platforms and outsourced activities.

In this scenario, the Bank would need to consider its perimeter or regulation to account for new market structures and the distribution of critical economic functions.

IMPLICATIONS FOR THE BANK

New risks, new practices, new policy choices

In line with its financial stability objective it is key for the Bank to keep up with risks to the financial system and the changes it undergoes.³⁴ And often, prevention is better than a cure.³⁵

Therefore, the Bank's Financial Policy Committee (FPC), works to oversee the financial system, scan the horizon for emerging problems, and act when risks become threats.³⁶ This ensures that essential financial services are available in both good times and bad, and that the banks, insurers, and financial market infrastructures in the system are safe and sound.³⁷

The FPC seeks to identify the overall level of risk in the financial system and is vigilant for signs of vulnerability, such as over indebtedness or asset price over-valuation that could be subject to sharp and disruptive adjustment. It makes policy judgements to help the system absorb any adjustments and losses, and potentially mitigate their impact.³⁸ To do this the FPC seeks to build resilience and strength when conditions are calm, and to allow relaxation of those requirements when times are more turbulent. This philosophy of “fixing the roof whilst the sun shines” supports sustainable growth, where the financial

system grows at a manageable rate that delivers long term prosperity, rather than going through cycles of “bubble and bust”.³⁹

The tools at the Bank’s disposal include oversight and horizon scanning, regulations and policies which put in place safeguards and shock absorbers informed by stress testing that build resilience and protect the system from unexpected events.⁴⁰

Regulatory perimeter

Familiar financial activities may increasingly be undertaken by new actors operating outside of the traditional regulatory perimeter. The UK regulatory authorities have an established, robust approach for monitoring and addressing shifts in how finance operates, but this will need to keep pace with change.⁴¹

The Bank’s Financial Policy Committee (FPC) conducts an annual assessment of risk and regulation beyond the core banking sector.⁴² It can recommend to HM Treasury changes to the “perimeter” of regulation, or additional powers if needed to address a systemic threat.

The framework is designed to identify emerging risks, assess the potential hazards they present and intervene if necessary. This is based on the significance of transmission channels of risk to the real economy and the severity of the threats involved.

A good example of this approach is the crypto-asset market (see Chapter 1). Valuations grew rapidly over 2017, with prices rising faster than any previous bubble in history.⁴³

The FPC acted decisively to assess the significance of the emerging issue, size the threat and consider whether action was needed. In this case, it did not seek to regulate crypto-assets, but did make clear that the limited scale and connectedness of crypto-assets meant they were not deemed to be systemically important at the point in time.⁴⁴ The UK Government’s 2018 Crypto Asset Taskforce report also highlighted risks to consumers and market integrity as well as potential illicit activity using crypto-assets.⁴⁵

The FPC will need to keep the implications of new business models and “unbundling” under close review and be ready to act if necessary to keep the system safe and stable.

Risks from market-based finance

Structural changes since the financial crisis have changed the dynamics in certain financial markets and altered market structures. The FPC has previously highlighted the increased risk of amplification created by tight market liquidity, especially where financial products promise a different liquidity from that of the underlying asset.⁴⁶ Open-ended funds promising daily liquidity but investing in illiquid underlying assets such as property is one such example.

If the potential of market-based finance is to be harnessed; the Bank will need to make sure it has effective mechanisms for oversight of developments and risks, techniques for diagnosing emerging vulnerabilities, and structures which promote resilience of these intermediaries, including under stressed conditions. Progress has been made on this through the Financial Stability Board and International Organization of Securities Commissions (IOSCO) internationally,⁴⁷ and through FPC and the FCA domestically. But as market-based finance continues to evolve and grow, this will be an ongoing area of priority.

Building on the FPC and FSB’s ongoing initiatives on system-wide stress simulation, the Bank with other regulators will also want to consider how an exit from a decade of ultra-low rates might play through new structures in capital market.⁴⁸ This will have to have regard to the different forms of intermediaries and investors and different behaviours, structures and liquidity dynamics.

Dynamic adjustments

Over time regulation has to make “dynamic adjustments” if it is to remain effective and to support innovation and resilience.⁴⁹ The scope of reforms following the financial crisis was remarkable. The Basel Committee on Banking Supervision (BCBS) published twice as many standards between 2009 and 2017 as it did in the 20 years before.⁵⁰ Internationally, this is embedded in the work of the Financial Stability Board and the BCBS which are both focusing on timely and consistent implementation of reforms, evaluation and, where needed, dynamic adjustment of policy to maintain its effectiveness.⁵¹

Open Banking

Together with other authorities, the Bank should maintain a keen interest in the evolution of Open Banking.⁵² As a framework to open up and share data, it can reduce costs and broaden access to products and services offered in the digital economy.⁵³ But for customers to benefit, it has to ensure consumer protection and continued operational resilience.

In considering the implications of how the framework evolves, UK authorities should have an eye to similar initiatives launched across the world. Design choices will result in different outcomes for effectiveness and resilience.

Central bank infrastructure

The Bank has reflected the dynamism of the fintech industry by being open to and enabling change, including through expanding access to settlement accounts in RTGS to non-bank payment providers.⁵⁴ The Prudential Regulation Authority (PRA) has authorised 43 new banks through its New Bank Start-up Unit since 2013. It has also launched a similar initiative for insurers.

As payments providers proliferate, they may take on new responsibilities previously reserved for major banks. This promotes greater diversity but also poses new risks that require oversight.

The Bank has been and should continue to keep under review the infrastructure it provides to different market participants (Chapter 2). It will have to focus on how its relationships with these actors changes. It will also monitor the effect on its market operations of providing access to central bank services and potential implications for its balance sheet such as the operation of reserve or settlement accounts.

A review of access to its services and balance sheet will have to evaluate potential risks of further opening and the obligations firms would have to fulfil, including appropriate oversight by the Bank.

RECOMMENDATIONS

7.1 Ensure regulation and infrastructure keep pace with innovative business models	Why does the Bank need to act? <ul style="list-style-type: none">• Technology and policy have opened up the financial system to many new entrants in recent years. With rapid innovation and the rise of new banking models alongside increased data portability, there is now a more diverse set of players in the financial system, benefiting customers through more competition and innovative services.• This diversity is a positive development, but it means important financial activities may increasingly be performed by new actors outside the traditional “banking” value chains and so the perimeter of regulation.• The UK regulatory authorities have an established and robust approach for monitoring and responding to change. The FPC conducts an annual assessment of risk and regulation beyond the core banking sector and can request that the Treasury amend or grant the Bank new powers if necessary.• While the UK starts from a good place, it is essential that the framework for overseeing risks to financial stability from new actors and activities keeps pace with innovation, changing business models and evolving market structures.
	What can the Bank (and others) do? The Bank should: <ul style="list-style-type: none">• Remain vigilant to developments in the financial system and be ready to act to protect resilience when needed. To do so, approaches and macroprudential tools may need to evolve. This report can provide suggestions on and risks to watch closely.• Evaluate the appropriate level of access to central bank infrastructure, including its balance sheet, for non-banks in order to support greater innovation while safeguarding monetary and financial stability.

7.2 Foster a dynamic and responsive regulatory regime

Why does the Bank need to act?

- Roundtables with experts conducted for this review highlighted a desire by firms, especially smaller ones, to have a channel to discuss problems with regulations outside normal supervisory processes. This is both where old rules pinch or have had unintended consequences, and where others need to evolve to new business practices.
- The goal is to assess whether specific regulatory reforms are operating as intended and to make policy adjustments if needed without compromising on the original objectives or resilience. This should, of course, be an integral part of any effective policy process.
- This coincides with the Financial Stability Board's thought leadership on regulatory evaluation and dynamic adjustment. With the finalisation of Basel III, the new global regulatory framework is now largely in place. As such, it argues for a shift in focus which includes a rigorous evaluation of implemented reforms, to ensure the reform programme is efficient, coherent and effective.

What can the Bank (and others) do?

The Bank should:

- Establish a dedicated "regulatory evaluation and response" unit to assess the effectiveness and impact of major policies across their life cycles. This includes anomalies, unintended consequences and continued relevance.

7.3 Contribute to an open banking policy framework

Why does the Bank need to act?

- The CMA's Open Banking initiative is developed to promote competition and empower consumers. These are worthwhile objectives, but stakeholders have highlighted several considerations.
- Open Banking is a powerful idea to give customers more control over their finances in the next decade. But it also poses issues around security, costs, resilience, data sharing and legal liability.
- The UK is one of the first countries in the world to undertake this experiment, so the onus is on authorities to get it right, or adapt fast. UK Finance estimates it has already cost the nine largest banks up to £1.5bn to kick-start. Boston Consulting Group argue data available through Open Banking does not enable the most attractive use cases and few customers are using it. Law firms have raised concerns around that legal liability questions remain unresolved and payment firms' problems could rebound onto banks.
- The treatment of liability in the event of a data breach or an unauthorised transaction is one example. Non-regulated financial institutions are generally not required to hold operational risk capital. Today's rules suggest a bank, not the payment company, might have to compensate the client for any errors or cyber-breaches and then counter-sue the payment firm. This does not seem to be an optimal design if the system was scaled. Additionally, the involvement of different parties in the flow of data and the initiation of transactions raises the issue of how to resolve potential disputes.
- A number of meetings suggested that the OBIE should transition to becoming a standards body going forward with implementation resting with the private sector.

What can the Bank (and others) do?

The Bank should:

- Work with the Financial Conduct Authority to suggest a Treasury-led review of lessons learned from the first 18 months of Open Banking. The Bank should consider how to mitigate risks and galvanise opportunities, including the implications of unclear liability for data loss and failed payments.

ENDNOTES

- 1 See www.bankofengland.co.uk/financial-stability.
- 2 See www.bankofengland.co.uk/knowledgebank/will-there-be-another-financial-crisis.
- 3 Embracing the promise of fintech, Mnohohitnei et al, Bank of England Quarterly Bulletin, (2019).
- 4 G20 Leaders' Declaration, Washington DC, 15 November, 2008.
- 5 How to: MACROPRU, 5 principles for macroprudential policy, speech given by Alex Brazier, London School of Economics, (2017).
- 6 Transforming Shadow Banking into Resilient Market-based Finance, FSB, (2015).
- 7 Prudential bank regulation: present and future, speech by Vicky Saporta, (2018).
- 8 See www.bankofengland.co.uk/financial-stability/resolution.
- 9 Central counterparties: what are they, why do they matter and how does the Bank supervise them?, Nixon et al, Bank of England Quarterly Bulletin, (2013).
- 10 Transforming Shadow Banking into Resilient Market-based Finance, FSB, (2015).
- 11 Global Monitoring Report on Non-Bank Financial Intermediation, Financial Stability Board (FSB), (2019).
- 12 Conquering the Crisis, Global Asset Management Report 2009, Boston Consulting Group (BCG), (2009).
- 13 Global Asset Management 2018: The Digital Metamorphosis, Boston Consulting Group (BCG), (2018).
- 14 Financial Stability Report, November 2018, Bank of England, (2018).
- 15 Market-based finance: a macroprudential view, speech given by Sir Jon Cunliffe, Asset Management Derivatives Forum, February 2017.
- 16 Market-based finance: a macroprudential view, speech given by Sir Jon Cunliffe, Asset Management Derivatives Forum, February 2017.
- 17 See www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKFwjgoeIj-7iAhXZRhUIHaZ3B8cQFjAAegQIBBAC&url=https%3A%2F%2Fwww.actuaries.org.uk%2Fdocuments%2Ffinal-draft-sessional-paper-wearables-and-iot-working-party&usg=AOvWaw2O59Hf3SNKEO-VwaBA_QEK.
- 18 Redrawing the lines: FinTech's growing influence on Financial Services, Global FinTech Report 2017, PWC, (2017).
- 19 See www.bankofengland.co.uk/news/2017/march/2017-stress-test-scenarios-explained.
- 20 See www.cbinsights.com/research/report/amazon-across-financial-services-fintech/.
- 21 See www.wsj.com/articles/worlds-largest-money-market-fund-is-shrinking-as-it-battles-rival-on-yields-11548934202.
- 22 Embracing fintech, speech given by Dave Ramsden, Innovate Finance Global Summit, April 2019.
- 23 See www.openbanking.org.uk.
- 24 See www.mckinsey.com/industries/financial-services/our-insights/data-sharing-and-open-banking.
- 25 See UK Finance research.
- 26 www.moneywise.co.uk/news/2018-08-02/brits-still-the-dark-open-banking.
- 27 BCG research.
- 28 See www.ashurst.com/en/news-and-insights/legal-updates/open-banking-open-liability-accountability-issues-for-open-banking-apis/.
- 29 An effective dispute resolution mechanism has not yet been trialled and issues may arise when disputes are cross-border or payment providers are too thinly capitalised to refund the bank.
- 30 SSM thematic review on profitability and business models: Report on the outcome of the assessment, European Central Bank (ECB), (2018).
- 31 See www.bankofengland.co.uk/news/2017/march/2017-stress-test-scenarios-explained.
- 32 Oliver Wyman research.
- 33 CRD 5/CRR2: Capital treatment of Software, Association for Financial Markets in Europe (AFME), (2018).
- 34 Five years of macro-prudential: Regulating the Square Mile for all 94,000 square miles, speech given by Alex Brazier, Imperial College Business School, April 2018.
- 35 How to: MACROPRU, 5 principles for macroprudential policy, speech given by Alex Brazier, London School of Economics, (2017).
- 36 See www.bankofengland.co.uk/financial-stability.
- 37 Five years of macro-prudential: Regulating the Square Mile for all 94,000 square miles, speech given by Alex Brazier, Imperial College Business School, April 2018.
- 38 When expectations meet the future, speech given by Sir Jon Cunliffe, London School of Economics, March 2019.
- 39 Three priorities for the global economy, speech by Christine Lagarde, Hong Kong, April 2018.
- 40 See www.bankofengland.co.uk/financial-stability.
- 41 Embracing fintech, speech given by Dave Ramsden, Innovate Finance Global Summit, April 2019.
- 42 Financial Stability Report, November 2018, Bank of England, (2018).
- 43 See <https://publications.parliament.uk/pa/cm201719/cmselect/cmtreasy/910/910.pdf>.
- 44 Financial Stability Report, November 2018, Bank of England, (2018).
- 45 Crypto-assets: Twenty-Second Report of Session 2017-2019, House of Commons Treasury Committee, (2018).
- 46 Financial Stability Report, November 2018, Bank of England, (2018).
- 47 Market-based finance: macroprudential view, speech given by Sir Jon Cunliffe, Asset Management Derivatives Forum, February 2017.
- 48 Financial Stability Report, November 2018, Bank of England, (2018).
- 49 Embracing the promise of fintech, Mnohohitnei et al, Bank of England Quarterly Bulletin, (2019).
- 50 Prudential bank regulation: present and future, speech given by Vicky Saporta, Westminster Business Forum, (2018).
- 51 See www.fsb.org/work-of-the-fsb/implementation-monitoring/effects-of-reforms/.
- 52 Embracing the promise of fintech, Mnohohitnei et al, Bank of England Quarterly Bulletin, (2019).
- 53 See www.mckinsey.com/industries/financial-services/our-insights/data-sharing-and-open-banking.
- 54 See www.bankofengland.co.uk/payment-and-settlement/rtps-renewal-programme.

8 ENHANCE PROTECTION AGAINST CYBER-RISKS

THE OUTCOME WE SEEK

A UK financial system that helps prevent cyber-crime and is resilient to cyber-risk. Law enforcement agencies, financial regulators and institutions that collaborate on critical security threats.

- The financial system is a constant target for cyber-criminals. Regulators and the private sector need to maximise their efforts to keep up with this dynamic threat.
- Cyber-penetration and simulation exercises to explore vulnerabilities and encourage firms to build greater resilience will be essential.
- The key part missing in the UK cyber-defences today is an industry response to a data wipe at an institution. Building a strong model for data recovery should be a priority for industry. US Sheltered Harbor is a useful concept to explore.
- Finance can help businesses manage cyber-risks, build resilience and recover from incidents through wider access to cyber-insurance products. But to become widely adopted, cyber-insurance needs richer datasets.

KEY DEVELOPMENTS

Cyber-crime is big business

The volume of remotely accessible sensitive data has expanded rapidly, as our lives become more digitised. The risk of cyber-incidents grows with our reliance on third parties that process and store our information. **Figure 1** maps out the scale of cyber-security breaches around the world since 2012.

Cyber-crime has become big business. The global impact exceeds US\$450bn a year as crime, extortion, blackmail and fraud move online.¹ Estimates suggest the vast majority of cyber-incidents on banks seek to steal funds. But a meaningful percentage are to steal intellectual property or disrupt activity. So firms will need to be alert to the different motivations and styles of attack.

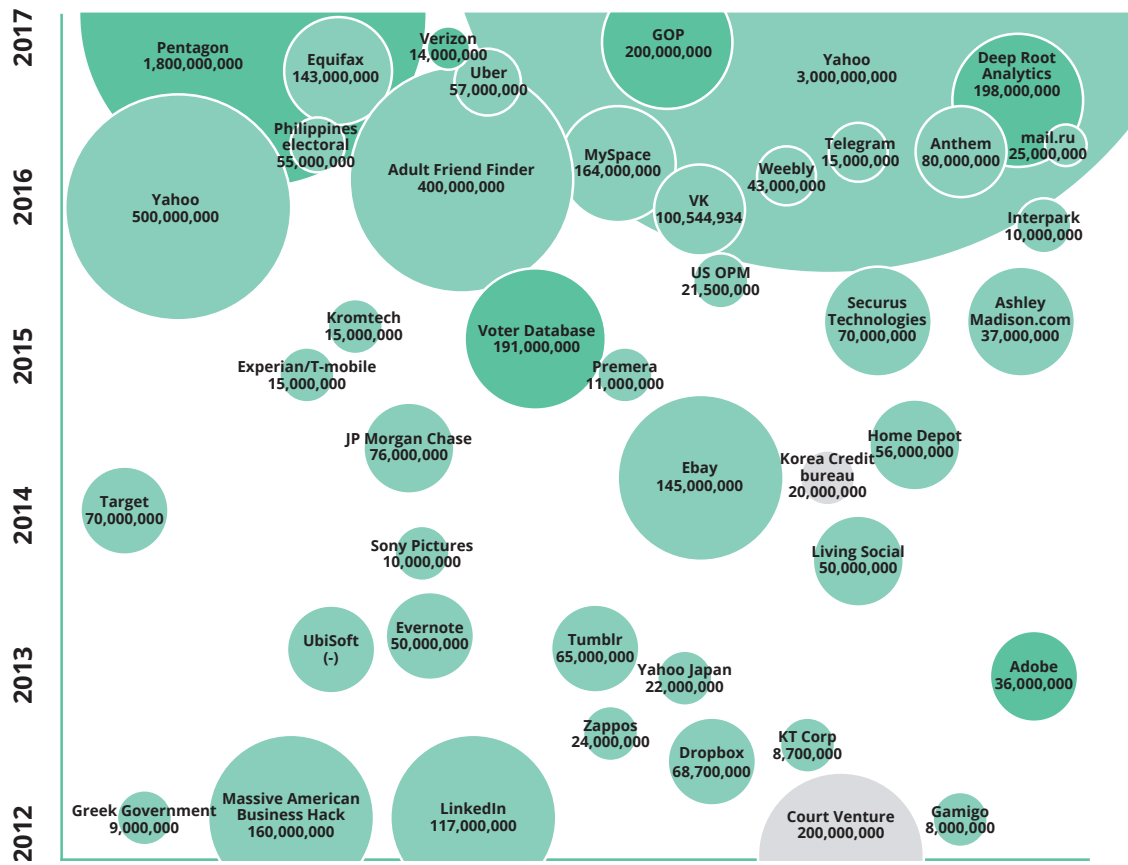
Industries across the board are under threat from cyber-attacks. Over four in ten UK businesses had experienced a cyber-security breach in the past 12 months in 2018.² And cyber-incidents cost the average business £25,700 annually.³

Financial services are an attractive target. Online fraud and account hacking have nearly completely replaced traditional theft of banknotes and gold. Nearly all attacks in financial services, 91%, are aimed at banks.⁴ They primarily affect retail banking 39% and credit cards 25%. Financial services firms already spend three times the amount that non-financial organisations do on cyber-security according to UK Finance.⁵ This investment will need to keep up with an ever growing threat.

Cyber-security is at the top of the financial sector's agenda. In the latest Bank of England *Systemic Risk Survey*, cyber-risk was the second-most cited source of risk by firms at 66%.⁶ Only "Brexit/political risk" was more common at 97% (see **Figure 2**).

The UK ranked 12th in the Global Cyber Security index in 2017.⁷ Arguably, it should be on par with countries that are leading cyber-security efforts, but strategic investment will be needed to achieve this.

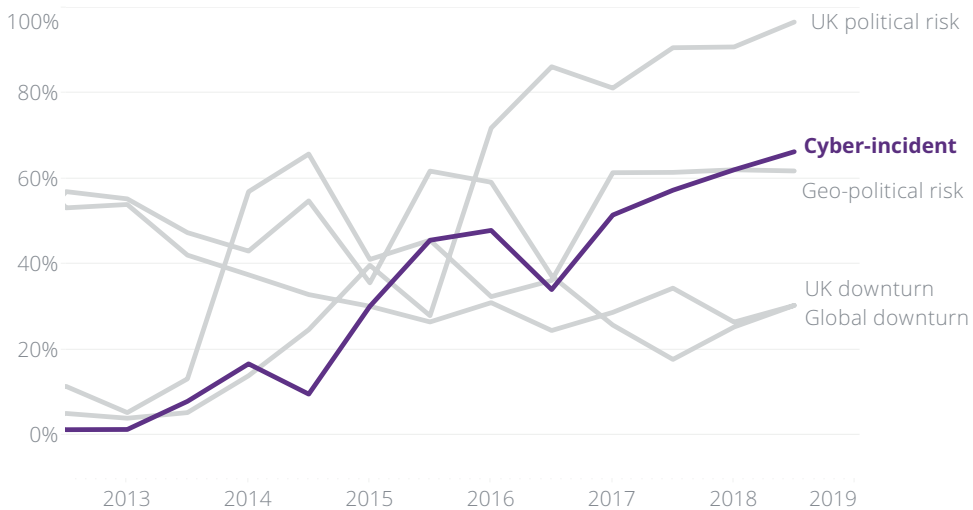
Figure 1: Cybersecurity breaches since 2012



Note: Size of the bubbles denote the records reported stolen in a selection of publicly acknowledged breaches.

Sources: Boston Consulting Group (BCG), BCG analysis, DataLossDB.org and informationisbeautiful.net.

Figure 2: Sources of risk to the UK financial system



Source: Bank of England Systemic Risk Survey 2018.

LOOKING TO THE FUTURE

The base case for the coming decade assumes ever-more sophisticated attacks. So the system will need greater protection and the ability to bounce back from successful attacks swiftly.

Firms are responsible for building resilience and recovering from attacks. Senior management own and should oversee firms' cyber-strategies. And the financial community must collaborate with law enforcement and governments, given the nature of the threat. This means creating new models for co-operation that are agile, responsive and focus on protecting customers against exploitation, as well as the integrity of the system. The public sector can also help underpin services which the private sector on their own will struggle to internalise.

Financial institutions are highly regulated entities that focus on controls, structures, and technology. Their security responses must be managed through carefully controlled and audited environments, delivered at the pace that this process allows. In contrast, criminals are agile and opportunistic. UK Finance recently said the industry needs to see cyber-security as competition with a digital rival rather than simply a governance, risk and control issue.⁸

Questions for the future

Meetings and workshops held as part of this review resulted in eight questions for the coming years that can help inform the approach to cyber-risk:

1. How will a more complex value chain interact with cyber-risks?
2. How can law enforcement, regulators and financial institutions co-ordinate better over threats and share information quickly and across borders?
3. How does a payments system with different levels of risk interact with cyber and the core banking system?
4. What would firms do if part of or a whole bank was to fall over or get wiped?
5. How will the desire for open finance trade off with cyber-risks?
6. What is the optimal way to operate cyber-penetration tests?
7. Can a cyber-insurance market be cultivated to mitigate the risks to firms?
8. And could the UK do more to promote itself as a cyber-security centre?

An approach to cyber-security

Authorities and firms have been collaborating to build cyber-resilience and recovery capabilities. Established frameworks have emerged that are useful for thinking about the features of effective cyber-defence. But if cyber-incidents are becoming more frequent and severe, the response and framework must keep up.

In 2016, the G7 published its "Fundamental Elements for Effective Assessment of Cybersecurity in the Financial Sector".⁹ It can be characterised by four aspects:

- Preparation: building cyber-strategies and preparedness.
- Assessment and Adjustment: assessing the effectiveness of those strategies and preparedness through realistic and thorough penetration testing. And dynamically evolving and adjusting defences based on the lessons learned.
- Recovery: building frameworks for effective, rapid and comprehensive recovery when defences are penetrated.
- Lessons learnt: promoting learning and co-ordinated responses through secure information-sharing and incident-reporting.

This approach is consistent with, and underpinned by, existing regulation guidance for firms and their senior management to build resilience and manage their cyber-risks.¹⁰ It promotes the integrity and stability of the system, enhances safety and soundness of firms and protects consumers.

In its evolving risk assessments, the Bank must consider complex supply chains, cloud providers and fintechs, who have expanded the surface area for cyber-attacks. Spreading best practice from top institutions to smaller, less well-resourced ones through collective defence should be a priority.¹¹

How can firms prepare for cyber-incidents?

Firms will and should assume operational disruptions will occur. Effectively sharing early warning information is also essential. The public and private sectors must collaborate to identify potential threats, establish responses and ensure that emerging threats are known, shared and acted upon.

Firms' investments in cyber-defences, systems and infrastructure should test the implications of an incident and its response to invest in the most effective way. This is crucial as financial institutions need to prioritise and maximise the impact of their operational investment spend. For example, according to research by BCG major banks' spending on cyber-security averaged 0.5% of revenue and 0.64% of opex with an estimated US\$3bn spent by banks on cyber overall in 2017.

Risk assessment

Penetration testing is a tool used to identify vulnerabilities and potential responses. Authorised hackers attempt to gain access to a firm's systems and data using the latest cyber-threat intelligence to identify weak spots in firms' cyber-defences. Firms then use this knowledge to inform the design and configuration of their defences, target their investment spending and to adjust their response and communication plans.

While penetration testing is mainly a tool for firms, testing is also undertaken in collaboration with authorities, using the latest threat information from authorities and benefiting from the system-wide view of regulators.

The Bank of England was an early adopter of such testing.¹² It is working with authorities at home and abroad to periodically test firms' cyber-resilience and develop rapid response mechanisms. These tests can be categorised broadly as:¹³

- Threat-led penetration testing for individual institutions (domestic): the Bank's CBEST framework targets firms' systems based on threat intelligence that is relevant to their individual business models and operations;
- Sector-wide exercises (domestic): the SIMEX initiative tests the impact of industry-wide scenarios. It simulated an outage of the UK's RTGS system in 2016 and an operationally paralysed G-SIB in 2018;¹⁴
- Joint testing exercises with other jurisdictions (international): these include the Resilient Shield Exercise between the UK and the US in 2015 and G7 Cyber Exercise in 2019.¹⁵

Penetration testing is likely to become ever-more important. And the Bank should continue to draw on the approaches that have been adopted by international peers to champion best practice and maintain its leadership position.

Joint exercises, which simulate real cyber-incidents, can help encourage greater information-sharing across borders. One frequently mentioned issue is the ability to share information on attacks across borders, such as from one stock exchange to another.

Recovery

Firms and authorities have mechanisms in place to respond to incidents. The aim of these is to minimise disruption, data loss and to speed up recovery by practicing the response to an incident. Response frameworks are vital to sustain critical financial services and to recover promptly. This is an area where the UK could improve in the years ahead.

In the US, the government ran a set of cyber-exercises called the "Hamilton Series" (see **Box 1**).¹⁶ This triggered an industry initiative, Sheltered Harbor, which allows the recovery of customer account information in the event of a cyber-incident.¹⁷ A UK version of Sheltered Harbor could become a powerful tool for firms and authorities.

Box 1: The “Hamilton Series” and Sheltered Harbor

In 2014–16, the US Treasury Department convened 13 cyber-exercises called the “Hamilton Series”. This was done in collaboration with the Financial Services Sector Co-ordinating Council (FSSCC) and other US government agencies. It aimed to prepare the financial sector for a large cyber-incident.

The exercises simulated a variety of incidents. They ranged from regional attacks on small and medium-sized companies to exercises involving large, systemically important financial institutions. The scenarios examined the impact of threats on different segments of the financial system, such as equities markets, exchanges, payment systems and large, regional, and medium-sized deposit takers.

The US financial services sector launched the non-profit initiative Sheltered Harbor, which followed the Hamilton Series in 2017.¹ The Financial Services Information Sharing and Analysis Centre (FS-ISAC) operates it. Current membership covers roughly 60% of US-domiciled retail bank and brokerage accounts as well as technology firms.²

Interoperability

Sheltered Harbor allows financial institutions to securely store and rapidly reconstitute account information. If an institution can't recover quickly from a cyber-incident, customers can access their information through a service provider or another financial firm.³

Participating institutions make a daily copy of their customer accounts data.⁴ The data is stored in a standardised and encrypted format and protected from change. Data storage follows a distributed model with no central repository of information.

Secure data storage

Sheltered Harbor members can store data directly themselves or outsource it. If a cyber-incident occurs, the data is validated, formatted, encrypted and transmitted through industry-established, standardised file formats.⁵ The underlying information is restored and accessible to customers within a week.⁶

Benefits and design choices

The benefits of Sheltered Harbor and specific design choices are important when considering the implications for the UK financial system. Sheltered Harbor is particularly targeted at mid-sized financial institutions with relatively limited accounts, with the largest institution relying on additional internal mechanisms.⁷ The “Hamilton Series” revealed that even a mid-sized institution's failure can undermine trust in the broader financial system. The initiative is limited to domestic retail assets for which the data is less complex to capture than wholesale or international exposures.⁸ It has not yet been used in response to an actual cyber-incident.

1 See <https://bankingjournal.aba.com/2017/02/sheltered-harbor-website-launches/>.

2 See <https://bankingjournal.aba.com/2017/03/how-sheltered-harbor-provides-safety-from-the-cyber-storm/>.

3 See <https://independentbanker.org/2018/01/can-fine-sheltered-harbor-participants-have-each-others-backs-2/>.

4 See www.aba.com/Tools/Function/Cyber/Pages/sheltered-harbor.aspx.

5 See www.icba.org/solutions/tools/cyber-security-guide/cybersecurity-mitigation.

6 FIS Data Restore, A Sheltered Harbor Solution, FIS, (2018).

7 See www.cio.com/article/3298538/sheltered-harbor-ensures-cyber-resilience-for-financial-services-firms.html.

8 See www.defenseone.com/ideas/2018/07/what-alexander-hamilton-can-teach-us-about-cyber-policy/149921/.

Delivering many of its public services online, the government of Estonia has developed an innovative mechanism for information recovery in the event of cyber-incidents through the world's first data embassy (Box 2).¹⁸ While it's uncertain whether this would suit the UK, there are lessons to learn.

Information sharing

Much can be gained if authorities co-ordinate their responses and firms share information. This will help to flag threats and promote learning from attacks and near-misses.

In the UK, the Authorities Response Framework (ARF) establish information-sharing protocols between HM Treasury, the Bank and the Financial Conduct Authority (FCA).¹⁹

Box 2: Estonia's data embassy

Estonia has built a digital system that allows citizens to access a wide range of government services electronically, underpinned by a digital ID.¹ Its paperless public services mean the country is highly reliant on protecting its information systems and data through cyber-security mechanisms.²

In 2007, hackers denied users access to almost 60 Estonian websites belonging to the government, several newspapers and banks.³ In response to this and many smaller incidents, Estonia developed the first data embassy in partnership with Luxembourg in 2017.⁴

Luxembourg hosts Estonian data servers with copies of the country's key databases in its data centre. Both governments signed an agreement

in 2017.⁵ The backup allows the Estonian government to access critical data in the event of an incident. Luxembourg has guaranteed to protect the data with the same legal guarantees as in Estonia.⁶

The embassy is a sovereign unit in a foreign data centre. It is a novelty under the legal arrangements governing international diplomatic relations. An immunity clause ensures the confidentiality and security of the critical data despite being in the jurisdiction of another state.⁷ The Estonian government is also exploring new technologies such as blockchain to keep the two data centres synchronised and ensure the integrity of the data.⁸

1 See www.techrepublic.com/article/how-estonia-became-an-e-government-powerhouse/.

2 See <https://qz.com/1052269/every-country-should-have-a-cyber-war-what-estonia-learned-from-russian-hacking/>.

3 [Denial-of-Service: The Estonian Cyberwar and Its Implications for U.S. National Security, International Affairs Review, \(2019\).](#)

4 See <https://e-estonia.com/estonia-to-open-the-worlds-first-data-embassy-in-luxembourg/>.

5 See www.opengovasia.com/estonian-government-approves-agreement-with-luxembourg-enabling-establishment-of-worlds-first-data-embassy/.

6 [Establishing the first Data Embassy in the world, Observatory of Public Sector Innovation, \(2017\).](#)

7 See <https://blogs.microsoft.com/eupolicy/2017/12/14/diplomatic-immunity-data-estonia-creates-virtual-embassy/>.

8 [Blockchains for Governmental Services: Design Principles, Applications, and Case Studies, Working Paper Series No. 7, Kello et al., University of Oxford, \(2017\).](#)

In 2018, 145 cyber-breaches were reported to the FCA.²⁰ This may still understate the actual incidence, and the UK authorities may wish to learn from international approaches.²¹

Some jurisdictions have specific requirements for the reporting of cyber-incidents, subject to thresholds.²² In the EU, this is done under the Single Supervisory Mechanism's (SSM) cyber-incident reporting framework.²³ The General Data Protection Regulation (GDPR), which also covers UK firms, further specifies firms have to report personal data breaches to the right supervisory authority within 72 hours.²⁴ Failure to comply can lead to fines of up to €20mn or 4% of global annual turnover.²⁵

In other jurisdictions, cyber-incidents are captured in existing reporting requirements.²⁶ For example, the US Treasury Department's office of Financial Crimes Enforcement Network (FINCEN) requires firms to report detailed information about cyber-incidents when filing their mandatory suspicious activity reports (SARs). This includes describing how their systems were breached, IP addresses of hackers' computers and device identifiers.²⁷

Firms may also want to share threat intelligence with each other. The authorities facilitate this in some jurisdictions by developing incident and risk taxonomies. The US Financial Services Information Sharing Analysis Center (FS-ISAC) shares information among members automatically using the TAXII CybOX STIX taxonomy.²⁸ And Hong Kong explicitly requires firms to participate in an infrastructure for sharing threat intelligence between banks, called the Cybersecurity Fortification Initiative (CFI).²⁹

Can cyber-insurance help businesses manage risks more effectively?

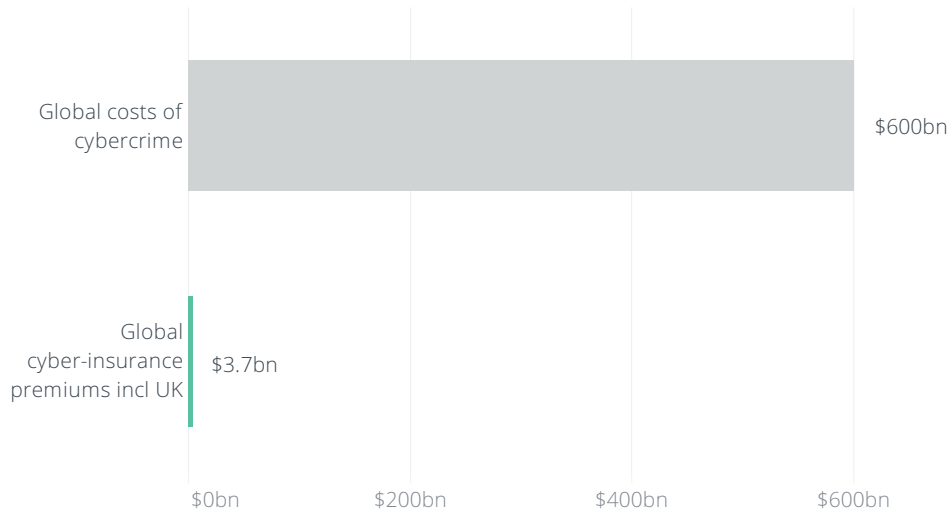
Finance can play an important role in helping businesses manage cyber-risks, build resilience and recover from incidents through better access to cyber-insurance products.³⁰

Insurance can help businesses recover from the potentially devastating costs of a cyber-incident to support and sustain activity and employment in the real economy. Insurance cover can also provide support from specialist insurance risk managers and create incentives to manage risk. But it is still

relatively new.³¹ For the market to deepen it needs richer data to assess risks and the nature and size of the exposure.

The economic and commercial case for cyber-insurance is clear. Globally, cyber-crime could have cost up to US\$600bn in 2017 according to an estimate by BCG (see **Figure 3**).³² Businesses had to pay about US\$900mn only for the NotPetya ransomware attack alone.³³ Despite the rising costs and disruption, the majority of losses remain uninsured. Lloyds of London have put this figure at 90%.³⁴ The Boston Consulting Group also estimate that the cyber-insurance premiums of US\$3.7bn cover less than 1% of losses.

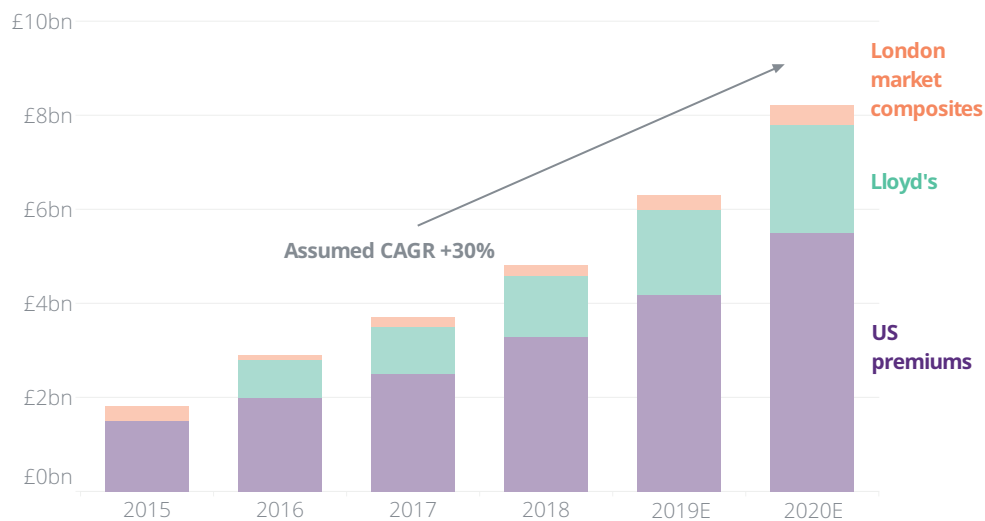
Figure 3: Global cyber and insurance premiums



Source: BCG.

Cyber-insurance is growing³⁵ and the market for global cyber-premiums is projected to reach US\$8.2bn in 2020 (**Figure 4**). Demand is expected to grow as businesses and authorities become more aware of cyber-risks.³⁶ Legislative initiatives such as GDPR and the Network and Information Systems Directive (NIS) may also increase demand as they require the reporting of breaches. Cyber-insurance could benefit the real economy and present an opportunity for the financial sector.

Figure 4: Estimated global cyber-premiums (US\$bn)



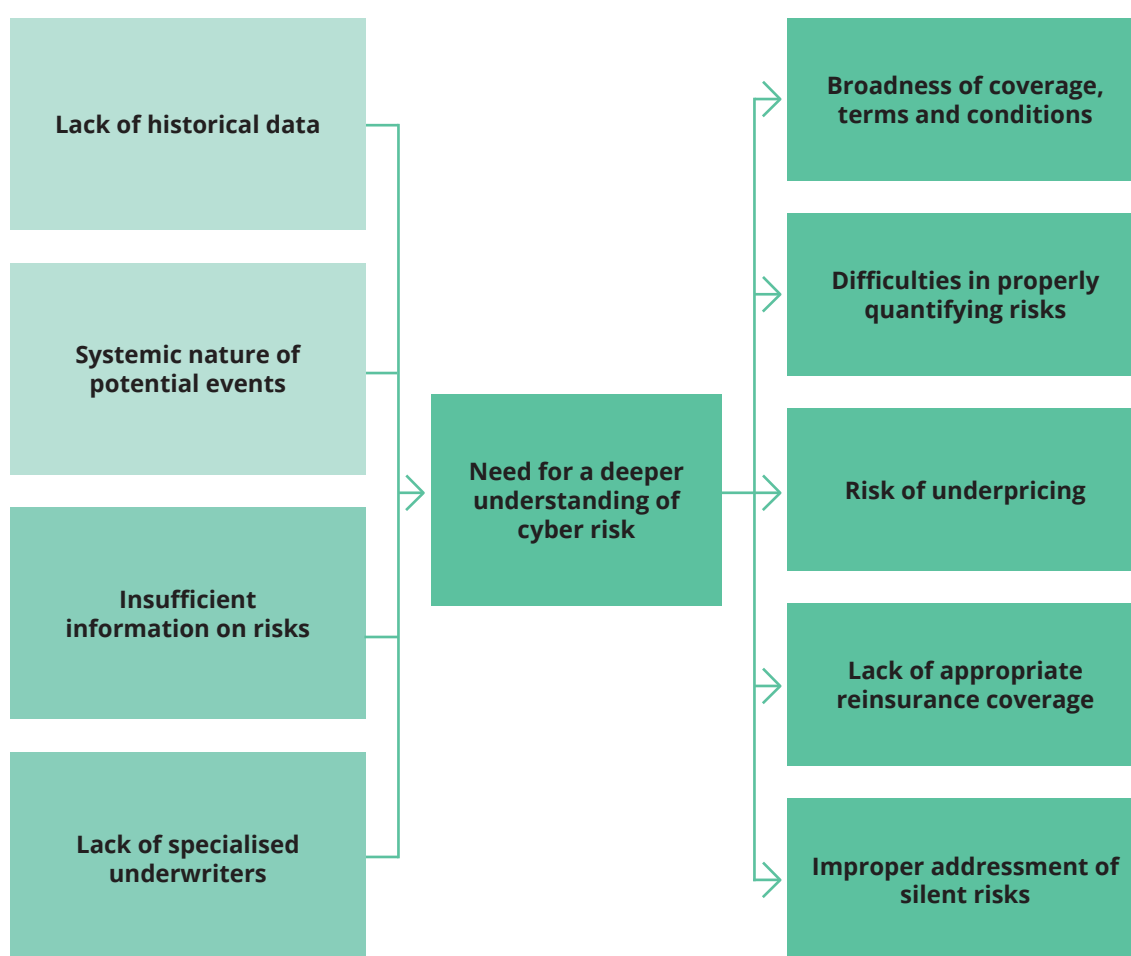
Source: BCG.

About 90% of stand-alone cyber-insurance was for US risks in 2016.³⁷ Some states require cyber-insurance coverage for certain businesses.³⁸ London has a significant share of the global market and could benefit from more growth. Its expertise in pricing complex, often international, risks in the wholesale insurance market puts it in a good position to do so (see **Figure 4**).

The private sector should seize the opportunities of the cyber-insurance market. Authorities and public policy can support it. Regulators will need to ensure that effective prudential and risk management practices are observed by insurers, so they have the financial resources to absorb losses and pay claims. About 70% of insurers say that pricing cyber-risks is still a black box, so making sure firms are effectively assessing and pricing risk will be important.³⁹

The European insurance standard setter, EIOPA, has published a diagnosis of key considerations for developing a cyber-insurance market (**Figure 5**).⁴⁰ They highlight the need for a deeper understanding of cyber-risk and the importance of available information.

Figure 5: Framework of the key considerations around cyber-insurance



Source: *Understanding Cyber Insurance — A Structured Dialogue with Insurance Companies*, EIOPA (2018).

The Department for Digital Culture, Media & Sports (DCMS) led a government-industry group to develop cyber-data sharing further after a consultation in 2015. It included the Information Commissioner's Office, The British Insurance Brokers' Association, The Association of British Insurers, the National Crime Agency, NCSC and the Bank. A renewed focus on this topic could be helpful. Consultation on gateways and protocols for sharing cyber-incident information for insurance underwriting would be of value. The consultation could review the themes set out below and may require mandatory sharing of loss experience and data breach events:

- Review incident breach notifications and whether existing mechanisms such as reporting under GDPR or Network and Information Systems Regulations can be used to gather data for risk assessment.
- Identify protocols for the dissemination of information.

IMPLICATIONS FOR THE BANK

Firms must have contingency plans in place regardless of what causes operational disruptions, including for cyber-incidents.⁴¹ The Bank's Financial Policy Committee (FPC) sets thresholds for risk tolerance and supervisors oversee firms' cyber-plans to maintain financial stability and confidence in the system. Considerations extend beyond business continuity and disaster recovery and include physical and cyber-incidents, IT system outages, third-party supplier failure and natural hazards.

There is not consensus on the link between cyber-risk and systemic risk.⁴² There are also no examples of cyber-risk becoming systemic and impacting the real economy as yet. Also, it is clear that users do expect systems to fall over occasionally and a modest outage is accepted by individuals and companies, as long as services resume quickly following an incident.

The Bank's focus on operational and cyber-risks will likely become as important as its supervision of capital and liquidity. It will have to continue to work with the financial sector to enhance cyber-resilience and keep up with the threat.

The Bank has the following objectives for a major operational disruption:⁴³

- To keep retail and wholesale markets, including payment and settlement systems, open and functioning;
- To provide effective channels of communication and a co-ordinated response in case market functioning is paused to ensure an orderly and early return;
- To involve relevant infrastructure providers/market participants and facilitate market initiatives where possible, when responding in ways that affect markets.

The dynamic and sophisticated nature of cyber-risks means the Bank must collaborate with the private sector to achieve these goals and to drive collective action. Co-operating with international partners, including through the G7, is also vital because of the financial interconnectedness and global nature of many threats.

Box 3: What is the Bank already doing?

The Bank has been a thought leader on cyber-resilience. It has several existing and upcoming initiatives to address cyber-risks:¹

- The FPC encourages firms to enhance their resilience to cyber-incidents, including through state-of-the-art penetration testing using the CBEST framework.
 - The FPC is launching a pilot cyber-stress test in Summer 2019. It will explore a scenario that assumes the systems supporting firms' payments services are unavailable.²
 - The FPC will also explore what affects firms' ability to restore activity quickly, whether doing so might have unintended consequences and what would happen if contingency measures were unsuccessful. This will allow the Committee to consider the implications of longer disruptions to payment services for financial stability.³
- The Bank is working closely with the National Cyber Security Centre (NCSC), HMT and the FCA to share information about cyber-threats in the financial sector.⁴
 - The Bank is working with its G7 counterparts to establish best practice information-sharing and cyber exercises.⁵
 - UK Finance, the Government Communications Headquarters (GCHQ), BoE and NCSC are working together to address cyber-risks in a faster and more co-ordinated way.⁶ This includes the Financial Sector Cyber Collaboration Centre which will be launched this year.⁷

1 See www.bankofengland.co.uk/financial-stability/financial-sector-continuity.

2 *At a glance: FPC plans for operational resilience stress testing*, PWC, (2018).

3 *Financial Stability Report — June 2018*, Bank of England, (2018).

4 See <https://publications.parliament.uk/pa/jt201719/jtselect/jtnatsec/1708/170807.htm>.

5 *G7 Fundamental Elements for Effective Assessment of Cybersecurity for the Financial Sector*, (2016).

6 *Cyber and the City: Making the UK financial and professional services sector more resilient to cyber attack*, TheCityUK, Marsh, (2016).

7 See www.bankingtech.com/2018/10/uk-financial-sector-unites-for-financial-sector-cyber-collaboration-centre/.

RECOMMENDATIONS

8.1 Enhance data recovery	Why does the Bank need to act? <ul style="list-style-type: none">• The data wipe of even a mid-sized institution could undermine trust in the system — as shown by the US “Hamilton Series” cyber-exercise convened by the US Treasury.• US firms have created an industry-led initiative that allows firms to securely store a protected, unalterable backup that can be used to serve customers in case of a major disruption, called Sheltered Harbor. This is an additional layer of resilience to business continuity and disaster recovery. About 60% of US retail bank accounts are now covered by this voluntary scheme. It offers the potential that a second bank could take over the operations of the first, in the event of a debilitating attack.• This additional layer of protection is currently a missing piece in the UK landscape.
	What can the Bank (and others) do? <p>The Bank should:</p> <ul style="list-style-type: none">• Map the mechanisms for data recovery and the potential for firms “stepping in” in the event of a major cyber-incident.• Consider the merits of the US private sector “Sheltered Harbor” initiatives.

8.2 Conduct cyber-exercises	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • Cyber-risk is one of the top priorities for financial services firms. Cyber-exercises are useful to understand vulnerabilities and reaction functions. • The Bank's CBEST penetration test is one of the supervisory tools available to test firms' resilience to cyber-incidents. CBEST mimics skilled attackers who are able to steal, corrupt or destroy their target. It runs every three years for banks and five years for infrastructure and systemic payment firms. • The US "Hamilton Series" simulated a variety of plausible cyber-security incidents to better prepare the financial and public sector in responding to cyber-attacks. These cyber-exercises are developed in collaboration with the FSCCC, the US Treasury Department and other US government agencies. Since 2015, US financial institutions have partnered on 19 "Hamilton Series" cyber-security exercises through the voluntary body Financial Services Information Sharing and Analysis Center. This has improved public and private sector policies, procedures and response capabilities.
	<p>What can the Bank (and others) do?</p> <p>The Bank should:</p> <ul style="list-style-type: none"> • Enhance the frequency of domestic and international cyber-penetration tests. Growing focus should be on payments from traditional and new entrants and the full value chain of providers.

8.3 Encourage better information sharing	<p>Why does the Bank need to act?</p> <ul style="list-style-type: none"> • Cyber-risk is complex with insufficient insurance coverage in scale and scope. A material cyber-incident could disrupt public and private sectors in the UK and worldwide. • The pace of developments and scale of opportunity suggest developing a deeper insurance market for businesses at home and abroad might be worth exploring. • Increased collation and availability of anonymised data on cyber-incidents would be a tangible step in this direction.
	<p>What can the Bank (and others) do?</p> <p>The Bank should:</p> <ul style="list-style-type: none"> • Encourage better disclosure on cyber-threats domestically and internationally to help develop the data required for developing a more effective cyber-insurance market.

ENDNOTES

- 1 [Staying ahead of cyber crime](#), UK Finance, KPMG, (2018).
- 2 [Cyber Security Breaches Survey 2018](#), Department for Digital, Culture, Media & Sport (DCMS), (2018).
- 3 See www.hiscoxgroup.com/news/press-releases/2018/18-10-18.
- 4 [Cyber Risk for the Financial Sector: A Framework for Quantitative Assment](#), International Monetary Fund (IMF), (2018).
- 5 [Staying ahead of cyber crime](#), UK Finance, KPMG, (2018).
- 6 [Systemic Risk Survey Results, 2018 H2](#), Bank of England, (2018).
- 7 [Global Cybersecurity Index \(GCI\) 2017](#).
- 8 [Staying ahead of cyber crime](#), UK Finance, KPMG, (2018).
- 9 [G7 Fundamental Elements for Effective Assessment of Cybersecurity for the Financial Sector](#), (2016).
- 10 [Building the UK financial sector's operational resilience](#), Discussion Paper 01/18, PRA, FCA, (2018).
- 11 [Building the UK financial sector's operational resilience](#), Discussion Paper 01/18, PRA, FCA, (2018).
- 12 See www.bankofengland.co.uk/-/media/boe/files/news/2014/june/boe-launches-new-framework-to-test-for-cyber-vulnerabilities.
- 13 [CBEST Intelligence-Led Testing: CBEST Implementation Guide, Version 2.0](#), Bank of England, (2016).
- 14 [Self-assessment of the Bank of England's Real-Time Gross Settlement Service against the Principles for Financial Market Infrastructures](#), Bank of England, (2016).
- 15 [Summary of the 2016 Sector Security and Resilience Plans](#), Cabinet Office, (2016).
- 16 [Financial Services Sector Cybersecurity Recommendations](#), Financial Services Sector Coordinating Council, (2017).
- 17 See <https://shelteredharbor.org>.
- 18 [The world's first data embassy — Estonia case study](#), OECD, (2018).
- 19 See <https://publications.parliament.uk/pa/jt201719/jtselect/jtnatsec/1708/170807.htm>.
- 20 See www.information-age.com/data-breaches-financial-services-firms-123479537/.
- 21 See www.ft.com/content/6a2d9d76-3692-11e9-bd3a-8b2a211d90d5.
- 22 [Cyber Security in Securities Markets — An International Perspective: Report on IOSCO's cyber risk coordination efforts](#), OICV-IOSCO, (2016).
- 23 [ECB Banking Supervision: SSM Supervisory Priorities 2019](#), ECB, (2019).
- 24 See <https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/personal-data-breaches/>.
- 25 See www.itgovernance.co.uk/dpa-and-gdpr-penalties.
- 26 [FSI Insights on policy implementation No 2: Regulatory approaches to enhance banks' cyber-security frameworks](#), Bank for International Settlements (BIS), (2017).
- 27 [Advisory to Financial Institutions on Cyber-Events and Cyber-Enabled Crime](#), Financial Crimes Enforcement Network (FinCEN), (2016).
- 28 [Cyber Threat Intelligence — Issue and Challenges](#), Abu et al., Indonesian Journal of Electrical Engineering and Computer Science, Vol. 10, No. 1, (2018).
- 29 See www2.deloitte.com/cn/en/pages/risk/articles/cyber-resilience.html.
- 30 [Enhancing the Role of Insurance in Cyber Risk Management](#), OECD, (2017).
- 31 [Global Cyber Market Overview: Uncovering the Hidden Opportunities](#), Aon Inpoint, (2017).
- 32 See www.financialdirector.co.uk/2018/07/16/financial-risk-analysis-methods-and-techniques/.
- 33 See www.securityweek.com/steps-improve-critical-infrastructure-and-ics-network-security.
- 34 [Counting the cost: Cyber exposure decoded](#), Emerging Risks Report 2017, Lloyd's, (2017).
- 35 [Black swans and fat tails: The market for cyber-insurance is growing](#), The Economist, (2019).
- 36 [Understanding Cyber Insurance — A Structured Dialogue with Insurance Companies](#), European Insurance and Occupational Pensions Authority (EIOPA), (2018).
- 37 See <https://home.kpmg/xx/en/home/insights/2018/10/lead-in-cyber-insurance-fs.html>.
- 38 See www.ncsl.org/research/telecommunications-and-information-technology/cybersecurity-legislation-2018.aspx.
- 39 [Gaining Ground on the Cyber Attacker: 2018 State of Cyber Resilience](#), Accenture, (2018).
- 40 [Understanding Cyber Insurance — A Structured Dialogue with Insurance Companies](#), European Insurance and Occupational Pensions Authority (EIOPA), (2018).
- 41 [Building the UK financial sector's operational resilience](#), Discussion Paper 01/18, PRA, FCA, (2018).
- 42 [Could a cyber attack cause a systemic impact in the financial sector?](#), Quarterly Bulletin 2018 Q4, Bank of England, (2018).
- 43 See www.bankofengland.co.uk/financial-stability/financial-sector-continuity.

9 EMBRACE DIGITAL REGULATION

THE OUTCOME WE SEEK

A world-leading, technology-enabled and cost-effective regulator that uses modern technology to gather data, monitor risk and maintain a safe and effective financial system.

- Markets have been made far more transparent in response to the financial crisis. Technology and new techniques are now essential to monitor them most effectively.
- There is huge scope for the Bank to use of advanced analytics for analysis of macroeconomic trends, financial surveillance and supervision.
- Routine tasks should increasingly be automated. A shift will free up resources to focus on value added analysis.
- The PRA needs a long-term strategy for data and regulatory technology. This requires investment and collaboration from firms. Costs may rise temporarily but then transform in the longer term.

KEY DEVELOPMENTS

Using new technologies to keep the financial system safe from threats

There is huge scope for the Bank to use advanced analytics for analysis of macroeconomic trends, financial surveillance and supervision. The explosion in data in finance demands new techniques. The UK's financial system is creating more data, and perhaps moving faster, than ever before. Technology can enable better surveillance and analysis.¹ It can also help regulators to spot irregularities and problems earlier,² to fight financial crime and get a better picture of the overall system's health and risks.³

The PRA's philosophy is based on forward-looking judgment-based supervision.⁴ Technology can automate routine tasks, offer new analytical and oversight techniques and provide information and diagnostics. All of this will support and enhance rather than replace high value-added human judgement.⁵

Technology may also help with threats to operational resilience. Since the crisis there has been a large shift to market based finance (Chapter 7). This diversity is welcome, but markets can have many participants with complex interconnections and behaviours, and transaction flows are at high volumes and rapid frequency.⁶ Technology can help track these better.

More sophisticated regulation and growing volumes of supervisory data

The volume of data in the economy has surged in recent years (Chapter 3). This is also true of the quantity of data available to regulators.⁷ Aggregate data collections have increased more than fivefold since the crisis (**Figure 1**). In addition, mandatory reporting of granular trade repository data offers the potential to monitor trading behaviour in near real-time.⁸ But it means the Bank now receives more than one billion rows of data every month.⁹ Supervisors must take advantage of the ongoing developments in data science and processing power.¹⁰ This includes artificial intelligence (AI) and machine learning that automate data collection and processing.¹¹ Given regulation is global, the increase in data is a common theme across the world. Therefore the Bank can learn from international peers.

New tools will be essential to digest the extraordinary growth in data. For example, the Bank could decide to reach out for data rather than requesting submissions of regulatory returns.¹² Some other regulators around the world are embracing technology to improve their effectiveness in this and other ways.¹³ A central bank that uses innovative technologies and data science for market surveillance and to monitor financial activities will make the system safer and improve regulation.

Over the coming years, the system would benefit from a shift in mindset from the cost to the regulator of compliance, to efficiency of the system, including the costs to the private sector. McKinsey & Company estimates that regulatory reporting for UK banks costs the industry £2bn–£4.5bn per year in run costs and risk change costs alone.¹⁴

Box 1: Reforming and repairing the financial system — a decade of regulatory investment

The global financial crisis revealed a system that needed fundamental reform and repair. G20 Leaders acted in 2008 to halt the crisis and, a year later, established the Financial Stability Board to address underlying issues in the financial system.¹

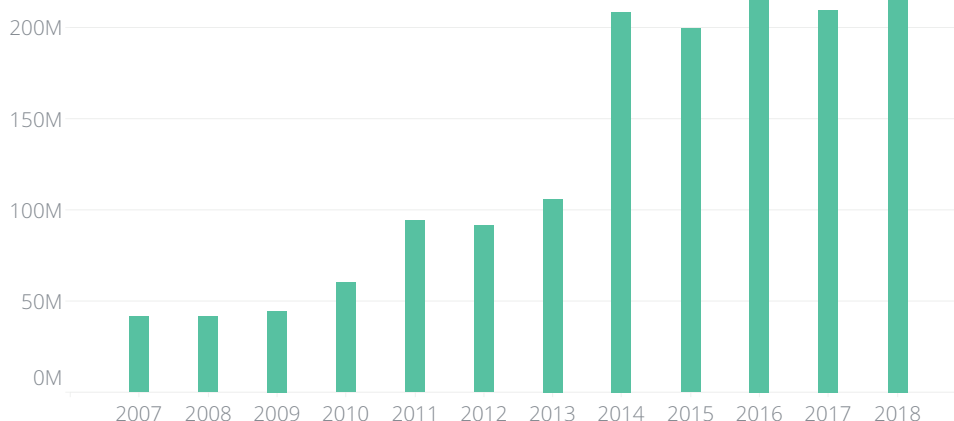
A decade on, bank regulation is significantly stricter.² Capital requirements are ten times higher for the largest banks and supplemented by resolution plans and other standards that mean that banks can fail safely in the future.³ Other parts of the financial system, including central counterparties⁴ and shadow banking,⁵ have also been reformed in order to strengthen their resilience and limit the damaging effects of contagion across the system. And regulators now gather more data with which to monitor financial stability.⁶

These were global reforms, endorsed by G20 governments.⁷ The European Union has legislated to apply them consistently across all EU Member States. In the UK, the authorities complemented international regulation⁸ with structural reform to increase the resilience of UK retail banking operations,⁹ stricter governance requirements for those running UK financial institutions¹⁰ and measures to address misconduct in wholesale markets.¹¹

Inevitably, given the depth of the financial crisis and the scale of reform, this “re-regulation” has been the priority of the last decade.¹² With the repair of the financial system now largely complete,¹³ the Bank and firms alike can now focus on strategic and long-term investment in capabilities, technology and infrastructure.

- 1 [Improving Financial Regulation: Report of the Financial Stability Board to G20 Leaders](#), FSB, (2009).
- 2 [Basel III Monitoring Report](#), Bank for International Settlements (BIS), (2018).
- 3 [The Bank of England's approach to resolution](#), Bank of England, (2017).
- 4 [Central counterparties: what are they, why do they matter and how does the Bank supervise them?](#), Bank of England, (2013).
- 5 [Transforming Shadow Banking into Resilient Market-based Finance](#), FSB, 2015.
- 6 [Artificial intelligence and machine learning in financial services: Market developments and financial stability implications](#), FSB, (2017).
- 7 [Leaders' Statement, The Pittsburgh Summit, September 24–25, 2009](#).
- 8 [Changing banking for good](#), Report of the Parliamentary Commission on Banking Standards, (2013).
- 9 [Ring-fencing: what is it and how will it affect banks and their customers?](#), Bank of England, (2016).
- 10 See www.bankofengland.co.uk/prudential-regulation/authorisations/senior-managers-regime-approvals.
- 11 [Fair and Effective Markets Review — Final Report](#), Fair and Effective Markets Review (FEMR), (2015).
- 12 [Prudential bank regulation: present and future](#), speech given by Vicky Saporta, Westminster Business Forum, 4 July 2018.
- 13 [Basel III Monitoring Report](#), Bank for International Settlements (BIS), (2018).

Figure 1: Data collected by the Bank has grown rapidly since the crisis^a



a Selected regulatory and statistical aggregate data collections.

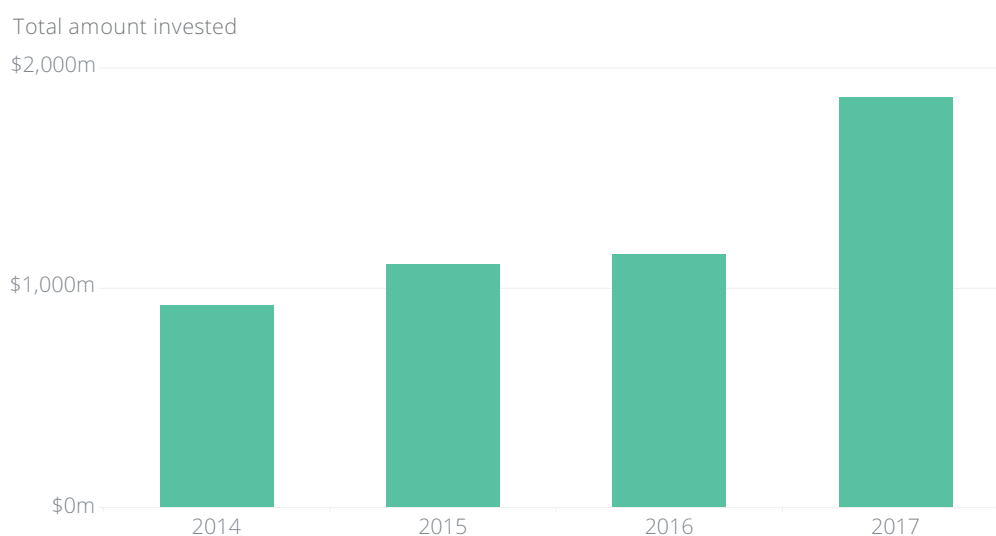
Regulation and the rulebook for firms have become more sophisticated, but also more complex. As a result of the “re-regulation” following the crisis (**Box 1**), the current rulebook at 638,000 words, is longer than *War and Peace*.¹⁵ Technology, through the use of machine-readable rules and AI could help firms and supervisors navigate and use the rulebook more effectively and efficiently.¹⁶ This can improve compliance and risk management outcomes, reduce costs and ease the process of implementing and adjusting regulation.

Co-ordinated and led by the Financial Stability Board, with membership from across all G20 countries, financial sector reform was global.¹⁷ Detailed international standards have been developed by global standard setters such as the Basel Committee on Banking Supervision. This provides a baseline of international consistency across jurisdictions. In Europe, reforms are implemented through “maximum harmonised” regulation and harmonised pan-EU reporting taxonomies and templates. Taken together this means that the trends observed are global, and that UK authorities may not have much latitude to change regulation or reporting requirements.¹⁸

Embracing digital regulation

Technology can help improve the use of the information and reduce costs for firms and supervisors alike. An ecosystem for regulatory technology, or regtech, has emerged in recent years (**Figure 2**). Regtech companies are cutting costs of collating and submitting regulatory data by streamlining and automating some of the manual processes at financial services firms.¹⁹

Figure 2: The regtech industry has attracted considerable investment



Source: McKinsey & Company *American Banker*, press releases; International RegTech Association (IRTA); Thomson Reuters; CBI Insights; and Fintech Global.

Technology is also improving the quality of oversight within firms. As well as using algorithms for hyper-fast trading, firms are using AI to monitor trading activity and spot anomalies.²⁰ They are also using anomaly detection to combat fraud in consumer credit and to improve money laundering controls.²¹

Given the volume of information created, transmitted and received, embracing leading technology is no longer a choice. The explosion in the volume of regulatory data means supervisors receive more information than they can absorb and analyse using traditional methods.²² This may cause distraction and creates the risk of missing the wood for the trees in safeguarding the financial system. Technology could help make the best use of this data.

As firms become more digitised, regulators globally are keen to keep up and explore ways to use the latest techniques. Some are deploying machine learning to analyse granular datasets, while others are trialling the use of natural language processing to evaluate firm reports. And a number are completely re-thinking the way they gather data from firms.

The Bank has conducted proofs of concept on using AI for data analysis and is exploring making its rule book machine-readable.²³ And it has an advanced analytics hub, which is using some of the most progressive techniques in analysing policy data. But there is considerable scope for further development.

Reducing time spent cleansing and manipulating data

Supervisors spend most time on preparation in the data lifecycle. Compiling supervisory information can require considerable manual manipulation and reconciliation for even the most basic analysis. Estimates suggest that supervisors spend around two thirds of their time on manipulating rather than analysing data. This makes it difficult to focus on high-value analysis.

Data on the scale and granularity received by regulators is hard to manipulate and analyse using traditional methods.²⁴ And combining disparate datasets to conduct network analysis, for example, requires sophisticated techniques. But even with the latest techniques, cleansing and cataloguing incomplete and erroneous data is arduous and time-consuming. Today's approach is a long way from real-time monitoring.

Better regulatory data can reduce the need for *ad-hoc* requests

The Bank collects two main types of data for supervisory purposes. It has large structured datasets that are mandatory, consistent across firms and regularly collected.²⁵ These have some downsides. They are untimely, often quarterly with a six-week lag. They can be unwieldy, comprising a large number of aggregate data points with complicated definitions, about 15,000 for a small firm and 300,000 for a large firm. They are expensive to replace or update. And firms collect them based on the appropriate regulatory balance sheet, which is often hard to relate to their business lines.

To supplement the structured information, supervisors ask firms for management information (MI).²⁶ This is generally produced by business line, on the basis of an accounting balance sheet and on a much timelier basis. As a result, MI is regularly used to supervise larger firms with regulatory returns only being a periodic secondary "sense check". In contrast, regulatory data is often the primary information source for smaller firms that produce far less firm MI.

This means supervisors receive an enormous body of unstructured data.²⁷ As supervisors get barraged with data, they have to be smarter about how they spend their time. And they must use ever more sophisticated techniques to gather, organise and interrogate the data.

Effective storage and access is needed to make the most of data

Most regulatory data is stored in legacy Bank or Financial Conduct Authority (FCA) systems that may be slow and clunky to use, making it difficult to blend and in some case construct time series or cross-firm analysis.

Supervisors collect firm MI — unstructured data — directly and store it locally. This can make managing and manipulating it harder. The general process for comparing and contrasting data from different sources is often manual. And increasing amounts of public data are now behind paywalls. Given budgetary constraints, supervisors cannot access all of this information.

Improving efficiency of regulation for an industry facing cost pressure

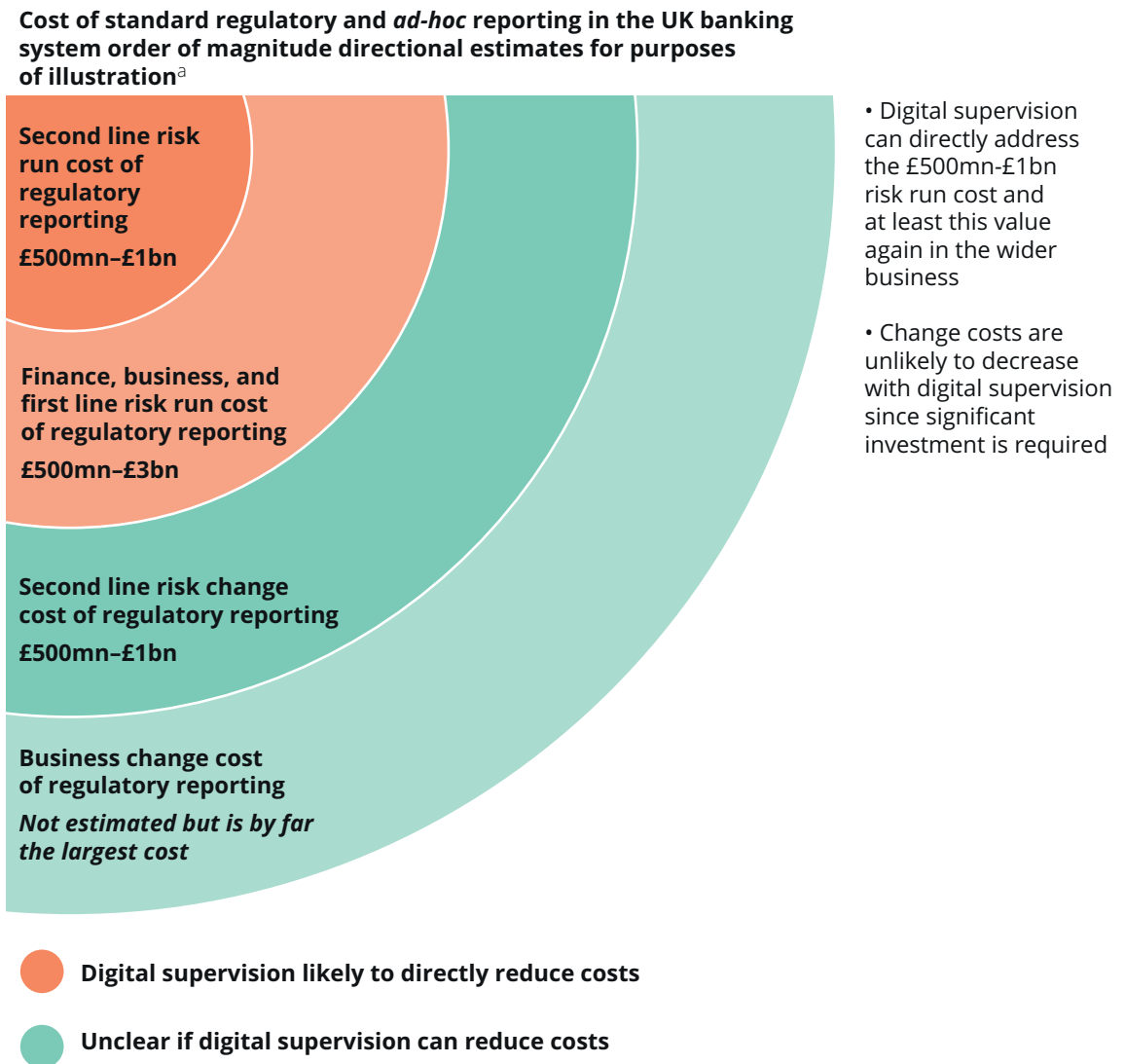
McKinsey & Company estimates that the cost to the industry of regulatory reporting amounts to £2bn–£4.5bn a year for UK banks in run costs and risk change costs alone (**Figure 3**).

Simultaneously, UK banks' return on equity is under pressure from all angles (Chapter 7).²⁸ Net interest margins have been compressed as the low interest-environment has pushed down the rate earned on lending. And the rate banks pay on deposits has hit an effective lower bound. After many years spent rebuilding balance sheets, regulatory initiatives such as the recent Directive (2014/65/EU) and Regulation (600/2014/EU) on markets in financial instruments directive (MIFID II) and Open Banking have placed considerable costs on the banking industry. And regulatory fines and redress, such as £35 billion in PPI pay-outs to compensate customers for systemic mis-selling, have absorbed resources.²⁹

Alongside this, competition in the banking industry has increased. Several challenger banks have emerged in the past decade. More recently non-bank fintechs are also competing for some of the most profitable parts of the banking value chain. Although take-up has so far been slow, its proponents argue that Open Banking could create further competition.³⁰ PWC predicts that 40% of banking revenues could be at risk from fintech.³¹

Banks increasingly recognise the threat and opportunity from technology. The Bank's 2017 Biennial Exploratory Scenario (BES) asked the major UK banks to estimate the impact of these trends on their profits over the next three years.³²

Figure 3: UK banks spend between £2bn–£4.5bn yearly on regulatory data, according to one estimate



Sources: McKinsey & Company, Capital IQ, industry interviews, expert estimates and team analysis.

^a Estimating cost of regulatory reporting is extremely challenging due to the breadth of institutions, diverse range of processes, and fragmentation of activities across business/first line/second line, and across run/change. These numbers have been calculated using a best endeavours approach based on banks' self reported figures combined with expert interviews. Therefore the numbers should be seen as an order of magnitude guiding indication rather than a precise calculation.

Learning from overseas

International experience emphasises the need for a step change in investment, prioritisation and collaboration if long-term data strategies are to succeed. This chapter presents four case studies from Australia, Singapore, the Philippines and Austria. Each country has taken a distinctive approach. But the uniting factor is that each initiative was a strategic, management and investment priority. If the Bank launches a long-term data strategy, it should ensure these conditions are in place.

Taking a strategic view on data is a fundamental starting point for a digital transformation. This means understanding the role and purpose of data in the organisation, its value and how the organisation wants to use it. Once this strategic vision is in place, design, investment and operational choices can be made with greater certainty. The example of the Australian ASIC three-year data strategy could have helpful lessons for the Bank (**Box 2**).

Box 2: What the Bank can learn from the ASIC three-year data strategy

In 2017, the Australian Securities and Investments Commission (ASIC) introduced a consultation and framework on a three-year data strategy.¹ It included some valuable elements, which are worth considering for the UK.

- **A clear objective and purpose to – in their own words:**

“Transition ASIC into a more data-driven and intelligence-led organisation, more capable of “connecting the dots” to achieve better regulatory outcomes.”

“Describe our vision for data, our objectives and our approach to improving how we capture, share and use data. Understanding the regulatory environment, how the regulated community behaves, and the outcomes for consumers and markets is key to performing our role.”

- **Collaboration with industry with regular review and a strategic plan:**

“Our data strategy is part of One ASIC which is about “connecting the dots” to achieve better regulatory outcomes. It is about working together and sharing data seamlessly using common language, systems and processes. Where possible, we will streamline our processes to make clear to our regulated population what data we need and why, and to ensure that we collect it in a proportionate and fair way. We will review our progress and publish an update annually.”

- **A set of clear and specific initiatives:**

Creating a Chief Data Office.

Establishing the Data and Information Governance Framework.

Opening a data science lab.

Setting up governance forums that are public/private bodies, including the Digital Governance Board, Data Governance Council, Data Analyst Network and Data Champions Forum.

Forming data exchange frameworks with other agencies.

Educating staff on the value and potential uses of data.

Implementing the One ASIC Regulatory Transformation Program. This includes:

- *Creating a repository of the regulatory data captured, and a new search tool for staff, providing a consolidated view of the regulated entities;*
- *Replacing legacy workflow systems with a single integrated customer relationship management system;*
- *Using a common language that supports consistent recording, reporting and analysis across the regulatory business;*
- *Developing a new online portal to support improved stakeholder interaction and better collection of digital data.*

Such a strategic view of data can be enhanced by thinking about the wider regulatory ecosystem. This gives a 360 degree view on data and analytics, and how industry collaborations and consultation can leverage best practice. The Singapore Fintech Ecosystem strategy (**Box 2**) could provide some lessons for the Bank in this regard.

1 [ASIC's Data Strategy 2017-20](#). Australian Securities & Investments Commission (ASIC), (2017).

Source: [Australian Securities and Investments Commission data strategy](#).

Box 3: What the Bank can learn from Singapore's active stance on modernising regulation

MAS fintech ecosystem strategy

The Monetary Authority of Singapore (MAS) launched a new strategy in 2017 with clear objectives and a coherent series of plans.¹ As part of Singapore's Smart Nation agenda, MAS is helping to create an "open API economy", enabling service providers to use information directly from multiple sources.² It wants to: "create an ecosystem for innovation, where established financial institutions and fintech start-ups compete as well as collaborate".³ It has four key elements:

1 Regulation

A regulatory strategy that is conducive to fintech innovation and harnesses technology for greater effectiveness. It relies on people, identification, payments, data governance, applied research and platforms for innovation.

2 Collecting and sharing data

MAS is transforming its approach to data collection from financial institutions by using machine-readable templates to automate it.⁴ The goal is to eliminate any duplicated data requests. It has also encouraged firms to develop and openly share application programming interfaces (APIs).⁵

3 Using enhanced analytics

To enhance the use of data analytics, MAS has designated a supotech office within its data analytics group (DAG) with dedicated SupTech and regtech teams conducting data analysis on supervisory and financial sector data.⁶ This includes machine learning techniques, such as natural language processing (NLP) to analyse structured and unstructured data that helps regulators review suspicious transaction reports. It also includes studying trading behaviour through machine learning.

4 International and industry collaboration

As part of its wider strategy, MAS is operating a regulatory sandbox and runs regular hackathons for smaller fintechs to develop solutions to industry problems.⁷ It cooperates domestically and internationally with research and government institutions and industry bodies.⁸ This includes research and development collaboration with MIT, which explores pilots using distributed ledger technology, cryptography, quantum computing and AI.⁹ It also has several fintech cooperation agreements with institutions such as The French Prudential Supervision and Resolution Authority (ACPR), the French markets watchdog AMF and the Swiss Financial Market Supervisory Authority (FINMA).

MAS has created a referral mechanism to support Singapore fintech start-ups in overseas markets and to facilitate foreign start-ups to set up gateways in Singapore.

1 See www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre.aspx.

2 See www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Financial-Industry-API-Register.aspx.

3 Singapore FinTech journey 2.0, speech by Ravi Menon, Singapore FinTech Festival, 14 November 2017.

4 MAS Moves Towards Zero Duplication of Data Requests to Financial Institutions, Monetary Authority of Singapore (MAS), (2018).

5 Singapore's FinTech Journey — Where We Are, What Is Next, speech by Ravi Menon, at Singapore FinTech Festival, 16 November 2016, and The Future of Banking — Evolution, Revolution or a Big Bang?, speech by Ong Chong Tee, German-Singaporean Financial Forum, 16 April 2018.

6 MAS Sets up Data Analytics Group, MAS, (2017).

7 See www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/FinTech-Regulatory-Sandbox/Understanding-and-applying-to-the-sandbox.aspx.

8 See www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/FinTech-Cooperations.aspx.

9 Singapore FinTech — innovation, inclusion, inspiration, speech by Ravi Menon at Singapore Fintech Festival 2018, 12 November 2018.

Source: Monetary Authority of Singapore.

LOOKING TO THE FUTURE

A global leader in financial regulation needs to use the latest technology. This is to analyse the increasing amounts of data that will continue to become available without disproportionate costs to the industry. It should aspire to:

- Only require firms to submit data once;
- Develop a taxonomy and data standard that are clear, widely recognised and machine-readable;
- Leverage cloud technology to benefit from increased scale, agility and cyber- and operational resilience;
- Minimise the risk of human error by reducing the need for manual data cleaning;
- Use dashboards to monitor and compare risks across firms in real-time;
- Be able to request further data instantly to interrogate it as the need arises;
- Have the analytical tools to make tangible inferences from large datasets and present them in a meaningful way to policymakers.

In terms of data, it should also be ambitious:

- **Collection:** Requests for structured data should be machine-executable. Regular requests would be coded so firms can automatically read the requirements and pull the data from their systems. This requires defining the suite of data that matters most, including more comparable forward looking information on firms' business models.
- **Storage:** Rather than collecting data every week, the Bank could access it from firms' cloud infrastructure when needed through a shared data lake.
- **Analysis:** The Bank could use pioneering NPL, machine learning and big data analytics to chart data points in real time for supervisors. This provides an instant view of how firms' business models are performing against forecast and actual updates of key ratios. It also allows supervisors to apply real-time shocks and stresses to better predict breaches of regulatory requirements.

This would allow supervisors to focus on what matters most. By creating a set of definitions with the industry that are machine-readable and executable, supervisors will be able to go straight to processing. This will maximise time spent on high-value activities and improve the quality of the analysis.

To respond to the rapidly changing environment, the Bank could consider four options with varying degrees of ambition. All involve greater use of the technology and require learning and development of the supervisory workforce. The Bank can develop them as modular improvements that build incrementally towards a new technology stack. How far it chooses to go is a decision for its executive. The costs and benefits are set out below.

Optimising the existing framework for gathering, storing and analysing data

- **Option 1 — optimise unstructured data:**
Recognising that much information received by supervisors is unstructured, the Bank could seek to achieve "quick wins" by improving the receipt, storage and analytics of unstructured information.
- **Option 2 — optimise within current structure:**
Supervisors can continue to use firm reports but these would be improved by a common reporting taxonomy and the use of better data management and analytics. The Bank could make efficiency savings by improving its ability to analyse big data sets. And through improved analytics, raise the quality of micro- and macro-prudential analysis and action.

Transforming the regulatory approach

- **Option 3 — supervise within firms' systems using APIs:**
Work with industry to access data through APIs directly from firms' systems using a common format. Select three high value use cases and sequence them into a roadmap that delivers tangible benefits in the first two years. Build in-house analytical capabilities in tandem with specific use cases. This could reduce submission time from 30 minutes to just 10 seconds. It requires transparency and firms to be comfortable with supervisors accessing their data.
- **Option 4 — create a shared data repository:**
Work with the industry to build a data utility that firms and supervisors can access. All statistical and regulatory reports are run from the central repository. Near real-time analysis is possible with granular data. This allows transparency over impromptu data requests and low marginal costs on firms. It takes a long time to build and runs a higher risk of obsolescence (**Figure 4**).

The Bank can learn much about different models for data receipt, storage and manipulation from overseas. It is not clear that any single model stands out. But increasingly distinct strategies and models are emerging. Those include the models adopted in the Philippines (**Box 4**) and Austria (**Box 5**).

Box 4: What the Bank can learn from the Philippines' use of an API for regulatory data

The Bangko Sentral ng Pilipinas (the Philippines Central Bank, or BSP) is developing an API and prototype application for back-office reporting and visualisation, which will:¹

- *"Allow financial institutions to submit high-quality, granular data digitally, and automatically to the financial authority with higher frequency."*
- *"Enable BSP staff to make data validation faster and analysis sharper by generating customised reports for supervisory and policy development purposes in different formats."*

Currently, BSP's Supervisory Data Center (SDC) receives incomplete, late, and inconsistent reports. Data cleaning and validation is manual and consumes significant resources.²

1 See www.r2accelerator.org/bsp.

2 See www.r2accelerator.org/api-visualization-prototype.

3 See www.r2accelerator.org/bsp.

BSP launched a competition with Regtech for Regulators Accelerator (R2A) with a maximum grant value of US\$100,000 in October 2017. A panel of judges selected Compliant Risk Technology (CRT) as the winner to develop the API and visualisation prototype.

The project aims to address late, lacking and inconsistent reporting by improving the quality and access to data, and developing new tools for visualisation and analysis. It should help BSP: *"implement a risk-based supervisory approach that reduces compliance costs and promotes financial inclusion while ensuring financial stability and integrity."*³

Source: [Bangko Sentral ng Pilipinas](#) and [Regulators Accelerator](#).

Box 5: What the Bank can learn from Austria's central data platform

In 2014, seven of the largest Austrian banks came together to found a central platform (AuRep) for statistical and regulatory reporting.¹ Its objective was to improve data quality while generating medium-term cost savings for the whole market. Banks created a standing committee (SCom) with the Austrian central bank (OeNB) to develop the integrated reporting model.

Banks make sure their raw data meets basic reporting requirements (Basic Cube). AuRep then transforms it into multi-dimensional reporting forms using smart cubes. But banks remain responsible for data accuracy.





The basic cube achieves:

- A harmonised database model at a very granular level;
- Consistency, absence of redundancy and ease of expandability;
- Joint platform development between banks and regulators;
- A future basis for almost all reporting obligations;
- More clarity regarding definitions and higher submission quality through the Cube;
- The re-use of data for different needs through multi-dimensional cubes;
- Consistency of input-and output data (internal, external reporting);
- Transparent communication;
- Stepwise approach and a well-planned transition period with a parallel testing phase.

¹ [OeNB's innovative reporting data model as RegTech/SupTech solution?](#), Oesterreichische Nationalbank (OeNB), (2018).

Source: [Austrian Reporting Services](#) and [Bearing Point](#).

Figure 4: Options for a future approach to gathering data

	Optimise within current framework		Transform the regulatory approach	
	 A: Short term: optimise unstructured data	 B: Optimise within current structure	 C: Supervise and test within firms' systems	 D: Create a shared data repository
Description	BoE invests in document management and AI tooling to optimise supervisor ability to locate and drive insights from unstructured data, especially firm MI	BoE continues to see reports but these are enhanced via common reporting taxonomy and deploy document management/AI for supervisors	BoE accesses data in common format on-demand via APIs directly from firm systems.	BoE access granular data in common format in shared data repository (e.g., data lake)
Who generates insights	Firms in reports		Regulator with direct analysis	
Where is data held	Firms' systems			Shared data lake
When can supervision occur	Defined regulatory reporting schedule and <i>ad-hoc</i> requests		On demand	
How can BoE supervise	Past data	Past data	Past data and in real time	Past data
Benefits	Reduction in time taken to process MI and compile initial reports Increase in capacity of supervisors to focus on deriving insights for entities and sectors at risk e.g., dynamic visualisation	All benefits from option A High data consistency across firms, minimising burden on firms to define data taxonomy, removing ambiguity and allowing comparisons across firms	(Potential for much greater granularity, timeliness and access Granular data drawn directly minimising burden on firms and request duplication, ultimately reducing the run costs Near real-time data extraction, analysis, and intervention possible Could enable multiple regulators to access shared data if common reporting taxonomy adopted across jurisdictions	
Investment needed	Low: Requires some BoE investment (e.g., in moder-nising IT, cloud and AI)	Moderate: Requires investment from firms to achieve common reporting taxonomy; requires investment from BoE as in option A	High: Requires investment from firms to achieve common reporting taxonomy and enable APIs; requires BoE investment to develop and manage APIs	High: As per option C and also requires investment in common data lake infrastructure

Sources: Industry and expert interviews and McKinsey & Company.

IMPLICATIONS FOR THE BANK

The Bank has a statutory objective to maintain financial stability by ensuring the safety and soundness of regulated firms and reducing risks to the system. But it also needs to use resources in the most efficient and economic way. With the memory of the financial crisis still strong, it is committed to harnessing data and technology to monitor risks and mitigate them early (**Box 6**).

Box 6: How the Bank uses data and technology

The Bank is modernising and improving the resilience of its services through the Data Centre Migration Programme (DCMP).

It has begun investing in internal digitalisation — for example through initiatives such as Data Analytics, Cyber2020 and how it manages firms through its Risk and Work Manager. The One Bank Service Transformation (OBST), a three- to five-year programme, also addresses internal processes. Staff are encouraged to improve their digital literacy, for example through the Digital Ninja Network.

Practices like resource pooling and improved online digital collaboration are making the Bank more agile. It is considering how supervisors need to adapt to a more digital world as part of the PRA Target Operating Model 2025.

The Bank has done proofs of concepts with fintech to automate analysis of unstructured data. And it is exploring whether parts of its rulebook can be made machine-readable with small-scale pilots.

The Bank has taken steps to minimise the fees on regulated firms in recent years. But it must commit to an ambitious and transformational long-term plan, if it wants to move the dial on how it uses data.

Firms and regulators are trialling different approaches globally. All require a multi-year programme. The Bank and the PRA, the wider system and firms will need to make significant investments over a long horizon to reap the benefits of technology.

The mindset must shift from minimising costs to investing in the future. The case for transformation should focus on benefits to the system as a whole through more agility, flexibility, space for innovation and reduced compliance costs. Delivery will require funding, and short-run costs may rise. But the long-term payoffs will be considerable.

A data strategy will need to be a strategic and management priority. Understandably, the past decade has been characterised by an intense focus on repair and reform of the system, and in the UK, more recently, Brexit. This has inevitably resulted in tough prioritisation decisions for the Bank and the PRA and less than ideal investment in systems and capabilities.

Collaboration must bring together thought leaders from technology, finance and regulation to shape the programme. The Bank will need to harness advice from technology experts, consult widely and work closely with the industry. This is to ensure the strategy is effective, efficient, targeted on delivering long-term benefit and executed ruthlessly to maximise impact.

RECOMMENDATIONS

9.1 Consult on a new digital data strategy	Why does the Bank need to act? <ul style="list-style-type: none">• Adapting to the new data environment requires a significant change in the Bank's approach and capabilities, which will take time.• Firms have limited funds to deploy for change programmes. Working with the industry to set a clear direction will enable firms to align their investment plans with the Bank's vision of the future.• To be effective, the Bank will need to develop a wide-reaching and ambitious regtech strategy to transform how it collects data from firms.• Looking to the growth in data volumes, current practices are unlikely to scale and there are significant efficiencies from defining a supotech strategy on how the Bank should analyse and use data in supervision.
	What can the Bank do? <p>The Bank should:</p> <ul style="list-style-type: none">• Develop and consult on a medium-term regulatory data strategy, ideally for three to five years, with specific initiatives to embrace data-driven and intelligence-led risk monitoring.• Foster data science capabilities and deliver a medium-term roadmap for its digital transformation. This includes a recruitment and training strategy that meets the need of a central bank of the future.• Consider making its rulebook machine-readable so it can be interpreted more efficiently and accurately.• Consider not just the cost of its own regulatory functions but the total cost of regulation for the UK financial system.

9.1 Enhance risk monitoring through digitalisation of supervision

Why does the Bank need to act?

- Financial services firms are facing shortages of staff with skills in machine learning and advanced analytics.³³ As the quantity of information increases, the Bank will need more data scientists to enable smarter regulation and better analysis. Future supervisors will need different skills.
- There are not enough data scientists coming out of universities.³⁴ And many of the best will go to big tech firms. The Bank will need to develop more of its own. Life-long learning will be key for the Bank to adapt to the fourth industrial revolution.
- The Bank has many highly able mathematicians, including amongst its economists. Experience from Bloomberg, Aviva and others suggest individuals with strong Bayesian maths can be trained to be data scientists in three to 12 months. Bloomberg developed a training course with academics at NYU and have since made it freely available to their clients.³⁵ UK academia has considerable AI expertise, so the Bank could partner with universities to create a joint learning programme (and possibly a formal UK hub to attract new skills).

What can the Bank do?

The Bank should:

- Consider which new regulatory and supervisory technologies could make the data capture and analysis of information from firms less resource-intensive.
- Increasingly automate routine tasks and so free up resources to focus more on value-added processes.
- Over the longer term, make a choice about reaching out for data rather than ask for it to be submitted.

ENDNOTES

- 1 [Regtech in financial services: technology solutions for compliance and reporting](#), Institute of International Finance, (2016).
- 2 [Cyborg supervision — the application of advanced analytics in prudential supervision](#), speech given by James Proudman, Workshop on research of bank supervision, 19 November 2018.
- 3 [FSI Insights on policy implementation No 9: Innovative technology in financial supervision \(supotech\) - the experience of early users](#), Bank for International Settlements (BIS), (2018).
- 4 [The Prudential Regulation Authority's approach to banking supervision](#), Bank of England, (2018).
- 5 [Cyborg supervision — the application of advanced analytics in prudential supervision](#), speech given by James Proudman, Workshop on research of bank supervision, 19 November 2018.
- 6 [Global Shadow Banking Monitoring Report](#), FSB, (2017).
- 7 [Cyborg supervision — the application of advanced analytics in prudential supervision](#), speech given by James Proudman, Workshop on research of bank supervision, 19 November 2018.
- 8 [The use of derivatives trade repository data: possibilities and challenges](#), Iman van Lelyveld, Netherlands Bank, (2017).
- 9 Bank of England.
- 10 [FSI Insights on policy implementation No 9: Innovative technology in financial supervision \(supotech\) - the experience of early users](#), Bank for International Settlements (BIS), (2018).
- 11 [FSI Insights on policy implementation No 9: Innovative technology in financial supervision \(supotech\) - the experience of early users](#), Bank for International Settlements (BIS), (2018).
- 12 [Embracing the promise of fintech](#), Bank of England, (2019).
- 13 [MAS Moves Towards Zero Duplication of Data Requests to Financial Institutions](#), Monetary Authority of Singapore (MAS), (2018).
- 14 McKinsey & Company research.
- 15 Bank of England.
- 16 [Cyborg supervision — the application of advanced analytics in prudential supervision](#), speech given by James Proudman, Workshop on research of bank supervision, 19 November 2018.
- 17 [MAS Moves Towards Zero Duplication of Data Requests to Financial Institutions](#), Monetary Authority of Singapore (MAS), (2018).
- 18 [Regtech in financial services: technology solutions for compliance and reporting](#), Institute of International Finance, (2016).
- 19 [The regulator's new toolkit: Technologies and tactics for tomorrow's regulator](#), Deloitte, (2018).
- 20 [The Future of Trader Surveillance: The ABCD of Successful Surveillance](#), EY, (2017).
- 21 [Machine Learning in Anti-Money Laundering](#), Institute of International Finance (IIF), (2018).
- 22 [Innovative technology in financial supervision \(supotech\) - the experience of early users](#), BIS, (2018).
- 23 [www.bankofengland.co.uk/research/fintech/proof-of-concept](#).
- 24 [Will Big Data Keep Its Promise?](#), speech given by Andrew Haldane, Data Analytics for Finance and Macro Research Centre at King's Business School, 19 April 2018.
- 25 See [www.bankofengland.co.uk/prudential-regulation/regulatory-reporting/regulatory-reporting-banking-sector](#).
- 26 [Supervisory Statement 5/16: Corporate governance: Board responsibilities](#), Bank of England, (2018).
- 27 [Cyborg supervision — the application of advanced analytics in prudential supervision](#), speech given by James Proudman, Workshop on research of bank supervision, 19 November 2018.
- 28 [Stress testing the UK banking system: 2018 results](#), Bank of England, (2018).
- 29 See [www.fca.org.uk/data/monthly-ppi-refunds-and-compensation](#).
- 30 See [www.openbanking.org.uk/wp-content/uploads/One-Year-of-Open-Banking.pdf](#).
- 31 [UK financial services firms fear up to 40% of revenue at risk from FinTech](#), PwC, (2017).
- 32 [Stress testing the UK banking system: 2017 results](#), Bank of England, (2017).
- 33 [The future of talent in banking: workforce evolution in the digital era](#), EY, (2018).
- 34 See [www.forbes.com/sites/louiscolumbus/2017/05/13/ibm-predicts-demand-for-data-scientists-will-soar-28-by-2020/#72c1fd7e3b](#).
- 35 See [www.techatbloomberg.com/blog/foundations-machine-learning/](#).

GLOSSARY

- ACH** – Automated Clearing House.
AI – artificial intelligence.
AMF – Autorité des Marchés Financiers.
AML – anti-money laundering.
API – application programming interface.
ASIC – Australian Securities and Investments Commission.
ASP – account information service provider.
ATM – automated teller machine.
AuRep – Austrian Reporting Services GmbH.
BCBS – Basel Committee on Banking Supervision.
BES – Biennial Exploratory Scenario.
BIS – Bank for International Settlements.
BSP – Bangko Sentral ng Pilipinas.
CAGR – compound annual growth rate.
CBDC – central bank digital currencies.
CBI – Confederation of British Industry.
CCP – central counterparty.
CDE – Critical Data Elements.
CEBR – Centre for Economics and Business Research.
CMA – Competition and Markets Authority.
CPIS – IMF Co-ordinated Portfolio Investment Survey.
CPMI – Committee on Payments and Market Infrastructures.
DB – defined benefit.
DC – defined contribution.
DCMP – Data Centre Migration Programme.
DDoS – distributed denial-of-service.
DLT – distributed ledger technology.
DNB – Dutch Central Bank.
DVLA – Driver and Vehicle Licensing Agency.
DVS – document verification service.
DWP – Department for Work and Pensions.
ECB – European Central Bank.
EIOPA – European Insurance and Occupational Pensions Authority.
EME – emerging market economy.
ERM – equity release mortgage.
ESG – Environmental, Social and Governance.
ETC – exchange-traded commodity.
ETF – exchange-traded fund.
FCA – Financial Conduct Authority.
FDI – foreign direct investment.
FINMA – Swiss Financial Market Supervisory Authority.
FMSB – Fixed Income, Currencies and Commodities Markets Standards Board.
FPC – Financial Policy Committee.
FSB – Financial Stability Board.
FSMA – Financial Services and Markets Act (2000).
FTSE – Financial Times Stock Exchange.
FVS – Face Verification Service.
FX – foreign exchange.
G7 – Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.
G20 – The Group of Twenty Finance Ministers and Central Bank Governors.
GDP – gross domestic product.
GDPR – General Data Protection Regulation.
GFSN – Global Financial Safety Net.
G-SIB – global systemically important bank.
HMT – Her Majesty's Treasury.
ICMA – International Capital Market Association.
IMF – International Monetary Fund.
IOSCO – International Organization of Securities Commissions.
IPCC – Intergovernmental Panel on Climate Change.
IRTA – International RegTech Association.
KYC – know your customer.
LEI – Legal Entity Identifier.
NBPSP – non-bank payment service provider.
NGO – non-governmental organisation.
NLP – natural language processing.
NYU – New York University.
OBIE – Open Banking Implementation Entity.
OBST – One Bank Service Transformation.
OECD – Organisation for Economic Co-operation and Development.
ONS – Office for National Statistics.
OTC – over the counter.
PBoC – People's Bank of China.
PISP – payment initiation service provider.
PPP – purchasing power parity.
PRA – Prudential Regulation Authority.
PSD2 – Payment Services Directive II.
RoE – return on equity.
RTGS – Real-Time Gross Settlement system.
SME – small and medium-sized enterprise.
TCFD – Task Force for Climate-related Financial Disclosures.
TDIF – Trusted Digital Identity Framework.
UID – unique biometric ID.
UNEPFI – United Nations Environment Programme Finance Initiative.
WEO – IMF World Economic Outlook.

ACKNOWLEDGEMENTS

I am extremely grateful to the very wide range of individuals and companies who engaged with me throughout the Review and provided valuable contributions. These include:

8 EIGHT ROADS	British Business Bank
A16Z	Bruegel
ABACO	Burning Glass
Aberdeen Standard Investments	BYNMellon
ACBM	CalSTRS
Access for Cash Review	Capital
ADYEN	Caranegie Mellon
AFME	Cardinal Analytics
Age Scotland	Carmignac
Algebris	Catalyst Inc
Allianz Global Investors	Cerberus
Allstate	CISCO
Amazon	Citigroup
American Express	ClearBank
Amundi	Clifford Chance
AntFinancial	Cobalt
APG	Codebase
Arabesque	Cognizant
Artemis Partners	Copper Street
Association for Financial Markets	Corsair Capital
Association of Corporate Treasurers	CPP Investment Board
Atom Bank	CQS
Autonomous Research	Credit Suisse
Aviva	Credit Union
Axa	CRYSTAL AMBER
Bain & Company	CSIT
Bain Capital	CYBG
Balderton Capital	Datactics
Balyasny	Deka
Bank North	Deloitte AG
Bank of America Merrill Lynch	Deutsche Bank
Bank of Canada	Devoff
Bank of China	Digital Identity
Bank Pekao	Digital Mortgage Broker
Banque de France	Donata Denny
Barclays	Dow Jones
BBVA	E.L. Rothschild
Blackrock	Eastspring Investments
Bloomberg	EBF
Bluebay	Edelman
Bluecrest	Egertoncap
BlueVoyant	Emerging Payments Association
Boston Consulting Group	ENA
Brent Hoberman	ERLAM

Ernst & Young LLP
 Euroclear
 Fannie Mae
 FCA
 FCLTGlobal
 Fidelity Investments
 FIDEURAM INVESTIMENTI
 Finastra
 Finsbury
 Fintech Envoy for Northern Ireland
 FinTrU
 Firstminute Capital
 Founders Factory
 Funding Circle
 Funding Xchange
 Gadhia Group
 GDP Equity Experts
 General Atlantic
 GIC
 Google
 Goldman Sachs
 Greensill
 Gulf International Bank
 Harvard Business School
 Hellman & Friedman
 Hermes Growth Partners
 HM Treasury
 HSBC
 Hub Culture
 HVMD
 ICMA
 IHS Markit Ltd
 IMF
 Index Ventures
 Innovate Finance
 Institute of International Finance
 InvestNI
 Irish League of Credit Unions
 ISDA
 Iwoca
 iZettle
 Janus Henderson Investors
 JC Flowers & Co
 JP Morgan
 Jupiter Fund Management
 Kempen
 King & Wood Mallesons
 KKR
 KPMG
 L&G
 Lansdowne
 Leeds Building Society
 Leeds University
 Legal & General
 Legal & Regulatory
 Linklaters LLP

Lloyds Banking Group
 London Stock Exchange
 Lone Pine
 Lord Hill of Oareford
 Lynn Forester De Rothschild
 M&G Prudential
 Macro Advisory Partners
 Mambu
 Man Group
 Manchester Square Partners LLP
 Marshall Wace
 Mastercard
 McKinsey & Company
 Metlife
 Michael Milken
 Microsoft
 Milken Institute
 Monese
 Moneybox
 Monzo
 Moore Capital
 Morgan Stanley
 MSCI
 Natalie Ceeney MBE
 NBC
 NEST
 New Day
 New Financial
 Nordea
 Nucleus
 NYU
 Oaknorth
 OBIE
 OECD
 Oliver Wyman
 PayPal
 Per Ardua Associates Ltd
 PIMCO
 Pricewaterhouse Coopers
 Professor Jason Furman
 Professor Charles Goodhart
 Raiffeisen Bank International
 Ratesetter
 RBS
 Refinitiv
 Renosys
 Richard Berner
 Richard Sharp
 Ridgeway Partners
 Ripple
 Royal Banking Group
 Royal London
 Russell Reynolds
 S&P
 Said Business School
 Samos

Santander UK
SASB
Scottish Financial Enterprise
Scottish Fiscal Commission
SETL
Shell UK
Simon Gleeson
Societe Generale
Standard Chartered
Starling Bank
Stepchange
Stripe
Style Research
Suade
Summit
Tenax Capital
Teneo Blue Rubicon
TG Americas
TheCityUK
Thomson Reuters
Thought Machine
Tortoisemedia
Tosca
Transfer Wise

TV Squared
UBS
UK Finance
UniCredit
University of Edinburgh
University of Glasgow
Upstream Working Capital Ltd
USS
Virgin Money
Visa Inc.
Wall Street Journal
Wapping Consulting Group
Warburg Pincus
Wellcome Trust
Wellington Management
White Cap Consulting
World Economic Forum
Worldline
Y analytics
Yorkshire Building Society
Zopa
Zurich
And a wide range of policymakers and some who preferred to be anonymous

I would like to thank all staff across the Bank who shared advice, analysis and helped compile this report. In particular, the Review's Advisory Group.

Advisory Group:
Sandy Boss (Chair)
Alex Brazier
Andy Haldane
David Bailey
James Proudman
David Rule
Andrew Hauser

Mark Yallop
Sarah Breen
Sonya Branch
Victoria Cleland
Vicky Saporta
Rob Elsey

And:
Tom Mutton
Varun Paul
Julia Kowalski
Justin Jacobs
Ronnie Driver
Andy Murfin
Clair Mills

Andrew Lodge
Lewis Webber
Stefan Claus
Mark Cornelius
Himali Hettihewa
Eir Nolsoe
Oliver Burrows

I would also like to thank the following for their *pro bono* research and support on scenario analysis:

McKinsey & Company on payments and digital regulation.

Christian Edelman, Lisa Quest, Magnus Burkl, James Davis, Davide Taliente and colleagues at Oliver Wyman on corporate and wholesale markets, and asset management.

Ian Walsh, Dean Frankle, Sukand Ramachandran, Paul Clark, Brandon Miller and colleagues at The Boston Consulting Group on retail/SME banking and insurance.