

A close-up portrait of an older man with white hair, wearing a dark suit, white shirt, and blue patterned tie. He is smiling slightly and looking towards the camera. The background is a solid light blue color.

WORLD COMMERCE REVIEW

WINTER 2021

POLICYMAKING IN A
CHANGING WORLD.
CHRISTINE LAGARDE
ADDRESSES MISINFORMATION

GRAHAM BRIGHT CONSIDERS
THE ROLE OF THE FINANCE
SECTOR IN COLLABORATIVE
TRADE

RENÉ KARSENTI AND
APOSTOLOS THOMADAKIS
DISCUSS FINANCING THE
ENERGY TRANSITION

THE GLOBAL TRADE AND FINANCE PLATFORM

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Year-end offers chance to consider opportunities on the horizon

As we look toward 2022, Ed Bolen is confident that business aviation will continue to innovate, respond and adapt quickly to the challenges ahead

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FOREWORD

A return to the 1970s

Transitory – the term used to describe inflation as the world emerged from lockdowns – has been consigned to the dustbin of history. Federal Reserve Chairman Jay Powell acknowledged in evidence to Congress that it was time to ‘retire’ the word. America’s inflation rate has climbed inexorably above the long-term inflation goal of around 2%, leading the Fed to conclude it should bring an end to its money-printing programme.

It has been assumed that the rise in consumer prices largely has been driven by temporary supply-side issues. The Fed is now acknowledging that something more serious is afoot and higher prices and the hardship imposed on consumers are too persistent for comfort. Quantitative easing will have to be reined in. If ending the monetary largesse is going to be difficult for the US, where employment and growth have been rising, it is going to be even harder for the European Central Bank.

How did we get here? Blame the pandemic.

In the spring of 2020, as COVID-19 spread, it pulled the plug on the global economy. Factories around the world shut down; people stopped going out to restaurants; airlines grounded flights. Millions of people were laid off as business disappeared practically overnight.

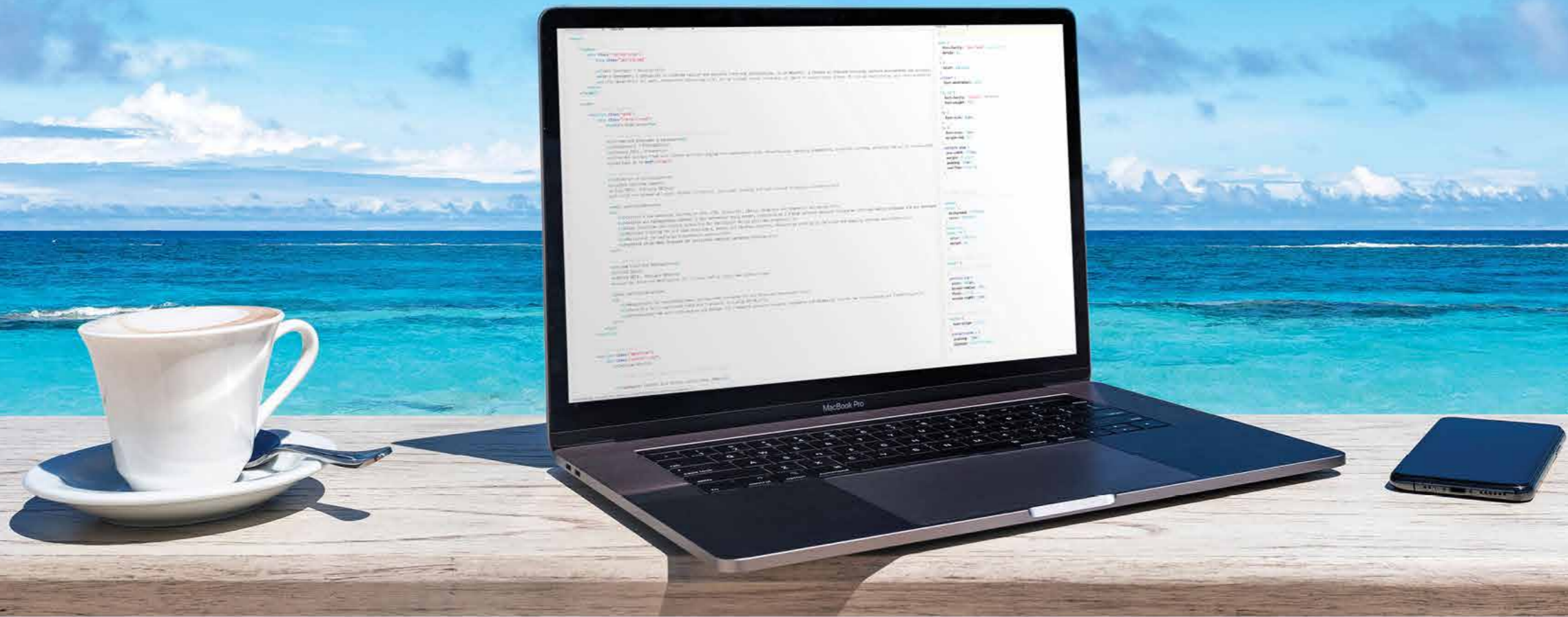
By the summer, however, demand for consumer goods started to pick up. Rapidly. Consumers were flush with cash and government assistance. Demand shot up, but supply couldn't bounce back so easily. This led to supply chain bottlenecks, and has become a priority of policymakers to unblock. This may take until well into 2022, particularly if COVID variants become an excuse to lockdown again. Powell believes they're temporary, and he's probably right.

But there's a deeper structural reason for inflation, one that appears to be growing worse: the economic concentration of the economy in the hands of a relative few corporate giants with the power to raise prices.

Corporations are using the excuse of inflation to raise prices and make larger profits. Since the 1980s two-thirds of all American industries have become more concentrated. The trend is similar in the EU. Whatever the industry, be it finance, pharmaceuticals, air travel, car manufacturing, increasing consolidation of the economy in a relative handful of big corporations with enough power to raise prices and increase profits.

Does this signal a return to the 1970s, big government, national industrial champions, protectionism? We will have to wait and see, but the signs are not promising. ■

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GOVERNMENT OF BERMUDA

Economic Development Department



Dialogue in a changing world

The challenges facing the world today are unprecedented. Christine Lagarde says they can only be addressed by integrating scientific analysis into policymaking and acting together

The task of separating truth from falsehood has plagued policymaking for centuries. During the Roman civil war following the death of Julius Caesar, Octavian famously prevailed over Mark Antony by spreading 'fake news' about his fitness for office. He did so via slogans forged on specially commissioned coins – an early version of a tweet¹.

Today, this task of distilling the truth is more urgent than ever. We have seen during the pandemic how quickly misinformation can spread – be it about possible treatments, such as drinking chlorine, or about the safety of vaccines. Indeed, falsehoods on Twitter are found to spread about 10 to 20 times faster than facts².

At the same time, the nature of the challenges we face are increasingly global, complex and fast-moving. This means that establishing the facts and understanding how they are interconnected is a precondition for charting a course through a shifting, uncertain world.

In this context, good policymaking has to rest on two foundations. First, policymakers have to be committed to searching for the truth, as best they can, through robust analysis and evidence-based policymaking. And because we can never have perfect knowledge, they must be prepared to adjust their views as the facts change.

Second, they need to explain their analysis to the public in a way that reduces complexity and unites people around the case for action. We will not solve the challenges of today, in a world of 'fake news', unless we can bring the public on board.

I would like to explain why today's challenges are different, why they can only be addressed by integrating scientific analysis deeply into policymaking, and why the public has to be mobilised in a new way to bring about change.

Ultimately, we need to be guided by Leonardo da Vinci words: *“learn how to see [and] realise that everything connects to everything else.”*

The nature of today’s global challenges

So what is it that makes the challenges we face now so difficult? Many of today’s challenges are not new. Environmental threats such as smog and acid rain plagued the developed world in the 19th and 20th centuries. Pandemics have ravaged many parts of the world. And global economic crises have been a feature of the world economy for as long as globalisation has existed.

The benefits of science, policy and the public joining forces to realise our full potential are overwhelming. Only by working together in all areas can we draw on our strengths and build hope for a brighter future

But what makes the contemporary challenges unique is their sheer scale – and their potential to change the world profoundly. The challenges have intensified in at least three ways: their scope, their complexity and their potential to amplify.

First, the scope of today's challenges is genuinely global. A century ago, the Spanish flu spread like wildfire across the globe, infecting around a third of the world's population at the time³. But even in the highly globalised world that existed at that time, there were parts of the world the disease did not reach.

COVID-19, on the other hand, has been the first truly global pandemic. In less than six months, no region of the world was left untouched (save for a few Pacific islands) and virtually no aspect of our lives was unaffected. Unprecedented containment measures, in turn, triggered one of the most severe economic slumps since the Second World War⁴.

Second, global challenges are now highly complex and require unprecedented levels of multilateral coordination. For example, when countries set out to close the hole in the ozone layer in the mid-1980s, the solution essentially required only a handful of the largest chemical companies to stop producing CFCs⁵ and find alternatives. This in turn laid the ground for major economies to agree to the Montreal Protocol in 1987.

But addressing climate change is orders of magnitude more difficult. Not only do we have to contend with the multiple faces of climate change – more extreme weather patterns, rising sea levels, loss of ecosystems and biodiversity – but regions are also affected in different ways and at different speeds⁶. This makes devising timely and appropriate mitigation measures across countries exceptionally complex.

Third, global shocks tend to amplify in the face of a more integrated global economy. The OECD estimates that, in advanced economies, the contribution of global factors to changes in GDP growth has risen from around 35% in the 1980s to almost 70% today⁷.

The internet also amplifies the spread of misinformation, which in certain situations can make global shocks worse. For instance, research suggests that in the first three months of 2020, nearly 6,000 people worldwide were hospitalised because of coronavirus misinformation⁸.

At a minimum, the spread of 'fake news' leads to greater cynicism among the public about who is telling the truth and what sources to trust.

The upshot is that we are operating in a world of much higher uncertainty – about the nature of the shocks we are facing, how they will propagate, and what the public will believe about them. And policymakers have to change the way they approach problems and the way they communicate to adapt to this world.

Integrating science into policy

First of all, when faced with rising uncertainty policymakers have an even greater responsibility to commit themselves to a rigorous search for the truth.

To that end, their analysis has to be grounded in deep analysis, expert knowledge and the scientific method – which means constantly testing hypotheses and adjusting decisions in the light of new evidence. The public would be ill-served if policymakers mirrored what they believed to be the public mood and based their decisions purely on instinct rather than on objective reason.

We have had a striking demonstration of the need to integrate scientific analysis into policymaking during the pandemic. This has been a fast-moving crisis that could not be addressed through hunches or preconceived notions. The only way to fight it has been to act on the basis of the emerging evidence.

It is now clear that governments which chose to draw on the evolving science to inform the trade-offs lying before them have performed better – in terms of both protecting lives and shielding the economy – than those that did not⁹.

And this has produced a virtuous circle of increasing demand for policy-relevant research. In the first half of 2020, publications on COVID-19 doubled every 20 days¹⁰.

Yet the search for truth does not only apply to governments. In fact, for independent institutions such as central banks, the responsibility is even greater. We are entrusted with narrow mandates precisely to ensure that our decisions are based on facts rather than political influences. We therefore face an even stronger burden of proof to show that our decisions are guided by the weight of evidence alone.

This is a key reason why we invest so heavily in research and analysis. The ECB is ranked first among central banks worldwide for the quality of its research, it is ranked first in the field of monetary economics, and 15 of its economists are among the top 10% of authors globally¹¹. That knowledge base – which involves constantly studying the effects of our own policies – gives us the foundation to act in the face of new challenges.

The benefits of that foundation were clearly visible in our own response to the pandemic. The shock to the economy was unprecedented, but we were able to draw on our past experience of financial disturbances in the

euro area; on our analyses of how self-fulfilling destabilising dynamics could emerge; and on our research into the effects of our previous asset purchase programmes, to deliver a rapid and effective response.

Indeed, our pandemic emergency purchase programme and long-term lending operations were able to rapidly remove tail risks in financial markets and avert a liquidity and credit crunch. Coupled with the actions of our banking supervision arm, our researchers estimate that these measures saved more than one million jobs¹².

Overall, the exceptional level of evidence-based policymaking in our societies during the pandemic has taken place because we have faced an existential threat, leading to the type of relentless focus on results that we usually only see in times of war.

It is simply remarkable that, within weeks, the genome of the coronavirus had been sequenced. Within a few months, tests for infection had been made available. And within a year, highly effective vaccines had been developed.

Having seen the incredible progress we can make when science and policy are united behind a common goal, in my view we should not now slide back into the pre-pandemic status quo. We must strive to continue this joined-up approach if we are to tackle the challenges we face today – and this applies perhaps most of all to climate change.

It is not by chance that the international architecture set up to tackle climate change has placed the science-policy nexus firmly at its core. Over the years, the Intergovernmental Panel on Climate Change has acted as an anchor for the understanding of climate science, helping ground policy agreements in knowledge and evidence¹³.

Without this institutional anchoring, we would now be facing even more dangerous and irreversible levels of climate change. Absent global measures, the world would be at or over the 1.5°C warming threshold and heading towards a projected 4.4°C. That would translate into a 30% loss of global GDP by the end of this century¹⁴.

But clearly the work is not yet done. The drawn-out negotiations at the COP26 summit illustrate the difficulties in reaching global political consensus, despite solid scientific evidence and the buy-in of large parts of the private sector. And an important reason for this is that, to achieve sustained progress, the public must be brought on board as well.

Engaging the public

Indeed, the job policymakers is not only to make decisions based on the best assessment of available evidence, but also to explain that assessment in a way that reduces complexity and underpins the case for action.

Today, faced with challenges that require far-reaching and unprecedented changes in all segments of society, the premium on effective communication has never been higher. To bring about change with the necessary speed and in line with democratic principles, we need a critical mass of people who are willing to overhaul many aspects of their daily lives.

Yet the barriers we face are high. In a world where 'fake news' can spread rapidly and people no longer know which sources they can trust, it is increasingly hard to centre public opinion around a broadly agreed course of action. However, it is not impossible.

The pandemic has proven that societies can be mobilised by scientific evidence to make profound changes, if that evidence is communicated in an effective way. People have accepted sweeping restrictions on their usual freedoms

in order to contribute to the common goal of saving lives and preventing an uncontrolled spread of the disease. So what are the elements that can help bring the public on board? To my mind, there are three: simplicity, framing and empathy.

Starting with simplicity, we should not underestimate the ability of the public to evaluate and absorb factual evidence – but it has to be presented in an accessible way¹⁵.

We have seen this in the area of climate. In an experiment where US citizens who knew little about the scientific consensus on climate change were shown a simple pie chart illustrating the overwhelming consensus in favour of its man-made origins, their estimates of the climate consensus increased by nearly 20% – and that was with just one exposure¹⁶.

We know that simplicity works for monetary policy communication, too. Research finds that providing households with simple statistics about inflation, such as the central bank's inflation target or forecast, has large and immediate effects on their inflation expectations. Providing more detailed statements and arguments, however, has no additional effect¹⁷.

This is an important reason why one of the cornerstones of our strategy review was to make our inflation target clearer. Our new, symmetric 2% target is clear-cut and unambiguous.

But the challenge is not only to present the facts simply. It is also incumbent on policymakers to find ways of framing those facts so they resonate broadly with the values of the people they are speaking to. This is the second element.

It is well-known, for example, that framing climate change as a difficult trade-off between environmental benefits and economic costs tends to reduce support for mitigation measures, even for those who generally support action¹⁸.

However, messages linked to healthier and more sustainable lifestyles – cleaner air, less waste – tend to meet with a positive response across a broad cross-section of the public¹⁹.

Even the words we use matter. Studies from the United States find that conservatives are more likely to support preparing for environmental disasters when climate change is framed as extreme weather²⁰. And people across the political spectrum feel more negatively about natural gas as a source of energy when it is termed 'methane gas'²¹.

Finally, we have to consider how the message is given and by whom. It has been clearly established that, when shaping people's perceptions of a crisis, empathy and compassion are critical elements of leadership communication²².

For instance, there is some evidence that female leaders have performed better during the pandemic²³, in part because their communication approach has balanced science and empathy. Female leaders have often sought to share common experience, engage with the public and reach out and speak to vulnerable groups²⁴.

We also understand the importance of empathy at the ECB. Trust in the ECB is found to hinge not just on our competence in delivering our mandate, but also on whether we are perceived to care about citizens and act responsibly. So, communicating how responsible ECB policy benefits people's welfare can foster greater trust²⁵.

This is why, as ECB President, I have set out to overhaul our approach to communications. Among other initiatives, we have made our monetary policy communication more accessible and we now convey our decisions in a 'layered' way that makes them more relatable for people. The aim is to be simple – but not simplistic.

Conclusion

The challenges facing the world today are truly unprecedented. They have immense scale, complexity and potential to amplify through our extensive economic and digital links. This places extraordinary demands on humanity to solve them.

The coronavirus pandemic has demonstrated the speed with which risks can spread across the globe. And it may only be a dress rehearsal for the type of threat to our livelihoods that an overheating planet will pose to all its inhabitants.

But crucially, our joint response to the pandemic holds important lessons for the future. It can provide, perhaps, an emerging template for dealing with the complexity and uncertainty of the global challenges ahead.

In many ways, this response stands out for the considerable efforts made by all policy areas and the unprecedented policy measures taken. However, our ultimate success in tackling this crisis has stemmed from recognising that we have all had to act together.

Indeed, joint action from different policy areas has proved hugely beneficial in coping with the breadth of the shock. Intensive dialogue between scientists and policymakers has been fundamental in dealing with complexity and uncertainty. And broad coordination across countries has proved crucial in managing the pace with which the virus has spread.

Without this intensive cooperation, we would not have progressed nearly as fast with the economic recovery and the introduction of vaccines.

So, the fundamental lesson to be learnt here is that we cannot afford to operate with a setup that confines our work to distinct spheres. In a more interconnected global economy, intersectoral and multilateral cooperation is more important than ever to face complex challenges that transcend national borders.

As John Donne wrote, *“no man is an island entire of itself; every man is a piece of the continent, a part of the main.”* This is the reality that we face in a world where our common challenges bind us closely together.

The benefits of science, policy and the public joining forces to realise our full potential are overwhelming. Only by working together in all areas can we draw on our strengths and build hope for a brighter future. ■

Christine Lagarde is President of the European Central Bank

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Adapting to change

COP26 has shown that consensus is not just confined to politics. Graham Bright considers the finance sector's role in promoting collaborative trade

If the recent UN COP26 *Conference of the Parties* has taught us anything, it is that nations can come together, appreciate the enormity of the task of tackling climate change, agree to closer political and economic ties and above all leave a planet cleaner and more sustainable for generations to come, with consensus.

And consensus is not just confined to politics. Banking and insurance are sectors actively in not only exploring but implementing practical solutions which will protect and promote future collaborative trade.

From standardised Basle III compliant policy wording in insurance markets to interoperability in open banking platforms, the challenge is on.

Above all there seems to be more global acceptance to take on the investment and navigation through new technology projects with blockchain and AI elements, with a vision to improve systems, supply and services.

With a raft of new ideas in the digital space, advanced technologies, emerging players in fintech challenging traditional delivery methods, the key drivers to competitive, sustainable international trade will be standardisation, rationalisation and re-usability of processes.

And this drive for smarter, faster, more efficiency and trusted process is not from the industry, but from savvy tech-enabled consumers.

Customers are reverting to pre-pandemic demand for goods, not only defined as what they need, but what they want and can easily get, as consumerism through the power of advertising re-emerges.

As the world gets to be a riskier place through cyberattacks, ongoing shortages and trade disputes, and active conflicts in over 40 countries, consumers are unphased by the underlying problems surrounding current issues with global supply chains. A possible lack of Christmas turkey and toys seems to be the biggest issue for many.

But let us get back to consensus, a general agreement.

Consensus can certainly be seen in the proliferation of free trade agreements. In Africa, putting aside nationalism, protectionism and isolationism, long debated differences between nations have finally resulted in 54 participants able to collectively exploit the new demand for raw materials and services.

...adapting to change in financial markets is a must as global companies cannot rely on past performance, budget or organisational structures

From vaccines to technology, the political will, means and finance have been made available to build manufacturing centres, reduce dependency on expensive imports and export more competitively through supply of finished goods to new markets.

More importantly, the example of the African AfCFTA gaining wide consensus, with a number of countries agreeing process, taxonomies, customs duties, acceptable documents, payment methods, infrastructure routes, all in the name of building resilience, creation of wealth in like-minded countries, is one where the continent may greatly benefit.

Nations are able to bypass latent technologies and take advantage of latest cost-effective advanced communications networks, supporting smart mobile technology for payments, and use of sophisticated applications (for example created and maintained by new technology centres in Ethiopia).

These new apps are for example, helping farmers and remote communities improving crop yield, and entrepreneurs to realise new projects providing payment and loan gateways to connect, enfranchise and lift some 30 million people living in extreme poverty, offering the unbanked financial security and bank accounts.

The consensus model for Africa will change perception, allowing it finally to be seen as a global collective powerhouse. No longer the continent to be feared or exploited but a major player in supply of the worlds limited precious resources.

Africa has the potential to create more goods locally and become more self-sufficient as opposed to remaining a victim to large external economic forces, excessive cost of loans and dependency on both international and charity.

It is sobering to think that without investment and further industrial development, it is forecast by The World Bank that 90 percent of the world's poor will reside in Africa by 2030.

Ultimately, by standardising and harmonising both international and domestic regulatory practice, reducing and uncomplacating tariff barriers and minimising punitive tit-for-tat tariff measures, technology will be a critical factor in assisting with economic efficiency, digitising documents and digitalising process for faster, trusted, cost-effective outcomes for all.

Today, multilateral and bilateral agreements between nations number in the hundreds, covering geography, farming, IT, intellectual property, and all manner of collaboration, where the goal is not always profit but fair, sustainable, ongoing trade.

The importance of these agreements and their action cannot be underestimated, and whilst we are in the later stages of the pandemic, with signs that trade is edging back to pre-COVID levels, there is cautious optimism of normality on high streets and improved global trade albeit with higher prices and threat of rising inflation.

But consensus is not confined to international trade. A different type of consensus, in blockchain, is a major element driving the power consumption required for validation of computational transactions.

Consensus protocols form the backbone of blockchain by helping all the nodes in the network verify transactions, making sure one hacker cannot access more than 51% of the nodes and therefore gain control, vast arrays of computers are now required to be the first to validate and then earn from the process.

There is always a price to pay. In the early days, consensus was simple, where a lone home computer could validate a transaction, consuming a negligible amount of electricity. But with multiple coins and enormous demand to earn (rewards equate to approximately 6.25 new Bitcoins for guessing the hash key correctly) it is no surprise that mining can be very lucrative, but needs major investment.

Due to the scale and size of the Bitcoin public ledger, distributed across many multiple network nodes, today it is estimated that 12 years of household electricity is consumed per coin mined.

This staggering operational cost has fuelled demand for faster devices, more efficient processors, better cooling systems and higher pressure on electricity supplies, costs which are out of reach for individuals but only sustainable by nation state funded or large corporation budgets.

According to the *New York Times*, the process of creating Bitcoin to spend or trade consumes around 91 terawatt-hours of electricity annually, more than is used by Finland, a nation of about 5.5 million.

It will be fascinating to see how mainstream crypto becomes, how consensus protocols which favour large arrays will flourish and to what extent the world can satisfy its unquenching thirst for energy.

In conclusion, adapting to change in financial markets is a must as global companies cannot rely on past performance, budget or organisational structures.

As the businesses of the world embrace digital processes, we see change in working practice, more cross-border agreements, new international entrants to support supply chains, new economic centres and mobilisation of people, and witness the continuing shift from agricultural to industrial economies.

Companies are at a critical stage as they must all prepare themselves for change, by standardising, rationalising and re-using systems and process immediately if they are to compete, work with consensus, collaborate and continue to exist in our new world. The time is now. ■

Graham Bright is the Head of Compliance and Operations at Euro Exim Bank

Finance disrupted



New technologies are disrupting every corner of the financial sector. Benoît Cœuré focuses on the role that central banks are playing in ensuring that technological innovation is a force for good

Let me begin by stating the obvious: we live in an age of disruption. We hear every day about businesses, industries, and governments being disrupted. And, of course, our private lives have been disrupted by the pandemic. But I would like to talk about a specific type of disruption – disruption arising from technological innovation in the financial sector.

Two years ago, *Banking disrupted* was the title of the 22nd Geneva Report. The report presciently raised competition issues arising from big techs and fintechs. I would like to make the point that disruption goes well beyond banking.

Think of cryptocurrencies¹, the rapid rise of decentralised finance, or DeFi, and digital ID systems using biometric data. Think of the explosive growth of data and how firms – particularly big techs – exploit these data. Think of the massive hacks that regularly compromise the personal data of millions of individuals.

What do these stories tell us? They tell us that technological innovation and associated disruptions can be good or bad. New technologies can foster greater efficiency, financial stability and inclusion. But they can also do the opposite, spawning financial instability, loss of privacy, and financial exclusion.

The Great Financial Crisis didn't stem from technological change but from opacity and greed, but it taught us a useful lesson: when finance doesn't work, it takes a heavy toll on society. It took a decade to clean up the mess and reform the financial system.

New technologies are disrupting every corner of the financial sector. Should we let disruption run its course, whatever the consequences? Or do we want to harness the power of innovation in a way that preserves the best elements upon which the financial system is built?

I think the answer is clear. And this is where central banks must step in.

I will focus on the role that central banks are playing in ensuring that technological innovation is a force for good, and in developing innovative technological solutions themselves – both domestically and, increasingly, internationally. I will focus on the work we are carrying out at the BIS Innovation Hub, and on the technological disruptions we see in payments and money, banking supervision, and financial markets. At the end, I will share some tentative thoughts about the consequences of innovation for monetary policy implementation.

... central banks are pursuing innovation and actively developing technological public goods. All of this is meant to have the global financial system deliver greater benefits for citizens

Digitalisation disrupting payments and money

Payments and money first jump to mind. This is an area of rapid and unprecedented change. Cash is declining while digital payments are on the rise. COVID-19 has just given another jolt to this transformation.

Change started with how customers make payments. We can use our smart phones and watches. Contactless and mobile payments have become part of daily life in many countries including emerging and developing markets. Four in five Kenyans are using a mobile money service like M-Pesa². Alipay and WeChat Pay accounted for 94% of all retail payments in China last year. Gloves with payment functions are being prepared for the Beijing Winter Olympics.

Most of innovation has been on the 'front end' but in recent years, it has moved to the 'back-end,' the part of the payments system that consumers don't see, involving money flows, and clearing and settlements between financial institutions – the part that not long ago used to be called 'plumbing'³.

Fast payment systems are a great example, although consumers don't see the new plumbing that is needed to ship money in real time between banks. Services such as the UK's Faster Payment Scheme or the ECB's TIPS allow real-time payments 24/7 and deliver new benefits to consumers.

But other changes come with risks as well as opportunities. Think of global stablecoins, especially if issued by big techs. They are promoted as a way to provide faster and cheaper cross-border payments and deeper financial inclusion. And they do.

But they also pose significant risks: they can create closed ecosystems or 'walled gardens' that fragment the monetary system, by potentially taking large volumes of payments outside the system that has central banks at its

centre. Stablecoins may also pose risks for financial stability. As clarified yesterday by the Committee on Payments and Market Infrastructures and the International Organisation of Securities Commissions, stablecoin arrangements should observe international standards for payment, clearing and settlement systems to safeguard financial stability, if they perform a payment function and are found to be systemically important⁴.

Walled gardens also have serious implications for competition. They augment the already significant market power of big techs. They also risk threatening consumer privacy and challenge existing regulatory practices⁵.

The history of private money initiatives is not a happy read. Whenever faced with the conflict of interest between making their money stable no matter what and making a profit, private issuers have always chosen profits.

This is where central banks come in.

Money is ultimately a public good whose stability and use needs to be protected by the public sector. This is why so many central banks around the world are working on central bank digital currency, or CBDC – essentially, to ensure that the next generation of money continues to serve the public interest.

If well-designed, CBDC could be a safe and neutral means of payment and settlement asset, serving as a common platform around which a new payments ecosystem can develop. It could enable an open finance architecture that welcomes competition and innovation; and preserve democratic control of the currency⁶.

The BIS Innovation Hub (BISIH) is helping to foster the international development of CBDC. Our centres in Hong Kong SAR, Singapore and Switzerland are building six proofs of concept, or prototypes, with ten central banks in Asia, Europe, the Middle East and Africa, looking at different types and uses of CBDC.

We are looking at wholesale CBDC, which may be used only by central banks and large financial institutions, to facilitate cross-border payments and avoid the use of the correspondent banking system that we all agree is slow, opaque and expensive. And we are investigating the digital equivalent of cash – general purpose (or retail) CBDC⁷. With the opening of new BISIH centres and partnerships, there will be more projects to come.

Big data and algorithms disrupting banking supervision

It's not all about CBDC though. Far from it. Innovation in the financial sector is usually referred to as fintech. Let me narrow the focus to regtech and suptech – the use of technology to improve financial regulatory compliance and supervision.

Algorithms, artificial intelligence and machine learning, empowered by big data, are transforming financial services. When big techs and credit platforms provide credit, some say that they turn data into collateral⁸. Actually, what they are doing is using data to reduce the need for collateral.

These firms know a lot about us. They collect enormous amounts of data about our preferences, spending habits and payment history – and those of our peers, who may be similar to us - even before we ask for a service or apply for a loan.

By using artificial intelligence and machine learning to study a treasure trove of data – typically more than 1,000 data points – they can determine how much we can borrow and repay. And they do it in part by using information that until recently did not have much financial value, like the model of smart phone someone has, or their browsing habits.

Collateral is needed when lenders don't have enough information about a borrower. Data help close the gap. This is very beneficial for the so-called 'thin file' customers, those who could not get a loan because of lack of credit history and couldn't build a credit history because nobody would give them loans – a chicken-and-egg problem.

There is a financial inclusion benefit from the use of non-traditional sources of data for lending decisions, but also a potential risk for privacy and the management of personal data.

Against this landscape which is changing in quick and often unpredictable ways, financial supervisors have mostly analogue tools. Their workflows are heavily manual. Data collection typically involves reports submitted by paper or email, with file size restrictions and operational and security risks⁹.

For example, performing a cross-firm review often requires going through spreadsheets and PDF files from different sources, minutes of meetings and data from different systems and in different formats. Most of these data are one or two quarters out of date, some could be from previous years.

Figuring out what is going on from these fragmented and outdated pieces of information is, to put it mildly, challenging. Understandably, supervisors are increasingly worried about being left behind.

Technology can change this game, by giving supervisors access to a lot more data, structured, unstructured, with better quality and granularity than ever before. It can also give them effective means to extract, query and analyse data.

To perform the same cross-check review that I just mentioned, a digitally native supervisor could build integrated platforms to avoid using spreadsheets and PDFs. She could use artificial intelligence tools to crunch the data and

apply natural language processing and machine learning algorithms to real-time, typically unstructured data from news and market developments.

The BIS Innovation Hub is doing exactly that. The BISIH Singapore Centre is working with the Monetary Authority of Singapore, the Bank of England and the International Swaps and Derivatives Association on project Ellipse, a prototype which investigates the feasibility of an integrated regulatory data and analytics platform.

Tools based on project Ellipse would enable supervisors to digitally extract, query and analyse in real time large and diverse sources of structured and unstructured data that are relevant to the residential mortgage market, and anticipate supervisory action¹⁰. Looking ahead, we will also investigate ways to use the supotech toolbox to support the green and sustainable finance agenda¹¹.

Changes in market structures

I just mentioned the problems of having data that are a quarter too old. Let me now discuss the risks of data that is a thousandth of a second too old.

I'm talking about the intense digitalisation of financial markets. High frequency and algorithmic trading have introduced new actors and redefined market structures. High frequency trading deploys latency arbitrage, or 'sniping'.

Simply put, if you are ultra-fast, you can jump the queue and make a great deal of money. The speed required to gain an edge - millionths or billionths of a second - renders humans and slower computer systems obsolete. A recent BIS working paper estimated that latency arbitrage accounted for 20% of FTSE stock trading volume and imposed a roughly 0.5 basis point tax on trading, increasing the cost of liquidity¹².

This transformation has given rise to new risks. As noted by the BIS Markets Committee, FX execution algorithms have enhanced the matching process between liquidity providers and consumers in a highly fragmented market, but they shift the execution risk from dealers to users (that is, firms and investors), who may be less capable of managing these risks¹³.

The problem is not new, of course. In the past decade, algorithmic trading has contributed to the occurrence of flash crashes. In May 2010, a flash crash wiped \$1 trillion of value of the Dow Jones index in about half an hour¹⁴. It may get even worse as computers become even faster and more powerful.

And just imagine what the future advent of quantum computing could do. If quantum computers were able to resolve in minutes the calculations that might take conventional computers months or years, imagine what they could do with the processes that normal computers can already process in nanoseconds.

Other changes in market structures stem from non-banks and fintech firms expanding their footprint in financial intermediation and challenging the role of banks. How can we trace financial contagion spreading in the non-bank financial intermediation universe, by trying to aggregate data from banks, asset managers, other non-bank institutions, clearing houses, and so on?

Looking ahead, how can we identify and analyse risks arising from decentralised finance platforms, or DeFi, and the ways in which they spill over to traditional finance?

Here also, new tools will be needed, and here also, the BIS Innovation Hub is helping. The BISIH Swiss Centre is building a tool to monitor trading in fast-paced foreign exchange markets in real time. Project Rio is a central bank-

specific market monitoring platform. The cloud-based stream processing platform will process real-time financial data feeds and compute relevant liquidity and market risk measures in real time. Watch this space!

Conclusion

The central banking community is playing a critical role to ensure that technological innovation and its associated disruptions are a force for good. With this goal in mind, central banks are pursuing innovation and actively developing technological public goods. All of this is meant to have the global financial system deliver greater benefits for citizens.

Could technological innovation also disrupt the conduct of monetary policy? This could be the next battle line. There are so many dimensions to this question, and I certainly don't have all the answers. I will simply raise two questions for our discussion.

First on CBDC. A great deal is being written about the effect that a retail CBDC could have on monetary policy. Some academics¹⁵ have suggested that it could provide an effective way to implement deeply negative interest rate policies and overcome the 'effective lower bound'. But if CBDC offers lower interest rates than cash or commercial bank deposits, would you still want to use it? The answer is: up to a point – but we don't know what that point is.

I believe in fact that CBDC could have a greater impact on fiscal policy. Think of the extraordinary support that some governments provided to the population during the pandemic. Some countries showed great ingenuity in using digital technology to reach those most in need¹⁶.

Others mailed cheques to people while bank branches were closed because of lockdowns and people were told to stay home. Imagine how much easier it would have been to transfer digital money to people's e-wallets in real time.

My second question is about technological innovation in market structures. Financial intermediaries are key nodes for monetary policy transmission. Could changes in financial structures affect how they work? It all depends. Disintermediation in forms that by-pass these intermediaries may make this channel less effective – unless central banks consider broadening access to their balance sheets or introducing new instruments.

As a thought experiment, let's imagine a world where treasuries are exchanged as tokens on decentralised platforms. How would this affect market concentration and the role currently played by large primary dealers and custodian banks in liquidity provision and price discovery? Would current frictions be reduced?

How would shocks to the supply and demand of Treasuries be transmitted through the market, and ultimately affect financial conditions? We may never go there, but if we do, consequences for financial stability and monetary policy effectiveness will deserve careful scrutiny.

These are all complex questions that will engage policy makers. What is clear is that we are in the midst of an age of disruption – for the financial system and the world. The road ahead is exciting but we don't know where it will take us three, five or 10 years from now.

However, what we know is that the direction we take will be defined by our own choices as policy makers and as market participants. I look forward to joining you all for the journey. ■

Benoît Cœuré is Head of the BIS Innovation Hub

Endnotes

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2. See Central Bank of Kenya, Kenya National Bureau of Statistics and fsd Kenya, *“2019 Finaccess Household Survey”*, April 2019.
3. On central bankers as plumbers, see B Cœuré, *“Farewell remarks as CPMI chair”*, Buenos Aires, 2 October 2019.
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7. For an overview of BIS Innovation Hub projects, see www.bisih.org
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9. See B Cœuré, *“Leveraging technology to support supervision: challenges and collaborative solutions”*, speech at the Peterson Institute for International Finance Financial Statement event series, 19 August 2020.
10. See BIS Innovation Hub, *“Ellipse: regulatory reporting and data analytics platform”*, 5 October 2021.
11. See B Cœuré, *“Digital rails for green transformation”*, speech at the Salzburg Global Finance Forum, 22 June 2021.
12. See M Aquilina, E Budish and P O’Neill, *“Quantifying the high-frequency trading “arms race””*, BIS Working Paper, no 955, August 2021. The authors define latency arbitrage as *“an arbitrage opportunity that is sufficiently mechanical and obvious that capturing it is primarily a contest in speed”*. Data was collected over a 9-week period in the autumn of 2015.
13. See Markets Committee, *“FX execution algorithms and market functioning”*, October 2020.

14. See A Haldane, [“The Race to Zero”](#), speech at the International Economic Association Sixteenth World Congress, Beijing, 8 July 2011.

15. See M Bordo and R Levine, *“Central bank digital currency and the future of monetary policy”*, Hoover Institution Economics Working Papers, 2017.

16. See A Gelb and A Mukherjee, *“Digital Technology in Social Assistance Transfers for COVID-19 Relief: Lessons from Selected Cases”*, CGD Policy Paper, no 181, September 2020.

This article is based on a [speech](#) delivered at the 23rd Geneva Conference on the World Economy, Geneva, 7 October 2021.



Under the western sky: the crypto frontier

Carolyn Wilkins talks about cryptoassets and the 'financial ecosystem' they are a part of. She looks at the risks and opportunities decentralised finance may bring and the regulatory response to these

"I'm a poor, lonesome cowboy and a long way from home." - Lucky Luke

I am writing about cryptoassets and the ecosystem of financial services that is developing around these assets. This new frontier has been compared to the Wild West, conjuring up images of lawlessness, and bandits whose purpose is crime. We should not forget the Wild West is also home to law-abiding pioneers, whose purpose is reinvention and expansion¹.

We are seeing expansion now. The crypto market has exploded from just US\$16 billion five years ago to some US\$2.6 trillion today². Whilst that is a small share of the US\$250 trillion global financial system, it is still an average annual growth rate of over 150 per cent.

We are seeing reinvention. The crypto ecosystem is challenging a traditional financial ecosystem that is, in places, inefficient and exclusive. Pioneers - from fintech to big tech – are creating new markets and targeting the margins of traditional financial services. And, Canada has been home to pioneers like Vitalik Buterin, the co-founder of Ethereum.

Unfortunately, we are also seeing crime. Much of the crypto-related illicit activity has so far been made up of scams and darknet markets³. Ransomware attacks grew an astonishing 300 per cent last year as work-from-home practices to combat COVID-19 presented new vulnerabilities for businesses⁴.

It is all enough to make one feel somewhat like Lucky Luke; a poor lonesome cowboy and a long way from home.

I hope to help us feel a little closer to home by sharing my views on three features of the crypto ecosystem that are relevant to those who depend on efficient, stable, and trustworthy financial services.

1. Cryptoassets are the bedrock of the emerging financial ecosystem, so supporting consumer protection and financial soundness is the first order of business for regulators. In this regard, there are important differences between cryptoassets that are backed and those that are not.
2. The opportunities and risks extend well past the cryptoassets themselves to encompass a rapidly expanding range of financial services, from lending to insurance. These crypto-based services are increasingly being enabled by decentralised protocols – or DeFi.

The future of this new frontier depends critically on the regulatory response to these new activities and how fast the traditional financial system modernises

3. The future of this new frontier depends critically on the regulatory response to these new activities and how fast the traditional financial system modernises. This will take major investments in domestic and cross-border payments, as well as digital governance.

Before I delve in, I will mention that the views I express here are my own and do not necessarily reflect those of the Bank of England or any of its policy committees.

Cryptoassets are the bedrock of the emerging financial ecosystem

Let me start with the bedrock of the emerging financial ecosystem. The world's first cryptoasset based on blockchain technology was launched over a decade ago by the mysterious Satoshi Nakamoto. It initiated a wave of innovation with now more than 14,000 cryptoassets in existence⁵.

A handful, including Bitcoin, Ether, Litecoin and Cardano, have dedicated communities of backers and investors, although many others have little or no trading volume.

While cryptoassets are often discussed as a single asset class, they differ in terms of whether they are backed and their underlying economic function. These differentiators are important when it comes to understanding what value these assets could add to the financial system, and what type of risks need to be managed.

Let us start with unbacked cryptoassets, taking Bitcoin as an example. Many proponents initially heralded Bitcoin as a revolutionary challenge to fiat-based monetary systems. Yet, Bitcoin has no intrinsic value and lacks a credible mechanism to stabilise its value, so its price is highly volatile.

This means it is not useful as a store of value or a means of payment⁶. The claims that the finite supply of Bitcoin somehow protects its value from eroding are doubtful because the total supply of cryptoassets has no upper bound.

In fact, Bitcoin serves as a speculative asset rather than money, and is at least in part a symptom of the prevailing low interest rate environment and search for yield. That is why, in many jurisdictions, individual holdings are viewed as investments and subject to capital gains tax at disposal⁷.

When you add to the mix estimates showing that the Bitcoin network currently uses as much energy as the Netherlands, the overall net benefit of Bitcoin to the public interest is questionable⁸.

Since around 95 per cent of the US\$2.6 trillion crypto market is unbacked, the bulk of these assets are vulnerable to major price corrections. This raises significant issues related to investor protection and market integrity, particularly given that exposure to these assets is widening to the retail investor via crypto exchanges like Binance, Coinbase and Wealthsimple, and new financial products such as crypto-based ETFs.

That is why regulators around the world have turned from simply monitoring the situation to action. The Basel Committee on Banking Supervision has proposed that banks back crypto positions one-to-one with capital, which sends a strong signal about their assessment of the risks associated with unbacked crypto exposures⁹.

The Canadian Securities Administrators has recently required crypto trading platforms that offer custody services and that are operating in Canada to register and is developing its regulatory and supervisory capacity¹⁰.

In the UK, cryptoasset businesses must comply with the Money Laundering Regulations (MLRs) and register with the Financial Conduct Authority, which has also banned the sale to retail clients of crypto derivative products¹¹.

This work is critical to driving out the bandits and creating an environment for crypto businesses and investors that both supports innovation and competition and mitigates risks.

To try to address the issue of instability of unbacked cryptoassets, crypto pioneers have introduced 'stablecoins'. These aim to achieve a stable value against a fiat currency or other assets by maintaining reserves or backing-assets to help achieve this.

Stablecoins, such as the USD coin, are not yet widely used for mainstream payments. Instead, they currently act as a bridge for investment in unbacked cryptoassets or collateral for loans and play a key role in the development of decentralised finance (DeFi).

In theory, stablecoins could yield important benefits in terms of lower-cost, real-time and competitive payments services, both domestic and cross border. In practice, these will only be realised if stablecoins are safe.

US regulators found that Tether, another big stablecoin, had falsely claimed that its tokens were fully backed by US dollars. This highlights legitimate concerns about both quality and transparency of backing arrangements¹².

The Bank of England's Financial Policy Committee on which I am a member has set out two main expectations for systemic stablecoins. These were clearly articulated in a recent speech by my colleague Sir Jon Cunliffe¹³.

The first is that any payments chains that are based on a stablecoin should be regulated to standards equivalent to those applied to traditional payments chains.

The second is that stablecoins used as money-like instruments should meet standards that are equivalent to those provided by commercial bank money – bank deposits. As Canada considers its regulatory response to stablecoins, it can look to these examples and the international work in this area.

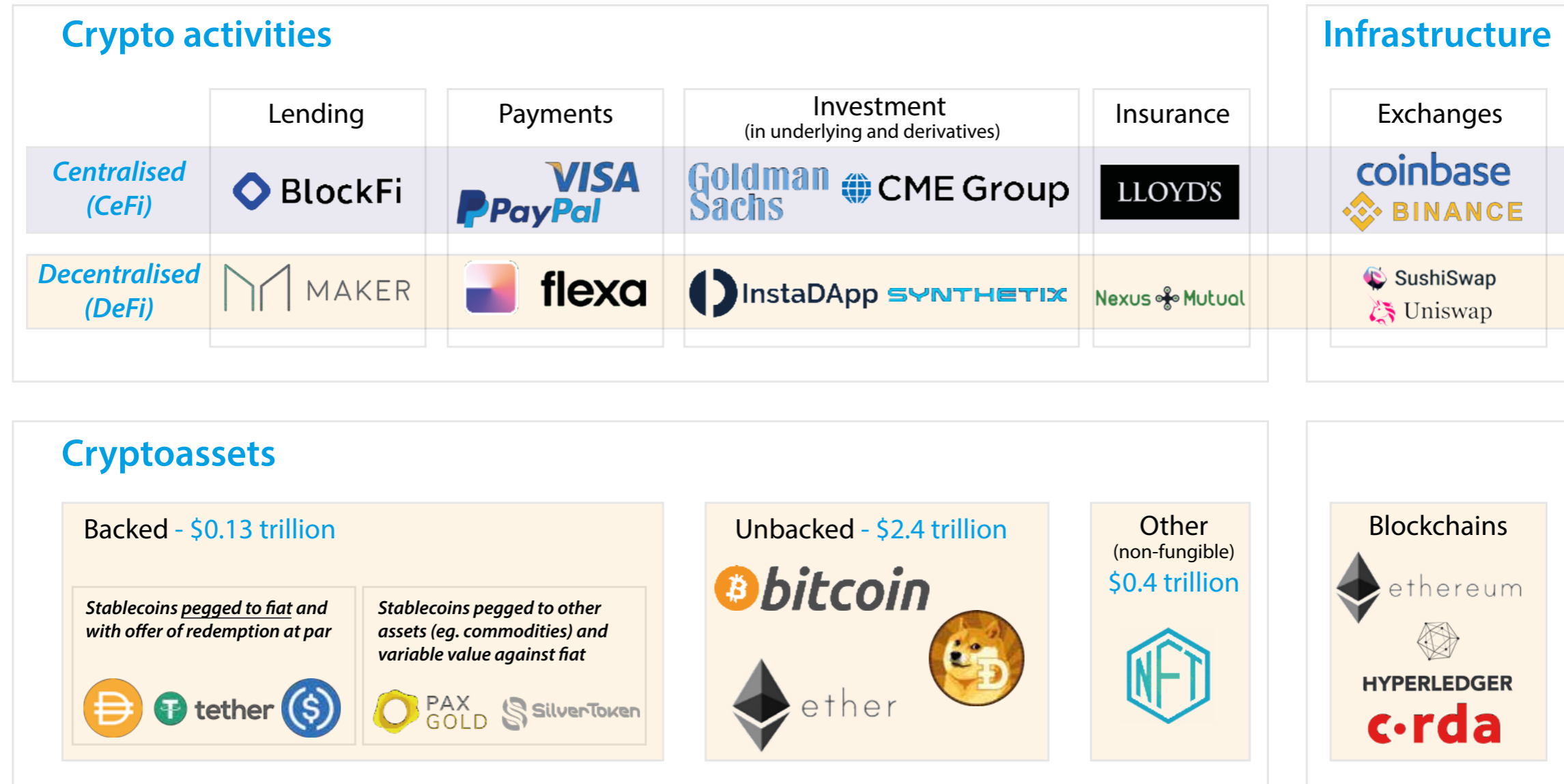
I agree with Jon that international co-operation is critical to ensure common stablecoin standards and avoid regulatory arbitrage across sectors and jurisdictions. The recent CPMI-IOSCO consultation on how the international standards for FMIs, the Principles for Financial Market Infrastructures should apply to stablecoin arrangements is a major step forward in applying ‘same risk, same regulation’ to systemically important stablecoins that are used for payments¹⁴. The Financial Stability Board is also working with standard-setting bodies to address any potential gaps in international standards.

The issue extends past cryptoassets themselves to the emerging financial ecosystem

Stablecoins and unbacked cryptoassets are facilitating a broader range of services than just payments, including lending, investment products, and even insurance. This brings me to my second point, which is that the issues extend past the cryptoassets themselves to the emerging financial ecosystem. The fact that this ecosystem is increasingly interconnected with the traditional financial system raises financial stability concerns.

These crypto-enabled services are offered in both a centralised (CeFi) and decentralised (DeFi) manner (Figure 1). In the CeFi space, I have already mentioned the exchanges run by newcomers, Binance and Coinbase, but traditional financial institutions such as Goldman Sachs and the CME Group have also begun facilitating investment in crypto underlying and derivatives.

Figure 1. Stylised map of cryptoassets, crypto activities and infrastructure



Because these entities have a legal structure and centralised governance, regulation and supervision should be straightforward. Compliance is nonetheless an issue, as the UK Financial Conduct Authority said that Binance's UK affiliate had failed to respond to some of its basic queries, and therefore was prohibited from undertaking regulated financial services activity in the UK¹⁵.

DeFi has more novel features than CeFi, and so presents some unique opportunities and risks. First a definition. 'DeFi' refers to a variety of financial products, services, activities, and arrangements that are supported by smart contract-enabled distributed ledger technology. The distinguishing factor from centralized finance is that these DeFi protocols take the place of intermediaries.

Ethereum is now the predominant blockchain on which DeFi protocols and applications function, with 70 per cent of the DeFi value locked in worldwide on the Ethereum blockchain.

I see from my work with the Creative Destruction Lab at the Rotman School of Management that there is a lot of energy and investment dollars going into development. The total value locked in DeFi now is over US\$100 billion, and growing fast¹⁶.

That is because DeFi has several potential advantages over centralised ecosystems. Decentralisation reduces the reliance on intermediaries and their inefficient infrastructure.

The real opportunity is with smart contracts, which enable automated execution and creation of new financial instruments and digital assets. These contracts are enabled by the fact that DeFi protocols can integrate with each other and so data are easily shared, as opposed to traditional siloed platforms that do not talk to each other. DeFi

protocols are also open source, so the code is also visible and auditable, and every transaction is visible on the blockchain.

Despite some asserted distinctions from more traditional or centralised financial products, services, and activities, DeFi arrangements raise familiar issues.

The most immediate relate to fraud, misappropriation, and conflicts of interest, including those arising from misleading disclosures, misuse of inside information, and manipulative trading activities.

And, in some cases, despite claims of decentralisation, operations and activities within DeFi are governed or administered by a small group of developers and investors. This raises serious governance issues, including whether miners, programmers, and others should have fiduciary duty¹⁷.

There is also risk related to money laundering and terrorist financing. That is why FATF (the Financial Action Task Force) recently updated their guidance for virtual assets and virtual asset service providers and added new guidance on how DeFi and distributed applications (DApp) relate to the FATF Standards¹⁸.

Investors and users of DeFi are also exposed to important risks related to the underlying technology.

Security around smart contracts has improved since US\$50 million of Ether was stolen in the decentralized autonomous organisation ('DAO') in 2016, but significant losses from cyber attacks remain frequent. One major DeFi platform disclosed last summer that cyber bandits made off with digital assets worth more than US\$600 million, and there have been over 24 such robberies so far this year¹⁹.

Many of these hacks have been 'flash loan attacks' that take advantage of temporary defects in price feeds. This has prompted insurance markets – like Lloyd's of London - to provide users with insurance against losses due to hacks or malfunctioning software²⁰.

The question for financial stability regulators is what risks does DeFi present, and are they important enough to be of systemic importance – either now or in the future. Price volatility is one issue that I've already mentioned. The share token of a DeFi protocol called Titanium that was once worth US\$2 billion fell precipitously to near zero earlier this year²¹.

The emergence of leveraged players only magnifies this risk. A sharp fall in the value of cryptoassets could trigger margin calls, forcing leveraged investors to liquidate positions. This could snowball into other asset class, especially if interconnectedness with traditional financial system keeps growing.

We are even starting to see synthetic collateral to get leverage. For instance, Synthetix allow users to take positions without ever holding the underlying asset²².

This is reminiscent of the emergence of synthetic collateralised debt obligations (CDOs) leading up to the global financial crisis. The Bank of England, along with international partners, is developing a framework on how to deal with these important financial system issues.

Future depends on how traditional players modernise

The 200-Bitcoin question is how successfully DeFi will ultimately compete with CeFi and traditional finance. When I refer to 'traditional', I am referring to a system that has fiat at the core, and relies on intermediaries and trusted

third parties, including central banks. The advantage of this is an ability to see who you are dealing with and who is accountable.

Nevertheless, as Jeff Bezos famously said, *“your margin is my opportunity.”* That means the traditional world cannot avoid competing along similar lines as DeFi – increasing quality of services, reducing costs to customers, and increasing inclusion.

Modernisation efforts in the traditional space will have to push further than replacing mainframes and better mobile banking apps. And, competitors are not standing still, whether they are banks and other FIs, or Big Tech.

This is a very positive outcome in terms of contestability of financial services.

Central banks also need to modernise. In that regard, there are over 50 central banks that are researching and experimenting with their own digital version of cash – central bank digital currency. The Bank of Canada and the Bank of England have been collaborating closely on these efforts²³.

No decision has been taken yet in most jurisdictions, including Canada and the UK. Much of the public discourse so far has focussed on winners and losers if this were to happen. One particular concern is that a CBDC would compete too successfully with bank deposits, and potentially raise the cost and undermine the stability of this source of bank funding. I think increased contestability for deposits would be positive, and the CDDBC could be designed to avoid any instability in bank funding.

The deeper issue relates to importance of universal access to a safe medium of exchange. It is foundational to trust in the financial system and is therefore a public good. Do we really want private profit-making institutions

or protocols to be the only game in town in a modern economy? Also, there is potential for CBDC to enable innovations like private, fiat-backed stablecoins, and smart money.

If the traditional financial system to compete with the emerging ecosystem private and public efforts will need to focus on three building blocks. The first, I have already spoken about: a legal, policy and regulatory framework for the crypto ecosystem.

The second relates to modernising the payments landscape both domestically and cross-border. We urgently need more efficient wholesale and retail cross-border payments, including remittances; the door is wide open for disruption from cryptoassets given how inefficient and costly payments systems are today.

International and domestic authorities are taking forward implementation of the G20 Roadmap to enhance cross-border payments and ambitious targets for addressing challenges have been set for 2027²⁴. Enhanced operating hours and increased direct access to domestic payments systems will help support cross border payments.

Payments Canada and the Bank of Canada are working right now on a domestic payments infrastructure that delivers 24/7, real-time, and low-cost clearing and settlement of transactions that can accommodate a wider universe of payment service providers. And the Bank of England is also developing a Renewed RTGS system²⁵.

The third building block relates to up-to-date data governance. We need a well-articulated data management framework, including for open banking, which recognises the rights of users of financial services and the protection of their privacy, as well as ethical use of personal data.

Whilst central banks have a role to play in this space, there is a vital role for government. GDPR covers this for UK and EU, but we are still waiting in Canada.

While the work related to these building blocks is underway, the many outstanding issues and divergent interests call into question whether progress will be made fast enough and risk producing a fragmented regulatory landscape and further unchecked growth in the crypto ecosystem.

Conclusion

I have said that cryptoassets are the bedrock of the emerging financial ecosystem, so supporting consumer protection and financial soundness is the first order of business for regulators. We must recognise that the opportunities and risks extend well past the cryptoassets themselves to encompass a rapidly expanding range of financial services.

The future of this new frontier depends critically on the regulatory response to these new activities and how fast the traditional financial system modernises.

Regulators and policymakers may feel like poor lonesome cowboys and a long way from home in this modern Wild West, but we must crack on.

To get the most out of these innovations, we need to modernise our legal and regulatory frameworks so that businesses and investors have clear and predictable rules of the game, and the risks to the financial system are managed.

This will take major investments in domestic and cross-border payments, as well as digital governance. If we do that, we will realise the promise of reinvention and expansion for those who rely on efficient and trustworthy financial services. ■

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Endnotes

1. For example, see Gary Gensler's [remarks](#) before the Aspen Security Forum.
2. Given the volatility in cryptoasset prices, it is worth noting that the figure quoted is as of 18 November 2021 ([Global Cryptocurrency Market Charts](#) | CoinMarketCap).
3. Chainalysis (2021) "[The 2021 Crypto Crime Report](#)", February 2021.
4. See recent [remarks](#) by Homeland Security Secretary Alejandro Mayorkas.
5. Given the volatility in cryptoassets, it is worth noting that the figure quoted is as of 18 November 2021 ([All Cryptocurrencies](#) | CoinMarketCap)
6. See Foley, Karlsen and Putnins (2019) "[Sex, drugs and Bitcoin: How much illegal activity is financed through cryptocurrencies](#)" *The Review of Financial Studies*, 2019.
7. See [Guide for cryptocurrency users and tax professionals](#) - Canada.ca and UK: [Overview of the taxation of cryptoassets](#) - KPMG United States
8. See, Bank of International Settlements (2021) "[Central Bank Digital Currencies: an opportunity for the monetary system](#)", *Annual Economic Report 2021*, Chapter 3, p.67.
9. See Consultative document - [Prudential treatment of crypto-asset exposures](#) | BIS

10. See *Joint Canadian Securities Administrators/Investment Industry Regulatory Organization of Canada Staff Notice 21-329 [Guidance for Crypto-Asset Trading Platforms: Compliance with Regulatory Requirements](#)* | OSC
11. HM Treasury has also *consulted* on bringing certain cryptoassets into scope of financial promotions regulation to enhance consumer protection.
12. Because of lack of transparency Tether recently was compelled to *deny claims* that it held commercial paper held by Chinese real estate firm Evergrande.
13. See *Is 'crypto' a financial stability risk?* - speech by Jon Cunliffe | Bank of England
14. See the recent *CPMI-IOSCO consultative report*.
15. See *UK's FCA says it is 'not capable' of supervising crypto exchange Binance* | Financial Times
16. Source: *defipulse*.
17. See for example FSB (2019) *"Decentralised financial technologies: report on financial stability, regulatory and governance implications"*, June 2019.
18. See FATF (2021) *Updated Guidance for a Risk-Based Approach for Virtual Assets and Virtual Asset Service Providers*
19. See *Decentralized Finance—Risks, Regulation, and the Road Ahead* | King & Spalding – JDSupra
20. *Lloyd's Launches New Cryptocurrency Wallet Insurance Solution For Coincover* | Lloyd's
21. *Iron Finance's Titan Token Falls to Near Zero in DeFi Panic Selling* | CoinDesk
22. See *Synthetix – Synths*
23. See *Central bank digital currencies - executive summary* | BIS
24. See *G20 Roadmap for enhancing cross-border payments: First consolidated progress report* | Financial Stability Board
25. See *RTGS Renewal Programme* | Bank of England

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Stablecoins and payments innovations



Christopher Waller reflects on stablecoins, and raises the risks and benefits they have, in particular the lack of a regulatory and supervisory framework



tether

The US payment system is experiencing a technology-driven revolution. Shifting consumer preferences and the introduction of new products and services from a wide variety of new entities have led to advancements in payments technology.

This dynamic landscape has also sparked an active policy debate—about the risks these new developments pose, how regulators should address them, and whether the government should offer an alternative of its own.

Earlier this year I spoke about the last of these questions: whether the Fed should offer a general-purpose central bank digital currency (CBDC) to the American public¹. My scepticism about the need for a CBDC, which I still hold, comes in part from the real and rapid innovation taking place in payments.

My argument—simple as it sounds—is that payments innovation, and the competition it brings, is good for consumers. The market and the public are telling us there is room for improvement in the US payment system. We should take that message to heart and provide a safe and sound way for those improvements to occur.

My remarks focus on ‘stablecoins’, the highest-profile example of a new and fast-growing payments technology². Stablecoins are a type of digital asset designed to maintain a stable value relative to a national currency or other reference assets. Stablecoins have piggybacked off the recent increase in cryptoasset activity, and their market capitalisation has increased almost fivefold in just the past year³.

Stablecoins can be thought of in two forms. Some serve as a ‘safe, liquid’ asset in the decentralised finance, or DeFi, world of crypto-trading. Examples include Tether and USD Coin. Alternatively, there are stablecoins that are intended to serve as an instrument for retail payments between consumers and firms.

Although these types of stablecoins have not taken off yet, some firms are working to assess the viability of such stablecoins as a retail payment instrument. This growth in usage of stablecoins and their potential to serve as a retail payment instrument has prompted regulatory attention, including a new report from the President's Working Group on Financial Markets (PWG). This report urges the Congress to limit the issuance of 'payment stablecoins' to banks and other insured depository institutions.

The United States has a long history of developing, refining, and integrating new payment technologies in ways that maintain the integrity of its financial institutions and its payment system

Fostering responsible payments innovation means setting clear and appropriate rules of the road for everyone to follow. We know how to handle that task, and we should tackle it head-on. The PWG report lays out one path to responsible innovation, and I applaud that effort.

However, I also believe there may be others that better promote innovation and competition while still protecting consumers and addressing risks to financial stability. This is the right time to debate such approaches, and it is important to get them right. If we do not, these technologies may move to other jurisdictions—posing risks to US markets that we will be much less able to manage.

Stablecoins: what's old, and what's new

Stablecoin arrangements involve a range of legal and operational structures across a range of distributed ledger networks. They are a genuinely new product, based on genuinely new technology. But despite the jargon surrounding stablecoins, we can also understand them as a new version of something older and more familiar: the bank deposit⁴.

As I have said before, both the government and the private sector play indispensable roles in the US monetary system. The Federal Reserve offers both physical 'central bank money' to the general public in the form of physical currency and digital 'central bank money' to depository institutions in the form of digital accounts.

Commercial banks, in turn, give households and businesses access to 'commercial bank money', crediting checking and savings accounts when a customer deposits cash or takes out a loan. This privately created money serves as a bridge between the central bank and the public.

Commercial bank money is a form of private debt. The bank issuing that debt promises to honour it at a fixed, one-to-one exchange rate with central bank money. The bank itself is responsible for keeping that promise.

However, the bank is supported in that task by a tried-and-true system of public support. That includes regulation and supervision, which ensure banks are safe and sound, not taking imprudent risks in their day-to-day business; the availability of discount window credit, which ensures well-capitalised banks can meet their emergency liquidity needs; and deposit insurance, which protects consumer deposits if the bank fails.

Put together, those programs leave very little residual risk that a depositor in good standing will ever have to leave the teller empty handed. They make a bank's redemption promise credible, and they make commercial bank money a near-perfect substitute for cash. As a result, households and businesses overwhelmingly use commercial bank money for everyday transactions⁵.

This arrangement has many advantages. Small retail customers do not have to spend their time vetting the safety and soundness of their banks—regulators and supervisors do that for them. Consumers have a safe place to keep their savings and a nearly risk-free way to make payments, which are settled in ultrasafe central bank liabilities.

Banks can focus their effort on investments, products, and services from a place of safety and soundness. Communities and customers benefit from those efforts in the form of more efficient capital allocation and higher-quality, lower-cost financial products.

These advantages, however, are not cost free. Regulation ensures that commercial banks issue 'sound money' by making sure those banks are safe and stable, and that they bear the risks of their own investment decisions.

But regulation also imposes costs, from the expense and time required to seek a banking charter to the costs of compliance with an array of regulations.

While regulations are necessary, they also limit free entry into at least some of the markets in which banks operate. As a result, regulatory oversight can insulate banks from some forms of direct competition. The Congress has long recognised the importance of private-sector competition and customer choice, particularly in payments, and the Congress and the Federal Reserve take regular steps to preserve a competitive payments marketplace⁶.

The objective of stablecoins is to mimic the safe-asset features of commercial bank money. They typically offer a fixed exchange rate of one-to-one to a single asset or a basket of assets. Payment stablecoins tend to choose a sovereign currency as their anchor, typically the US dollar.

Stablecoin issuers suggest that one can redeem a stablecoin from the issuer for one US dollar, although redemption rights are not always well defined. Nor is the entity responsible for conducting redemption always clearly specified.

To enhance the credibility of redemption at par, some stablecoin issuers go further, promising to limit the investments they make with the money backing each stablecoin by keeping it in cash or other highly liquid assets. In this respect, stablecoins can resemble a 'narrow bank', a well-known payment-only banking structure that monetary economists have studied for more than half a century⁷.

Constructed this way, stablecoins also resemble currency boards, which peg a foreign currency to the dollar and hold dollar reserves to back up redemption promises.

Although stablecoins try to mimic commercial bank money, they differ dramatically in terms of the payment networks they use. Dollar-denominated commercial bank money is a settlement instrument in a wide range of asset markets, and customers can transfer it using a wide range of payment platforms.

However, commercial bank money is not 'native' to public blockchains, the distributed networks that support trading and other activity involving cryptoassets. Stablecoins help fill that gap as a less volatile anchor for cryptoasset transactions and an 'on-ramp' for digital asset trading.

Promises and risks

This role—as a more stable private asset in digital markets that otherwise lack such assets—has meaningful benefits by itself, helping make those markets deeper and more liquid. A well-designed, well-regulated stablecoin could also have other benefits, which go well beyond digital asset markets.

It might allow for different activity on distributed ledger technology, or DLT, platforms, like a wider range of automated (or 'smart') contracts. It might serve as an 'atomic' settlement asset and thus help bring some of the speed and potential efficiencies of digital asset markets into more traditional ones.

With the right network design, stablecoins might help deliver faster, more efficient retail payments as well, especially in the cross-border context, where transparency can still be low and costs can still be high.

Stablecoins could be a source of healthy competition for existing payments platforms and help the broader payments system reach a wider range of consumers.

And, importantly, while stablecoins and other payment innovations could create new risks, we should not foreclose the possibility that they may help address old ones—for example, by providing greater visibility into the resources and obligations that ultimately support any system of privately issued money.

These benefits are substantial, and even where they are still uncertain, it is important to recognise them. But to capture those benefits, stablecoins must bridge the biggest gap between them and commercial bank money: robust, consistent supervision and regulation and appropriate public backstops.

Strong oversight, combined with deposit insurance and other public support that comes with it, is what makes bank deposits an acceptable and accepted form of money. Today stablecoins lack that oversight, and its absence does create risks. The PWG described several such risks in its report, but I will highlight just three.

The first is the risk of a destabilising run. The United States has a rich history of privately created money, stretching back to promissory notes that merchants and lawyers issued on the early frontier⁸.

Some of these instruments worked well for long periods; others came from unregulated or unscrupulous issuers, who promised safety and stability at a more attractive rate of return.

When these instruments went bad, the consequences could extend well beyond the depositors, investors, or even institutions who put their principal at risk. It is important not to overstate these risks; if the investors that participate in stablecoin arrangements know their money is at risk, then a run on one issuer is less likely to become a run on all of them.

But without transparency into those risks, or with retail users that are less able to monitor them, the possibility of widespread losses is more of a concern. As I mentioned, for commercial bank money, regulation, supervision, deposit insurance, and the discount window make this dynamic more remote by giving a bank's creditors less reason to run.

The second risk is the risk of a payment system failure. Stablecoins share many of the functions of a traditional payment system. If stablecoins' role in payments activity grows—which, again, could be a good development—their exposure to clearing, settlement, and other payment system risks would grow, too.

Stablecoins also present some unique versions of these risks because responsibility for different payment functions is scattered across the network. The United States does not have a national payments regulator, but it does have strong standards for addressing payment system risk, especially where those payment systems are systemically important. Regulators should draw on those standards with care and take a fresh look at what should or should not apply in the stablecoin context.

The third risk is the risk of scale. Stablecoins, like any payment mechanism, can exhibit strong network effects; the more people use a payment instrument, the more useful it is, and the greater the value it delivers to each participant. For this same reason, network effects can be (and usually are) highly beneficial.

As a result, rapid and broad scaling of a payment instrument is socially desirable. In fact, in a perfect world, there would be one payment system and one payment instrument that everyone uses. The problem with this is that, in our imperfect world, this would confer monopoly power over the payment system.

Any entity that has control over a large and widely used payment system has substantial market power and thus the ability to extract rents in exchange for access—which, again, hurts competition and decreases the network benefits to consumers.

Thus, there is a trade-off between the efficiency of having one large network and the cost of monopoly control of that network. I believe that we are a long way from a monopoly in stablecoin issuance; I see a lot of interest in offering this type of payments competition and ensuring that there are relatively few barriers to entry.

In my view, having stablecoins scale rapidly is not a concern as long as there is sufficient competition within the stablecoin industry and from the existing banking system. In this world, some form of interoperability is critical to ensure that competition allows consumers to easily move across stablecoin networks, just as they can move between different commercial bank monies or sovereign currencies.

Looking beyond the banking model

Jurisdictions around the world are grappling with these same risks, trying to foster the potential benefits of stablecoin arrangements while minimising their costs. The PWG report described one approach to that cost-benefit equation: restricting the issuance of ‘payment stablecoins’ to insured depository institutions and imposing strict limits on the behaviour of wallet providers and other nonbank intermediaries.

Given the economic similarities between payment stablecoins and bank deposits, I have no objection to the idea of banks issuing both instruments. The United States has a tried-and-true system for overseeing and supporting the creation of commercial bank money, and there is no reason to suggest it could not be adapted to work in this context.

However, I disagree with the notion that stablecoin issuance can or should only be conducted by banks, simply because of the nature of the liability. I understand the attraction of forcing a new product into an old, familiar structure. But that approach and mindset would eliminate a key benefit of a stablecoin arrangement—that it serves as a viable competitor to banking organisations in their role as payment providers.

The Federal Reserve and the Congress have long recognised the value in a vibrant, diverse payment system, which benefits from private-sector innovation. That innovation can come from outside the banking sector, and we should not be surprised when it crops up in a commercial context, particularly in Silicon Valley.

When it does, we should give those innovations the chance to compete with other systems and providers—including banks—on a clear and level playing field.

To do so, the regulatory and supervisory framework for payment stablecoins should address the specific risks that these arrangements pose—directly, fully, and narrowly. This means establishing safeguards around all of the key functions and activities of a stablecoin arrangement, including measures to ensure the stablecoin ‘reserve’ is maintained as advertised.

But it does not necessarily mean imposing the full banking rulebook, which is geared in part toward lending activities, not payments. If an entity were to issue stablecoin-linked liabilities as its sole activity; if it backed those liabilities only with very safe assets; if it engaged in no maturity transformation and offered its customers no credit; and if it were subject to a full program of ongoing supervisory oversight, covering the full stablecoin arrangement, that might provide enough assurance for these arrangements to work.

There should also be safeguards for other participants in a stablecoin arrangement, like wallet providers and other intermediaries. Again, however, not all of the restrictions that apply to bank relationships might be necessary.

For example, there is no need to apply restrictions on commercial companies from owning or controlling intermediaries in these arrangements. The separation of banking and commerce is grounded in concerns about captive lending—the idea that banks might lend to their owners on too favourable terms, giving the owners an unfair subsidy and putting the bank on shaky ground.

These traditional concerns do not apply to wallet providers and other intermediaries who abstain from lending activities. There are new questions to consider, such as around the use of customers' financial transaction data, but where anticompetitive behaviour happens, existing law (and particularly antitrust law) should still apply.

Policymakers will continue to work through these questions in the coming months, but in the process, we should not let the novelty of stablecoins muddy the waters. The United States has a long history of developing, refining, and integrating new payment technologies in ways that maintain the integrity of its financial institutions and its payment system.

Stablecoins may be new, but their economics are far from it. We know how to make this kind of privately issued money safe and sound, and, in designing a program of regulation and supervision to do so, we have plenty of examples to draw on. In the interest of competition and of the consumers it benefits, we should get to work. ■

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Endnotes

1. See Christopher J Waller (2021), [“CBDC: A Solution in Search of a Problem?”](#) speech delivered at the American Enterprise Institute, Washington (via webcast), August 5.
2. These views are my own and do not represent any position of the Board of Governors or other Federal Reserve policymakers.
3. See President’s Working Group on Financial Markets, Federal Deposit Insurance Corporation, and Office of the Comptroller of the Currency (2021), [Report on Stablecoins \(PDF\)](#) (Washington: PWG, FDIC, and OCC, November).
4. This analogy applies to the economics of stablecoins; I make no comment on their legal status.
5. See Waller, “CBDC,” in note 1.
6. See Federal Reserve System (2021), [“Fostering Payment and Settlement System Safety and Efficiency \(PDF\),”](#) in *The Fed Explained: What the Central Bank Does*, 11th ed. (Washington: FRS), pp. 84–111.
7. See, for example, Milton Friedman (1960), *A Program for Monetary Stability* (New York: Fordham University Press).
8. See Justin Simard (2016), “The Birth of a Legal Economy: Lawyers and the Development of American Commerce,” *Buffalo Law Review*, vol. 64, no. 5, pp. 1059–1134.

This article is based on a [speech](#) delivered at Planning for Surprises, Learning from Crises 2021 Financial Stability Conference, co-hosted by the Federal Reserve Bank of Cleveland and the Office of Financial Research, Cleveland, Ohio (via webcast)

The challenges of the digital euro



Denis Beau argues it is unlikely that banks will be erased from a future payments landscape in which stablecoins and central bank digital currency dominate

Over the past two years, most central banks around the world have been giving increasing thought to the idea of creating a digital form of their currency, a central bank digital currency (CBDC), to maintain the stabilising role of central bank money in a rapidly changing payments landscape: according to the BIS, about nine out of ten central banks have reported that they have launched studies.

To date, only two retail CBDCs have been introduced (in Caribbean archipelagos: the Sand Dollar in the Bahamas and DCash for the Organisation of Eastern Caribbean States), but over twenty pilot projects are underway around the world.

This observation naturally raises questions about the timing, form and role of central bank money in tomorrow's payments landscape and about the role of banks and commercial bank money in a world of stablecoins and central bank digital currencies.

From my point of view as a central banker responsible for ensuring that our payment system functions properly, it is difficult to answer these questions on the role of banks with anything other than caution yet confidence for two main reasons, on which I would like to focus my remarks at this point.

First, the stability of our payment system does not rest solely on our ability to make our central bank money available in digital form, and second, the effective introduction of such a digital currency raises complex problems that cannot be solved to the detriment of commercial banks in order to produce the expected effects.

1. The stability of our payment system does not rest solely on our ability to provide a CBDC

Changes in payment expectations and habits resulting from the digitalisation of our economies, the implementation of new technologies such as distributed ledgers, the emergence of new players such as fintechs

and big techs, and the development of the use of new settlement assets such as cryptoassets are likely to profoundly alter our euro payments ecosystem.

These innovations have the significant potential to improve the functioning of our payment system, in particular by making payment means simpler, easier and cheaper to use, and faster if not instantaneous.

My conviction is that, given the way in which investigations are being conducted into a digital euro [...] it is unlikely that banks will be erased from a future payments landscape in which stablecoins and central bank digital currency dominate

However, these innovations also carry risks for the smooth functioning of our payment system. In order to fully understand the scope of these risks, I believe it is important to recall the organisational principles of our payment system, which are at the root of its efficiency and stability.

a. The organisational principles of our payment system

The first is the dominance of currencies linked by a legally binding rule of convertibility at par: central bank or public money, and commercial or private money, issued by regulated financial sector players, first and foremost banks.

The second is that only central bank money is legal tender and must therefore be accepted by all.

The third is the complementary roles played by the dominant currencies: central bank money fulfils an integrating and anchoring function that guarantees the efficiency and stability of our payment system, while commercial money, and the services associated with it, which are traded on a highly competitive market, plays a key role in trade and the financing of the economy.

b. The risk of calling into question the foundations of the efficiency and stability of our payment system

However, these foundations are threatened by the diffusion of innovations across the payments field, which has been sped up by the health crisis and social distancing, if no measures are taken to preserve them.

Indeed, the reduction in the use of banknotes for transaction purposes and the prospect of the development, within the networks of the major global players in digital services, of cryptoassets as a means of payment, whose link with central bank money is complex and fragile, to say the least, if not non-existent for some, are likely to call into question the integrating and anchoring role that central bank money plays in our payment system.

These threats are reflected in a rise and a change in the dimension of the risks that any wave of innovation naturally carries, and which the health crisis has helped to amplify.

First of all, there are risks of a setback in terms of efficiency. Two risks are likely to change in scope:

- The risk of fragmentation of the payment system, both for everyday trading and between financial players due to a lack of secure and efficient structural interconnection, through convertibility at par between cryptoassets and central bank money, between old and new payment solutions.
- The risk of concentration, or even the emergence of monopolistic situations for the benefit of global digital giants and their private settlement assets, and therefore of Europe's increased dependence in terms of payment services vis-à-vis foreign players, with the associated issues of personal data protection and industrial and monetary sovereignty.

Then there are risks of a setback in terms of security. Prior to the health crisis, the risks of financial instability associated with the large-scale use, as a means of payment, of cryptoassets with unstable value, uncertain convertibility into central bank money, and without a responsible issuer and credible lender of last resort in the event of a destabilising shock, had been clearly identified.

With the crisis and the acceleration of the digital transformation, IT risk, and in particular cyber risk, has taken on a new dimension and added an operational dimension of systemic importance to the risk of financial instability, which also concerns cryptoassets.

c. Levers for action

For a central bank such as the Banque de France, which is responsible for ensuring the smooth functioning of our payment system, the objective is thus to make sure that innovations deliver the expected benefits for users in terms of speed, cost savings and ease of use, but without undermining the efficiency and stability of our overall payment system.

As a result, at the Banque de France, we are not ruling out that we might need to issue a digital form of our currency, to preserve the anchoring role of central bank money by providing it in a form that is better suited to the new, highly digitalised payments landscape.

This is why we have taken an ambitious experimental approach to a CBDC: we are currently in the process of finalising our programme of experiments on an 'interbank' or 'wholesale' CBDC, to test whether and how it could improve the performance, speed, transparency and security of transactions between major financial players, especially for cross- border payments.

In parallel, the Banque de France is closely involved in the investigation phase launched by the Eurosystem in July for the retail digital euro, which would be used by the general public in everyday payments.

However, a CBDC is not the only, or indeed the most urgent instrument we need to use.

We also regard regulation as a priority, because the smooth functioning of our payment system depends, first and foremost, on a regulatory framework that is clear, fair ('same activity, same risk, same rule') and balanced – in other words capable of encouraging innovation and at the same time maintaining the stability of our payment system.

This is why we have welcomed and are supporting the proposed Markets in Crypto-Assets (MiCA) regulation and the Digital Operational Resilience Act (DORA), presented in September 2020 – even though there is still room for progress on these texts in order to reconcile pragmatism and flexibility with the necessary requirements in terms of risk control and the prevention of regulatory arbitrage.

Moreover, other regulatory changes will have to be introduced which are also very important. I'm referring in particular to the supervision of the development of decentralised finance, where the usual regulatory frameworks are constrained by the fact that issuers and service providers are not easily identifiable in an environment where protocols are automatically executed without intermediaries, and there is no fixed jurisdiction for the services offered.

Lastly, in order to be effective, regulation must be multidimensional and coordinated at national and international level. At the Banque de France, we are very attached to coordination with other national and European regulators, which seems all the more essential given the increasingly cross-cutting nature of the issues.

This is also a priority for us, to limit regulatory arbitrage or indeed prevent it altogether. For this reason, we are closely involved in the work of multilateral fora (G7, G20, FSB, CPMI), especially on cryptoassets and the improvement of cross-border payments. Another action we see as a short-term priority is to facilitate and accompany initiatives by regulated players, which can help to foster a diverse and competitive market for efficient solutions, tailored to user needs.

Our institutions – such as the Banque de France's Lab, its Infrastructure, Innovation and Payments Directorate (DIIP), the ACPR's Fintech-Innovation Uni with its ACPR-AMF Fintech Forum – are fully mobilised to facilitate these initiatives and help them grow.

Among these initiatives, three in particular are worth highlighting. First, those in the field of instant payments, which open a new chapter in the payments industry. Second, the continuing development of open banking, thanks to the European financial sector's work on APIs. And last but not least, the European Payments Initiative (EPI).

Some major decisions on the effective launch of EPI are due to be taken in the next few weeks. But I would just like to remind you here that the Banque de France fully supports this initiative, as do the other Eurosystem national central banks and the European Commission, and currently seven EU member states, including France, that publicly announced their support for the initiative in a statement published on 9 November.

2. The introduction of a CBDC raises complex issues that need to be resolved without penalising banks in order to produce the desired effects

The second reason why we should take a cautious but confident approach to the role of banks in a world of stablecoins and CBDCs relates to the challenges that need to be met to ensure the digital euro contributes positively to the European financial system and payments landscape.

a. Avoiding disruptive effects for financial intermediaries

This implies making complex economic, financial, technical and organisational choices, to avoid generating disruptive effects for financial intermediaries that would conflict with our mandate to safeguard monetary and financial stability.

These disruptive effects could materialise in two ways:

- First, if the introduction of a CBDC were to lead, in normal periods and in periods of stress, to the conversion of a large share of bank deposits into assets held in CBDC.

A reduction of this size in deposits would have serious consequences. It could undermine banks' profitability and their ability to meet regulatory requirements, and ultimately affect their capacity to finance the real economy.

- The issuance of a CBDC could also reduce the role of banking intermediaries in client relationships, depending on the architecture chosen by the Eurosystem, which could restrict access to client information. To avoid these undesirable consequences, it is essential that commercial banks be involved. Their input is needed, for example, to set limits and/or remuneration disincentives for CBDC holdings.

In addition, choosing an intermediated architecture would allow us to exploit financial intermediaries' expertise in customer interface management, and thus preserve the essential role they play in this field.

b. Avoiding impediments to the conduct of monetary policy

Choices will also need to be made to avoid any adverse consequences for monetary policy conduct. The introduction of an unremunerated retail CBDC with no holding limit could make it difficult for central banks to pursue a negative interest rate policy, as market participants would prefer to hold the CBDC instead of assets remunerated at negative rates. This effect could be avoided by setting an appropriate level of remuneration for the CBDC.

c. Improving the efficiency and integration of payment solutions

Choices will also need to be made to ensure that the CBDC complements existing payment solutions, so that it can increase the efficiency and integration of certain market segments. This notably applies to cross-border payments. The work conducted under the aegis of the G20, in which the Banque de France played a leading role, has

confirmed that a CBDC can bring benefits in this area. However, to fully exploit this potential, central banks will need to coordinate their efforts to ensure that CBDCs in different jurisdictions are interoperable.

In its experiments on a wholesale CBDC, the Banque de France tested the main multiple-CBDC arrangements identified in the literature. As described in the report published by the Banque de France on 8 November, these experiments showed the different ways in which CBDCs can be made interoperable and highlighted the benefits of a CBDC in a cross-border setting (eg. more efficient correspondent banking, settlement security).

Lastly, choices will need to be made so that the CBDC interacts smoothly with private initiatives such as the EPI project, in order to strengthen the integration of the European payments market.

Conclusion

I would like to come back to a question that comes up regularly, about the future role of banks and commercial bank money in a world of stablecoins and central bank digital currencies and respond with one conviction and one wish. My conviction is that, given the way in which investigations are being conducted into a digital euro, which I have just summed up here, it is unlikely that banks will be erased from a future payments landscape in which stablecoins and central bank digital currency dominate.

My wish is that banks will assist the ECB and Eurosystem central banks in conducting these investigations, so that we are ready when needed to roll out a digital euro that can be a positive addition to the European payments landscape. ■

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Do robots dream of paying taxes?

The digital transition should be taxed alongside other societal transitions. Rebecca Christie argues that any tax on companies should be targeted and carefully designed to not stifle innovation

Executive summary

Robot taxes embody the more futuristic challenges of managing automation and legacy workers. As machines and artificial intelligence take on more roles that used to be performed by humans, policymakers and technologists are assessing the costs this transition imposes and what parts of society will pay them.

A robot tax on companies that replace employees with automated systems is easy to dismiss in its most simplistic forms but should be considered in the context of managing the next industrial revolution.

A robot tax is a political construction, a way to shape democratic debate around technological shifts and societal needs. It is a construct of the public debate, and as such can contribute to broader discussions about how to make sure profitable companies pay their way in the economy. The political capital of 'replacement robot' imagery may be useful in designing a tax framework for legacy firms making the most of new economic opportunities.

It is best to consider a 'robot tax' as a rallying concept for targeted levies. These policies should target finance and other data-driven sectors as well as traditional manufacturing and mining automation. Policymakers should consider overall employment, specific job losses and how to assess firms that make layoffs in specific areas of their workforces.

This last will be especially difficult in cases where total headcount rises, even though some generations of employees may be put out of work. Tax policy can compensate for distortions due to shifts from human-driven to capital-intensive production in specific sectors.

On the revenue side, there should be appropriate expectations of what a tech tax can raise and over what period, on the scale of targeted retirement assistance or retraining programmes with measurable outcomes, not long-

running cash cows. Smaller and more innovative firms should not be asked to contribute disproportionately, particularly in legacy markets that are hard to break into, and they should be eligible for waivers and exemptions.

Policymakers should stress that asking producers to help pay the costs of societal change is not immediately equivalent to stifling innovation, and they should make every effort to design policies in ways that protect against this type of side effect.

Finally, any new tax on employers needs to fit with broader discussions of the corporate fair share, and with taxing the most profitable parts of the economy instead of relying on workers and consumers to foot society's bills.

Fair taxation should be the starting point when considering whether to tax companies on their transitions from human to machine-assisted workforces

Welcome to the future

The 1982 movie *Blade Runner*, set in 2019, asked if robots have true emotions. By the actual year 2019, a more relevant question was should they be taxed. The vast technological advances of the late twentieth and early twenty-first centuries had given way to an economy that was more automated than ever, leading top industrialists and policymakers to wonder not whether robots could feel, but whether they should help with government funding.

Microsoft founder turned philanthropist Bill Gates raised the issue in 2017, kicking off serious discussions in areas where the idea had previously lain dormant. The concept had instant appeal for Silicon Valley progressives, who sought technological revolution and also backed a universal basic income.

The plan went something like this: 1) build robots to replace workers, 2) have the government pay former workers enough to live on, 3) tax robots to pay for the benefits, 4) societal profit.

If only the robots were *Blade Runner*-style humanoids, it might have been doable. But in practice, the idea is much more complicated. Human workers are not being replaced by lookalike machines. In some cases, robotic manufacturing has led to human layoffs, but in others the transition has created more jobs to build and program the advanced technologies. It is not a one in, one out exchange of headcount.

Nonetheless, the broader concept of increasing taxes on capital to offset falling revenues from labour is worth revisiting. Specific taxes on capital improvements that make it possible to cut workers are one way to preserve revenue from companies that are increasing their profits while paying fewer employer-related taxes.

Tax policy is social policy. Just as tax policymakers have redoubled efforts to prevent profit shifting to low-tax jurisdictions, it is also worth considering how big firms take advantage of the difference between how workers and capital improvements are levied.

In this context, 'robot' needs to be defined carefully. Plenty of labour-saving machinery has made its way into our daily lives without triggering mass unemployment. Even when machines have arguably made human labour redundant, it does not automatically make sense to dub that technology job-stealing when the labour it replaced was often underpaid and exploited.

For example, a robotic-arm drink vending machine is probably not the kind of robot that should be taxed on the basis that it generates massive shifts in the workforce, even if it did put a drink-seller out of a job. Nor should households pay a 'layoff tax' for buying a washing machine instead of hiring – or exploiting – servants to do laundry in a washtub, as they would have in prior generations.

Rather, policymakers will want to look at types of automation that take over manufacturing jobs and at artificial intelligence (AI) applications that cut back on human review of complex information.

Given that automation and AI improvements often increase overall employment over time, policymakers should not try to discourage such shifts. The goal is to identify sectors where a shift to automation changes the composition of the workforce, not to ban various machines in order to reinforce exploitive labour practices.

Any new tax needs to be scaled so that profitable companies will pay it, rather than see it as an incentive to reduce technological improvements to avoid the levies.

The International Federation of Robotics defines industrial robots as “*automatically controlled, reprogrammable multipurpose manipulators that are programmable in order to move in three or more axes,*”¹ and research on industrial automation has focused on these types of machines and the industries in which they are used.

For the purposes of displacement taxation, however, it may be useful to think more widely. Particularly with the rise of AI, workers may be pushed aside as much because a computer program is taking over their assignments as substituting for them on the factory floor. Financial services and other data-driven sectors may be as much in the crosshairs as car making.

In deciding what is a ‘robot’, compared to assistive technology or another kind of capital improvement, it is probably worth a measure of anthropomorphism. Early iterations of robotics policy focused on humanoid machines performing recognisable mechanical tasks. Modern forms of robotics will likely include computer brains that perform familiar groupings of analytical and communicative tasks.

Using this framing, a searchable database would not be a robot; but a neural network that used multiple data sets and screening questions to screen a mortgage application might well be. Virtual help desks, virtual loan officers and virtual insurance claims adjusters could thus fit alongside the more tangible familiarity of a mechanical autoworker, even if these humanoid systems only exist in the digital cloud.

Virtual personal assistants, self-driving cars and medical care are some examples of the sectors in which AI is a reality, and in which automated help is taking on roles that were played by humans in decades past. These changes can make our lives easier and also could help tackle longer-term challenges including climate change and cybersecurity (European Commission, 2021).

The AI transformation is rightfully getting more attention in the European Union, boosted by the European Commission's 2021 strategy on how to manage the associated benefits and challenges (European Commission, 2021). It is a plan that seeks to foster innovation and healthy competition balanced by social considerations, in keeping with Europe's longstanding prioritisation of citizens' rights.

The overarching goals are to place the EU at the forefront of technological developments, encourage the uptake of AI by the public and private sectors, prepare for socio-economic changes brought about by AI and ensure an appropriate ethical and legal framework.

The question of an ethical framework is as important for assessing the impact of related economic change as the more straightforward questions of growth and investment. One key safeguard has been to focus on maintaining human oversight of functions that are increasingly turned over to AI networks.

This makes determining the impact on the labour force more difficult. In particular, if net employment increases, has automation created or cost jobs? More likely it has just shifted worker demand.

This rearrangement, rather than replacement, is likely to continue to be the dominant employment trend and tax plans need to be envisioned accordingly. Serious consideration of a robot tax requires acceptance that labour-force shifts will need to be viewed at a more granular level than just assessing whether net employment has gone up or down.

Otherwise, empirical analysis can conclude that unemployment is actually lower in regions that have seen the greatest deployment of robots and information and communications technologies: *"In other words, the robot tax might be a response to a problem that is not real."* (Petropoulos *et al* 2019).

In looking for ways to design a new tax constructively, it is best to consider 'robot tax' as a rallying concept, while looking for temporary and targeted ways to impose levies and make use of those revenues. Policymakers will need to consider overall employment trends, specific job losses and how to help classes of workers who have been laid off due to technological shifts.

This last will be especially difficult in cases in which a firm's total headcount rises, even as it indisputably puts a generation of employees out of work.

In terms of revenues, it is worth considering what scale of money-raising such a tax can be expected to generate. Any new tax finds its proceeds spent five times over before stakeholders have even finished reading the first blueprints.

The robot tax itself was the brainchild not of economists or budget managers but of Silicon Valley would-be visionaries looking for a way to have robots and a civilized society too – hence their dreams that a machine tax could substitute for payroll taxes in bankrolling civil society.

On a practical level, this level of societal subsidy is unrealistic. Rather, policymakers should seek levies on a scale that could pay for targeted retirement assistance or retraining programmes, most likely over a short- to medium-term horizon. Any discussions of a new tax also need to align with overall efforts to tax the parts of the economy with big money instead of relying on ordinary workers and consumers to foot society's bills.

Productivity and globalisation

Increasing productivity, widely regarded as a key pillar of economic prosperity, generally means that companies are able to produce more while using fewer employees. On top of that, the economic shakeup necessitated by

the COVID-19 pandemic has accelerated the move to online and digitally-assisted spaces, as in-person gatherings became impossible due to the need to limit the spread of disease.

An ad-hoc European Central Bank survey of 72 non-financial companies (ECB, 2021) found that 90 percent of firms increased their use of automation and other digital services during the lockdowns. 'Hardly any' recipients expected productivity to decline as a result of the pandemic, and most respondents expected it to increase in the long run. Meanwhile, more than half expected a negative long-term impact on employment (Maqui and Morris, 2021).

We therefore can anticipate that a growing number of people who used to have jobs will not have them anymore, as the economy shifts. Even if the total workforce stays the same or grows – Dixon *et al* (2020) and Koch *et al* (2019) showed net employment increases in some sectors that have adopted more robotics technology – there will still be a population of displaced workers who will need assistance, in the form of retraining or early retirement or other support.

This suggests that companies that turn to automation where they previously turned to human workers should be asked to recalibrate the kinds of taxes they pay to make sure they contribute fairly.

Fair taxation, then, should be the starting point when considering whether to tax companies specifically on their transition from human to machine-assisted workforces. This fits into the broader narrative of how to make sure multinational companies pay their share in the countries where they do business, rather than shifting profits to countries where they can get a better deal from the tax authorities.

It also reflects a new focus on total tax bills that is superseding recent efforts to tax the digital economy specifically (Christie, 2021a, 2021b).

Globally, corporate taxation is on the cusp of a historic breakthrough: 139 countries are deliberating at the Organisation for Economic Cooperation and Development on a 15 percent global minimum tax on corporate profits, accompanied by a new framework for allocating profits in accordance with business activity.

The OECD talks aim to set a floor on corporate tax rates, anchored by mechanisms that will allow participating countries to directly collect 'missing' taxes if a company still manages to pay below the global rate in other jurisdictions.

By July 2021, all but nine of the negotiating jurisdictions had agreed on the 15 percent rate, and the talks were expected to conclude in late 2021 once technical details and a corresponding agreement on profit shifting protocols have been worked out². It remains to be seen whether the deal can close on time, even after 2021's remarkable progress.

Any move to tax automation will therefore need to work with, not at cross purposes to, the OECD framework. While a robot tax is not a specifically digital tax, any new offering will need to mesh with existing digital services taxes that aim to wring more government revenue out of companies like the big American technology giants, whose platform-oriented business lines do not generate profits along traditional lines.

France, the United Kingdom, India and Nigeria are among the countries that have, at time of writing, implemented some kind of digital tax³. Importantly, many of these taxes target companies whose business lines are highly dependent on data.

This is a different approach than looking to companies whose production models focus on automated work rather than human labour. There is, however, some overlap, especially when it comes to follow-on policy effects.

Many of the cross-border proposals under discussion, including at the OECD and within the European Union, use a 'formulary apportionment' model that looks at a company's total gross revenues, then allocates them to the countries where that company does business, so the countries can levy taxes accordingly.

In some cases, the formulas are calculated using customer counts. But other proposals look at considerations like employment numbers, and that, in turn, could accelerate the switch from human workers to machines. For example, *"profit allocation connected to employee numbers may unintentionally strengthen the lure of mine automation and reduce local mine employment levels"* in countries dependent on extractive industries (Baunsgaard and Devlin, 2021).

Whose jobs are going away?

Bottone (2018) looked at the possible design and follow-on effects of a robot tax, starting from the premise that if robots have a high elasticity of substitution with labour, tax revenue would be expected to fall because a significant portion of tax revenue has historically come from labour taxes.

Her paper also tackled the definition of AI, which may lead to a new kind of technological transition because of its potential to reproduce human cognitive capabilities. As she noted, it is difficult to assess what role AI is playing in the economy because of the way it diffuses into a wide range of activities.

In a survey of nearly 1,900 technology experts, Pew Research Center (Smith and Anderson, 2014) found an almost even split on whether the coming AI transformation would help or hurt the workforce by 2025. Slightly less than half envisioned mass job displacement for blue- and white-collar workers, followed by potential breakdowns in the social order.

A slim majority, however, predicted that technology would not displace more jobs than it creates. This group had *“faith that human ingenuity will create new jobs, industries, and ways to make a living, just as it has been doing since the dawn of the Industrial Revolution”* (Smith and Anderson, 2014).

Muro *et al* (2019) predicted uneven shifts in employment trends depending on geography, industrial sector and demographics. In a detailed report on automation’s coming impact, they noted a cycle of fear and reassurance that has given way to *“a more complicated understanding, suggesting that automation will bring neither apocalypse nor utopia, but instead both benefits and stress alike. Such is the ambiguous and sometimes disembodied nature of the ‘future of work’ discussion.”*

In thinking about the particulars of a robot tax, Bottone (2018) started from the premise that robots progressively substitute labour and policymakers will have to face massive unemployment, falling tax revenues and a subsequent lack of resources to handle the challenges that follow.

This type of analysis is both common and problematic. At the top level, new technologies have tended to create more new jobs than they erase. Deloitte (2017) and Jensen and Koch (2015, also for Deloitte) found that for the UK and Switzerland, job gains had more than made up for the specific posts lost.

In Britain, for example, a broad shift from low-skill, routine jobs to higher-skill, non-routine occupations took away 800,000 positions and also added 3.5 million new ones. The picture in Switzerland was a little more mixed – the study estimated that nearly half of current jobs could be subject to replacement by automation in coming years, yet it also found that employment on the whole was rising.

Jobs were shifting from low-skilled jobs likely to be replaced to high-skilled positions requiring creativity, social interaction and customer service, where it seemed unlikely machines could take over. According to Jensen and Koch (2015), *“more jobs have been created in the past 25 years than have been lost. Therefore it is reasonable to expect that automation will continue to offer more opportunities in the future.”*

Theoretical models back up these assessments. Autor et al (2003) found that computer capital both substitutes for workers and complements them. As a result, demand for college-educated labour increases to take advantage of the new opportunities that come from handing off old tasks to computers and making room for humans to use this to best advantage.

Later research shows how this is bearing fruit: Acemoglu and Restrepo (2018a, 2018b) derived specific predictions and insights about the different impacts of automation, using a task-based approach. They found some negative displacement effects as well as a transfer of tasks.

In a separate paper (Acemoglu and Restrepo, 2017), they found that automation makes production processes more capital intensive, increasing productivity more than wages and thus reducing labour’s share of national income.

Bottone herself defined ‘robots’ more broadly than the official definition for factory-floor machines, considering personal-service robots and speciality machines for tasks like pollution clean-up, mine-clearing and space exploration: *“we cannot imagine a robot tax sic stantibus rebus but according to possible future scenarios which might include a significant use of artificial intelligence and therefore might be very different from the present one”* (Bottone, 2018).

Automation-related job losses are likely to come in waves, according to a 2018 analysis of an OECD dataset of about 200,000 jobs across 29 countries (PwC, 2018). The first wave, taking place now in the early 2020s, was seen as an 'algorithmic' wave in which computational tasks and structured data analysis would take a growing role in financial services and similar data-driven fields.

For the latter half of the 2020s, the analysis predicted an 'augmentation' wave, in which clerical support and decision-making take on more technology, along with semi-autonomous tasks like moving objects around a warehouse.

The 'autonomous' wave, not projected until the mid-2030s, involves more complicated tasks like transport and construction. Job losses in the first wave were projected to be relatively mild and evenly distributed across education levels, before ramping up dramatically and targeting lower-skilled workers more directly in later iterations. PwC (2018), like most reports of its kind, calls for training programmes and government support to help the workforce make the necessary transitions.

Acemoglu (2021) took those recommendations one step farther, arguing that tax policy itself is one of the best levers available to governments looking to ease the transition. He argued that the first step is to address asymmetries in how labour and capital are taxed, raising taxes on capital to correct the imbalance and shift revenue-gathering to sectors of the economy more equipped to bear it.

This type of shift would need to be coupled with explicit support for technologies that enhance worker demand rather than undercut it: *"for example, via R&D subsidies targeted to specific technologies that help human productivity and increase labour demand"* (Acemoglu, 2021).

Frey and Osborne (2017) in a widely cited study identified 47 percent of all US jobs as at risk, looking at the workforce at the occupational level. But further research studying tasks instead of occupations, and accounting for shifts in how human talents are deployed, leads to less alarming conclusions.

Arntz *et al* (2016) found that on average across 21 OECD countries, 9 percent of jobs are automatable, and concluded that the threat from technological advances is much less pronounced than an occupation-based approach would suggest.

Getting a proper read on the situation will require considering all the things humans can do once they hand over some of their former responsibilities to the computers, not just the task transfer itself. An assessment of 46 countries from McKinsey (2018) found that even if you accept that half of all jobs will be affected, the proportion of prospective layoffs is far lower. By 2030, the range of displaced work is between nearly 0 and about 30 percent, with a midpoint of 15 percent. McKinsey (2018) also found that even with automation, the demand for work and workers could increase as economies grow.

Big shifts in sectors are nothing new – for example, the agricultural share of total employment declined from 60 percent in 1850 to less than 5 percent by 1970, and a third of China's workforce moved out of agriculture between 1990 and 2015 (McKinsey, 2018). Once again, the combination of technology, productivity and social considerations looks to outpace the specific losses to new automation.

Petropoulos *et al* (2019) raised the question of where tax revenues come from, particularly because different automated technologies interact with wages in different ways. Overall, employment in the EU is high, and welfare state spending is a big part of EU gross domestic product – around 25-30 percent in big countries pre-pandemic.

Meanwhile the share of national income going to labour is down, raising questions of who is taxed to fund the state, and the welfare state in particular. Capital income has gone up, but taxation of capital has been flat, leading policymakers to turn to consumption levies like value-added tax to make up the difference.

The complexity is summed up in the trade-offs between rising employment and suppressed wages that come from new technologies able to take on some jobs previously done by humans. Exposure to industrial robots and technology-related capital improvements are both positively correlated with employment rates.

“On average, a marginal increase in a region’s exposure to industrial robots is associated with an increase in the employment rate of 1 percent- age point. A marginal increase in the exposure to ICT capital has a similar effect on employment rates” (Petropoulos et al 2019).

This makes the future difficult to predict. Automation may have a huge impact, but it will not necessarily lead to massive unemployment even in the most affected sectors.

Practicalities of an actual robot tax

Bill Gates brought robot taxes into the mainstream in 2017 when, in an interview in *Quartz*⁴, he walked through some of the potential benefits and consequences of increased automation: *“Right now, the human worker who does, say, \$50,000 worth of work in a factory, that income is taxed and you get income tax, social security tax, all those things. If a robot comes in to do the same thing, you’d think that we’d tax the robot at a similar level,”* Gates said.

“There are many ways to take that extra productivity and generate more taxes. Exactly how you’d do it, measure it, you know, it’s interesting for people to start talking about now.”

Gates predicted the extra taxes would come on two fronts: some from general taxation on corporate profits, which he predicted would rise from labour-saving efficiencies, and some from an actual robot tax. He predicted the companies benefiting most from the shift would be willing to pay up: *"I don't think the robot companies are going to be outraged that there might be a tax. It's OK."*

After Gates put the idea in the spotlight, it was immediately shot down by economists from across the political spectrum, from Tyler Cowan to Larry Summers to Yanis Varoufakis (Merler, 2017).

Policymakers did not like it either: *"No way. No way,"* said Andrus Ansip, the former European Commissioner for Digital Single Market issues. Ansip said he opposed *"taxing progress"* as others would take a lead in areas such as artificial intelligence, leaving Europe behind⁵.

The European Parliament had already made a statement on the issue the day before the Gates interview was published, rejecting a resolution supporting a robot tax even as it also endorsed calls for the EU to lay out robotics ethics rules⁶.

So far, the real-world policies have been more soundbite than substance. Also in 2017, South Korea proposed one of the first robot taxes⁷. But it was technically a reduction in tax deductions for increasing automation rather than an explicit tax on robots as worker replacements, drawing criticism that it was more of a protectionist move to shield older jobs than true technology policy (Lewis Silken, 2019).

Academics have put forward a range of proposals. Bottone (2018) started from the premise that a tax should be designed to raise revenue, not just tinker with policy incentives, and needs to be considered in a global context to avoid cross-border tax evasion.

That said, policy goals do and should play a role; neutrality is not a requirement though it is frequently politically invoked. When it comes to how to actually impose the tax, however, she laid out a laundry list that covers everything from a value added tax on robot activities – which would be complicated, especially if the robot itself had already been taxed at an earlier point in the supply chain – to a Gates-style robot income tax, to even a financial-transactions tax to raise money for worker benefits.

The rationale for that last one is to avoid impeding technological innovation, which is ironic because most large-scale financial-transactions tax plans would be likely to extensively slow down capital markets, and hence financing for innovation too.

Thümmel (2018) designed a model in which robots substitute for routine labour and complement non-routine labour, finding that a US tax could be modestly effective by either taxing or subsidising robots in general pursuit of the optimal way to distort robot adoption.

He used the price of the robot as a way to assess the marginal returns for the companies that want to profit from them. This model tries to account for the effect of a tax on median-income workers while also noting differing effects on high earners, who might make more because their work cannot be done by robots, and those at the bottom of the wage scale, who are likely to be the most displaced.

Thümmel also tried to account for workers who switch occupations, and those whose employment depends enough on their relative cost of robotic labour to be swayed by what kind of tax is in place.

By its nature, introducing the tax is likely to reduce production efficiency and also change the current incentives for investing in capital improvements, trying to compress wages and other business strategies.

In the end, the model spat out some small numbers about what rate would generate the most money. Without occupational switching, it found the optimal robot tax to be 1.8 percent, with a welfare gain of \$21.14 per person per year; with occupational switching, the robot tax equals 0.86 percent, and its welfare impact is reduced to \$9.22.

Such a tax would likely become obsolete: *“As the price of robots falls, inequality rises but the robot tax and its welfare impact become negligible”* (Thümmel, 2018).

You do not have to be a quantitative tax specialist to imagine ways in which the burden of a robot tax, however imposed, is borne by someone other than the company officially assessed, either by the company raising prices on their customers or reducing the price at which they are willing to buy the machine from its creators.

Particularly for robots already in use, adding a new tax is a move more likely to squeeze smaller players in the value chain than the big companies who are more able to pay up, and more likely to employ tax optimisers so they will not have to. Given the role of populist politics in designing and passing tax legislation, these kinds of optics are worth bearing in mind.

Artificial intelligence

Robots do not need to physically resemble humans to play a growing role in the economy. In terms of job displacement, policymakers need to think conceptually about technological systems that take over human roles, rather than a machine with two arms, two legs and binary optical sensors. The invisible robots of the AI revolution thus need to play as prominent a role in the workforce transition conversation as the humanoid robots that automatically populate our visual minds.

Merely calling for human oversight can create shallow protection that companies and governments can easily avoid in superficial ways⁸. Policymakers and companies will need to acknowledge and engage with the limits of human oversight, rather than counting on human involvement as an antidote to algorithmic harms.

This requires moving away from abstract understandings of both the machine and the human in isolation, and instead considering the precise nature of human-algorithm interactions. Who is the specific human engaging with the algorithm? This is relevant for deciding who gets taxed, as well as who is ethically in charge.

So far, most computers are not in danger of being mistaken for human. Andrew McAfee and Erik Brynjolffson, in an article for the *Financial Times*⁹, made the case that policymakers should not assume a coming era of mass unemployment, but should rather consider the digital transformation in the context of a long-running race between technology and education that began with the nineteenth century industrial revolution.

“For most of the 20th century, humans won that race,” they wrote. “We have yet to see a truly creative computer, or an innovative or entrepreneurial one. Nor have we seen a piece of digital gear that could unite people behind a common cause, or comfort a sick child with a gentle caress and knowing smile.”

Giving humans the skills to work alongside new technologies could therefore be just as effective as it was in earlier transitional eras. As McAfee and Brynjolffson wrote, it would be a mistake to assume human workers will be permanently marginalised, especially when policymakers can actively create an environment that allows innovation and workers to thrive.

That does not mean AI can be taken lightly or bundled in with legacy technologies.

Bruegel's Mario Mariniello (2021) has written persuasively of the need for regulators to give AI special consideration. New technologies can exacerbate old biases while also creating new hurdles, and policymakers need to be mindful of everyone affected, not just the specific intentions of individual innovators: *"No matter how objective we try to be, the mere decision to adopt artificial intelligence solutions has profound implications. That decision is inherently subjective and thus comes with some political responsibility"* (Mariniello 2021).

What kind of innovation will matter as much as the sheer quantity of new developments. In the long run, innovators could compete to create human-centric technologies rather than chasing short-term business goals and absorbing corresponding failures.

Planning for the future

The movie *Blade Runner* was based on Philip K Dick's 1968 novel *Do androids dream of electric sheep?*, published when 'the future' was dominated by space travel.

The film came out in 1982, when robots as we think of them today were just beginning to revolutionise manufacturing. The internet was still entirely contained within the US defence department, and labour unions were still trading wages for pensions and not yet preoccupied with offshoring, let alone full automation.

Unlike *Blade Runner's* imagined future, as the actual year 2019 approached, humans had not conquered interstellar travel or developed artificial intelligence with good judgment. Instead, we connect to space through pocket computers that talk non-stop to location-tracking satellites, and we all traded in our slide rules for spreadsheets.

The future, therefore, is not something we are good at imagining. Our efforts to do it anyway reflect our current fears as much as any particular prescience. Any discussion of future taxation needs to keep this in mind. Technology

transition taxes are by their nature designed around liminal conditions. They should not be forecast as permanent sources of large and steady revenue.

That said, the move toward increased automation could be the basis for a smaller, more limited tax designed specifically to benefit displaced workers. Just as there are carbon offsets, there could be more done with layoff offsets. The trick will be tailoring these levies carefully to the broader context.

The goal is to foster innovation and provide a path forward for workers who need help adjusting. The potential peril is illustrated by the experience of urban planners who have tried to address homelessness via a veneer of affordable-housing construction rules rather than a real plan to get unhoused families off the streets and into shelter.

Tech luminaries like Bill Gates have lauded the robot tax as a way to levy companies directly on their use of robots and to apply those revenues toward a universal basic income.

This approach, while philosophically appealing, is overly simplistic. At the same time, it will be unrealistic to expect that companies will pay for it through an income tax on their robots and AI networks.

To the extent the concept of a robot tax is retained, it needs to be reframed as a rallying point rather than a literal strategy. Proposals for any new tax quickly degenerate into political slugfests accompanied by extensive lobbying from prospective winners and losers.

A successful tax plan therefore needs to be focused and bounded in ways that make it seem worth the trouble of pushing through. In that spirit, the following recommendations might make a deal possible:

- Taxes should be assessed on specific sectors that have demonstrable patterns of laying off classes of workers as they switch to new technology. A robot tax or other technology levy will be easier to impose if voters and legislators can see a connection to specific changing industries, rather than try to set a one-size-fits-all definition of a labour-saving machine.
- Such taxes should be time-limited and reassessed regularly, to make sure the transitions they are associated with are still relevant.
- Proceeds from these taxes should be earmarked to programmes that retrain affected workers or pay for early retirement, not to prop up general government budgets.
- Taxpaying target industries should be sought throughout the economy, not just the manufacturing and extractive sectors that are home to traditional industrial robots.
- Financial firms and other data sectors that are replacing human analysts with artificial intelligence should explicitly be included in the framing of which sectors to tax. A computer system that replaces a library card catalogue can be seen as an assistive technology, but a computer system that decides whether to approve a loan is stepping in for a prior generation of workers. 'Robot' needs to include brain as well as brawn.
- The phrase 'robot tax' can be used as political shorthand and as a way to build political support. It should not be invoked as a societal panacea.
- Robot taxes should be assigned to employers and corporate parent companies, not through value added taxes or other points lower down on the consumption chain.

- Carve outs for small businesses may make sense, as a way to encourage growth and innovation for companies with fewer than 50 employees. Companies that start out with robots are not the same as legacy firms that have achieved marketplace dominance through human labour and then used robotics to consolidate their position. Conceptually, policymakers should aim to tax companies with extensive market power and influence, not newcomers battling for a seat at the table, keeping in mind some level-playing field considerations.
- Any new tax needs to be considered in the broader context of global corporate taxation, including profit shifting, digital levies, minimum effective rates and cross-border formulas.
- Taxes on robots or related automation transitions should not be limited to cross-border companies.
- Politically, a tax that involves an explicit payment may be clearer to all stakeholders than a web of incentives and offsets, even if the economic impact is the same.
- Likewise, policymakers should stress that asking producers to help pay for the costs of societal change is not immediately equivalent to stifling innovation.
- Broader efforts to assess the balance between labour taxes and taxes on capital should continue, and existing imbalances should be actively challenged.
- Fair taxation should be a founding principle that is readily identifiable when making the case for a new tax. Fair is, by definition, a political concept, and the politicians who design and implement tax policy need to keep their broader values in mind.

To conclude, robot taxes cannot and should not be counted on to raise lots of money to keep humans fed and housed in the dystopian, automated decades to come. Rather, the digital transition should be managed – and taxed – alongside other societal transitions. To support the society that has allowed them to prosper, the companies that profit the most should pay their fair share. ■

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Endnotes

1. See <https://ifr.org/industrial-robots> for current definitions and specifications.
2. See OECD press release of 1 July 2021, '130 countries and jurisdictions join bold new framework for international tax reform', available at <https://www.oecd.org/newsroom/130-countries-and-jurisdictions-join-bold-new-framework-for-international-tax-reform.htm>
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Goodbye Glasgow

After COP26, and as the debate on whether Glasgow represents a success or a failure dies down, Klaas Lenaerts and Simone Tagliapietra ask what is next for global climate action

The world is on track for a 2.4°C global temperature increase above pre-industrial levels by the end of the century if countries stick to the 2030 emissions reduction targets (in jargon, nationally determined contributions, NDCs) they submitted in Glasgow ([CAT](#), [IEA](#), [UNEP](#)).

This is bad news, as the [science](#) has made clear that to avoid the most dramatic consequences of climate change, humanity needs to keep the global temperature increase within 1.5°C.

Taking into account the long-term net zero pledges that have been made by a number of countries, most recently by [India](#), would limit the rise to 1.8°C in 2100 after some limited overshoot (CAT, IEA, UNEP). However, this figure should be taken sceptically, as most of these pledges are currently not backed-up by real action or planning.

Reducing the global emissions gap

Given this context, the first climate priority for 2022 should be to reducing the global emissions gap by ensuring that NDCs are enhanced to a level compatible with the 1.5°C trajectory. The Glasgow Climate Pact agreed by the 197 countries at COP26 provides a solid foundation for this.

First, the [document](#) strongly emphasises the 1.5°C goal rather than on the 2°C goal, both of which are included in the Paris Agreement. All 197 parties agree that the 1.5°C goal should be the norm, as the 2°C goal has been shown to be significantly more harmful and riskier. This development is very important.

As the latest [IPCC report](#) illustrates, extreme heat events will occur roughly twice as frequently as today at 1.5°C warming levels, while at 2°C this their frequency would triple.

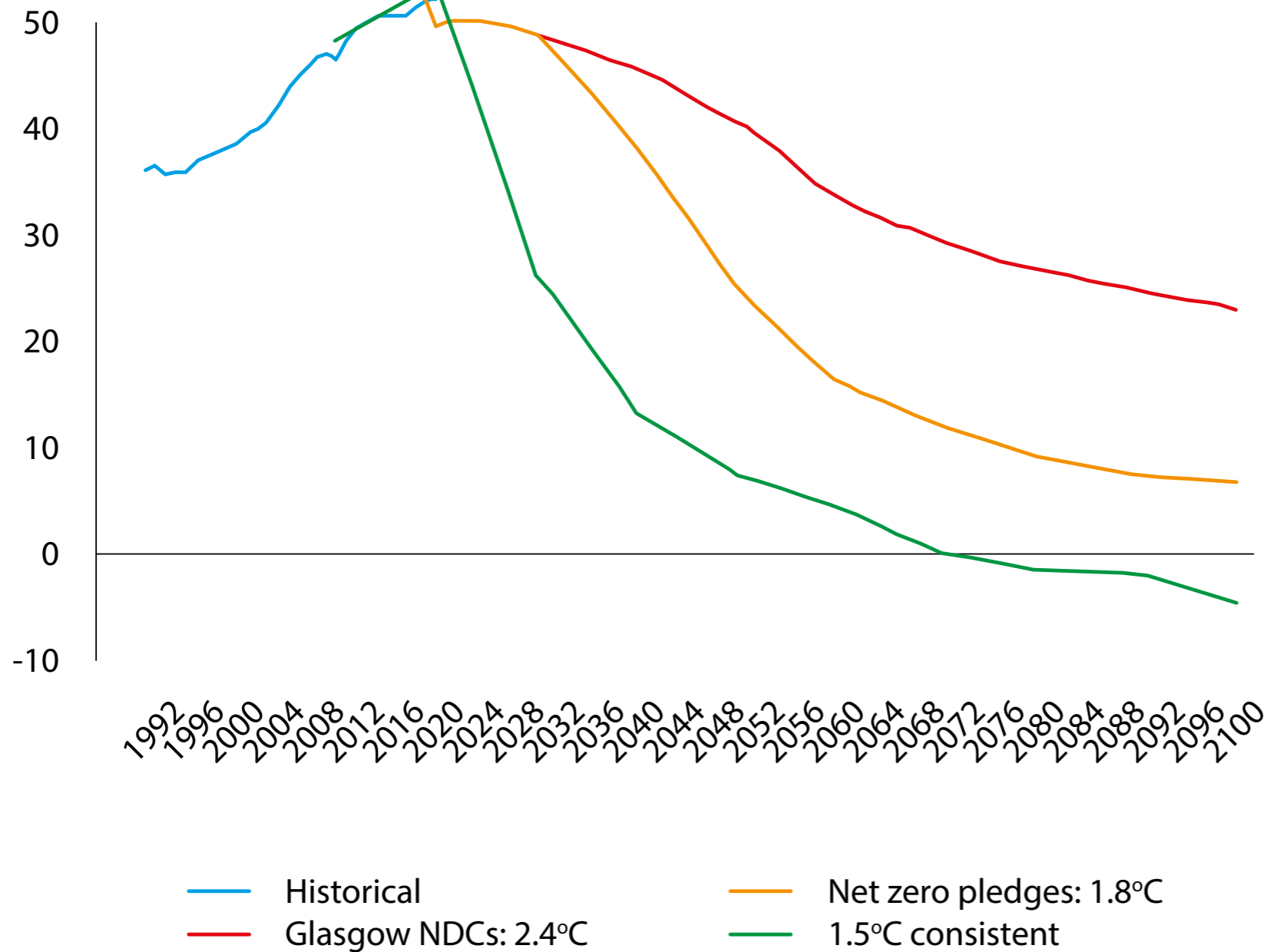
Second, in acknowledging the global emissions gap emerging from the current 2030 pledges, the document calls on countries to return with strengthened NDCs by the [end of 2022](#).

The European Union, the United States and the United Kingdom pushed for this earlier date because 2025, when NDCs should normally be revised again according to the Paris Agreement, is much too late to halve emissions this decade, as is required in a 1.5°C scenario.

Rich nations have a clear responsibility in the year ahead: make good on their \$100 billion climate finance commitment to support developing countries and act to protect vulnerable communities

Figure 1. Global GHG emissions (Gt CO₂e/year) and warming projections by 2100 in different scenarios

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Note: 1.5°C consistent scenario are median estimates. This scenario requires net negative emissions from 2070, which means that more GHG are extracted from the atmosphere (eg. through carbon capture technology) than emitted.

Source: Climate Analytics and New Climate Institute (2021) 'Glasgow's 2030 credibility gap: net zero's lip service to climate action', Climate Action Tracker November 2021

While the Glasgow Climate Pact provides the institutional foundation to deliver on this front in 2022, delivery should not be taken for granted. Even though the Paris Agreement requires updated NDCs to be more ambitious than the previous versions at each iteration, many countries submitted the same targets as before for COP26 (eg. Australia, Russia, Switzerland), while some even backtracked (eg. Brazil) (CAT).

And the omens for COP27 are not good: Australia and New Zealand have already said they will **not adjust** their NDCs, which are currently seen as inadequate. It might therefore be challenging to persuade laggards, to whom this call is addressed in the first place, to scale-up their pledges in 2022.

Two complementary actions might help incentivise countries to strengthen their 2030 climate pledges and, importantly, their climate action over the next years: international climate finance and bottom-up, sector-specific, climate deals.

While failing to deliver results, Glasgow did advance the global discussion in these respective areas. Building on these advances, global climate action could bring substantial results in 2022.

Delivering on climate finance to foster action and ensure international climate justice

In general, ambitious developed countries should use 2022 to convince their peers to strengthen their climate measures if they have not done so already, including through the G7 and the G20.

Much frustration was voiced over the last-minute intervention by China and India to weaken the pact on the 'phase out' of coal, and rightly so. China is no longer among the group of least-developed nations and is rapidly creating its own historic responsibility in terms of **cumulative emissions**.

India does not yet bear historic responsibility and still needs help to lift its population out of poverty. However, there is simply no carbon budget to allow India to take the same polluting path as China or the West did.

Instead, rich countries should scale up financial and technological support to provide credible alternatives to coal-powered development.

Agreements to wean individual countries off coal, like the \$8.5 billion [pledge made to South Africa](#), can serve as a template for future commitments as they produce greater accountability for the governments involved. At the same time, individual countries should not be neglected because of a lack of multilateral funding.

The issue of climate finance is perhaps the greatest source of frustration, which is of rich countries' own making: the [failure to deliver the \\$100 billion](#) per year by 2020 that was promised to developing countries during the Copenhagen summit in 2009.

Depending on how 'support' is measured – particularly how loans are treated – the shortfall can be anything from \$20 billion (as estimated by the [OECD](#)) to \$80 billion per year (estimated by [Oxfam](#), which notably argues that besides grants, only the benefit accrued from lending at below-market rates should be counted, not the full value of loans).

The Glasgow Climate Pact merely urges rich countries to deliver the same promised amount until 2025 and to at least double the financing destined for adaptation, from \$20 billion in 2019.

In comparison, the first dedicated [UN report](#) estimates that the NDCs of developing countries alone imply a total financing need of \$5.8 to \$5.9 trillion up to 2030.

Developed countries, starting with the US, should urgently make good on their promises and scale-up international climate finance. It is important to underline that several complementary options can be pursued: bilateral funding can be paralleled by multilateral funding, multilateral development banks, private sector contributions, philanthropy, Special Drawing Rights from the International Monetary Fund, and voluntary carbon markets – for which Glasgow did represent a game-changer with the adoption of rules governing the international trade in emissions reduction units after six years of haggling that had held up the Paris Agreement rulebook.

It is particularly important to flag the issue of loss and damage. This concept entered international climate negotiations in 1991, when the Alliance of Small Island States called for a mechanism that would compensate countries affected by rising sea levels.

Over time, more and more vulnerable countries also realised that they are affected by climate change that is beyond their capacity to mitigate alone. The idea of a mechanism to help them address loss and damage has gained wider support over time.

COP26 got very close to creating a 'Glasgow Loss and Damage Facility' aimed at channelling funding from rich nations to poor and climate-vulnerable countries. However, the initiative was ultimately [rejected by rich countries](#), as they feared unlimited liability. The issue of loss and damage represents a cornerstone of international climate justice and for this reason this item will now have to be placed at the top of the 2022 climate agenda.

Fostering global climate action through bottom-up and sector-specific deals

Some of the most notable achievements at COP26 occurred outside of the Paris Agreement framework, with numerous side-deals struck by varying groups of countries.

For example, some of the most forest-rich countries in the world signed up to [stop deforestation](#) by 2030, with over €16 billion in public and private funding promised to facilitate this.

More than 100 countries joined the US and EU-led pledge to cut [methane emissions](#) by 30% between 2020 and 2030. Apart from the contentious 'phasing down' of unabated coal power which all countries signed up for, some have also committed to [phasing out coal](#) by the 2030s and 2040s or as fast as possible thereafter. A number of small producers (but some with big reserves) of [oil and gas](#) said they will stop issuing new drilling licences after 2040 or 2050.

In addition, economies including China, India, the EU and the US signed a statement on the 'Breakthrough Agenda', declaring their goal of making clean power, zero-emission vehicles, green steel and green hydrogen globally available and competitive.

Finally, in the area of private finance, the Glasgow summit saw the birth of a 'Glasgow Financial Alliance for Net Zero', which could mobilise substantial resources, though the reported \$130 trillion is clearly a [gross overestimation](#).

Many of these deals suffer from softened language (eg. on phasing out/down coal), disappointing precedents (deforestation) and the absence of some of the parties that matter the most: Russia, India, China and Australia did not join the Global Methane Pledge and the biggest producers and users of coal also refused to sign the coal initiative. Furthermore, the additionality of these agreements with respect to NDCs has been [called into question](#).

Nevertheless, these sector-specific side-deals make commitments more concrete and 'modular'. They allow countries to create their own paths towards more sustainability, which may work better given their diverse

Table 1. Selection of side-deals made at COP26

Target	Deadline	Joined	Did not join	Note
Stop and reverse deforestation	2030	145 countries, including Brazil, Congo, Indonesia, Russia, Canada, US, China, EU	Including Venezuela	Covers 91% of world's forests
Reduce methane emissions by 30% w.r.t. 2020	2030	103 countries, including EU, US, Norway, UK, Canada, Japan, South Korea, Brazil, Mexico, Nigeria	Including Russia, India, China, Australia	Covers almost half of anthropogenic CH ₄ emissions
Transition away from unabated coal power	2030s for major economies and 2040s globally, or ASAP thereafter	Including EU, UK, Canada, South Korea, Vietnam, Chile	Including US, China, India, Australia	
End emissions from new cars	2035	2035 in leading market, otherwise 2040	Including Daimler, Ford, GM, BYD, Volvo, Canada, Chile, UK, Poland, Belgium, Netherlands, Turkey	Including most EU member states, US, China, Volkswagen, Toyota, BMW, Renault-Nissan, Hyundai-Kia
Stop granting oil and gas drilling licences	2040 and 2050 respectively	Denmark, Greenland, France, Costa Rica, Ireland, Sweden, Wales, Quebec	Including Russia, US, Canada, China, Norway	No major producer joined, but Greenland has vast reserves it will forego

Sources. [UK government](#), [European Commission](#) and [Reuters](#), consulted on 16 November 2021

circumstances and levels of ambition. And they allow participation of other parties that will ultimately have to deliver climate action: local authorities, the private sector and civil society.

Leading countries may want to consider joining and encouraging others to do so before the next COP at the end of 2022. For example, Germany could send a signal to domestic and global car makers by joining the plan to eliminate emissions from new cars by 2040, something which is being [discussed at EU level](#) already.

It is impossible not to mention another side-deal that galvanised attention in Glasgow: the '[US-China Joint Glasgow Declaration on Enhancing Climate Action in the 2020s](#)'. Coming from the world's two largest polluters – together representing 40% of global emissions – the declaration represented a breakthrough in the Glasgow negotiations.

This resembled a similar agreement brokered in 2014 by the same two lead negotiators, then-Secretary of State John Kerry and China's top climate envoy Xie Zhenhua, which paved the way for the adoption of the Paris Agreement a year later.

So, while the practical impact of the declaration remains ambiguous due to its lack of concrete commitments, it represents an important political document to establish some "[common-sense guardrails](#)" on climate, in an otherwise chilly relationship of mutual mistrust.

2022: crossing the climate bridge?

Closing the Glasgow conference, United Nations Framework Convention on Climate Change Executive Secretary Patricia Espinosa [said](#) that at COP26 parties built "*a bridge between the admirable promises made six years ago in Paris and the concrete measures that the scientific evidence calls for and societies around the world demand.*"

She was right: COP26 was an important step in the fight against global warming. However, the conference failed to narrow the global emissions gap. Building on the achievements of Glasgow, the world has a real opportunity in 2022.

Rich nations have a clear responsibility in the year ahead: make good on their \$100 billion climate finance commitment to support developing countries and act to protect vulnerable communities. This is the key to giving substance to the Paris Agreement's core principle of common but differentiated responsibilities, and to ensure international climate justice.

Laggard countries, meanwhile, must revise their 2030 emissions reduction pledges and policy actions, taking into account the sector-specific deals signed in Glasgow that will hopefully be further enlarged over the following months.

It is only by promptly undertaking these actions during 2022 that countries will ultimately demonstrate that Glasgow was about real progress rather than 'blah blah blah'. ■

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Putting climate scenarios into action

Sarah Breeden shares lessons we have learned from designing and applying climate scenarios, as well as some thoughts on their future, including the vital contribution research needs to make

Climate science tells us that the planet has already warmed by about 1.1 degree Celsius since pre-industrial times¹. Indeed, the news is full of the devastating effects of physical changes already taking place around us. And existing commitments from countries to reduce greenhouse gas emissions are not enough to keep warming to well below 2 degrees, let alone 1.5².

The United Nations Intergovernmental Panel on Climate Change (IPCC) estimates we will reach 1.5 degrees by 2040 even under their 'very low emissions' scenario³. Failure to formulate more ambitious commitments and deliver against them this decade will mean we miss the last opportunity significantly to deter the course of climate change.

The case for action is clear - the question is whether our actions will match that case, in particular whether we turn aspiration into action on the scale required. Delivering a path to net zero requires all of us to take necessary steps – governments and business, investors and individuals, as well as central banks and financial regulators.

Here at the Bank of England, we have taken a range of actions in line with our objectives – including setting expectations for banks and insurance companies on their approaches to managing climate-related financial risks, running a system wide climate scenario exercise, and setting out how to green our corporate bond purchase scheme⁴ – to play our part in the transition to a net zero economy.

Through all this work, one thing has become abundantly clear – that the actions we take today will determine the consequences we face in the years to come. And so if we are to take the right decisions, we must stretch our horizons, taking different decisions today well before the consequences of inaction manifest at scale.

This needs to occur across the entire economy. And the financial system needs to be a key enabler. As central bank and financial regulator, these implications put climate change squarely within our remit. We cannot solve climate

change and drive the transition – those with the responsibility and tools to do this sit elsewhere in government and industry. But we must ensure that the financial system is resilient to climate-related financial risks, that it can support the transition, and that we understand its macroeconomic impacts.

I want to speak specifically on the system-wide and economy-wide impacts of climate change, using insights from the most recent work we have done on climate scenarios through the central banks and supervisors Network for Greening the Financial System (NGFS).

... climate scenario analysis is of fundamental importance in managing the risks from climate change, helping us to chart the course to net-zero and to drive different decisions today

I will cover three things: first, lessons we've learned from designing climate scenarios? second, lessons we've learned from applying them? and third, I will share some thoughts on the future of scenario analysis – including the vital contribution research needs to make.

Scenario analysis

The first step in understanding the impact of climate change to the macroeconomy and the financial system is to recognise that we must look forwards not backwards.

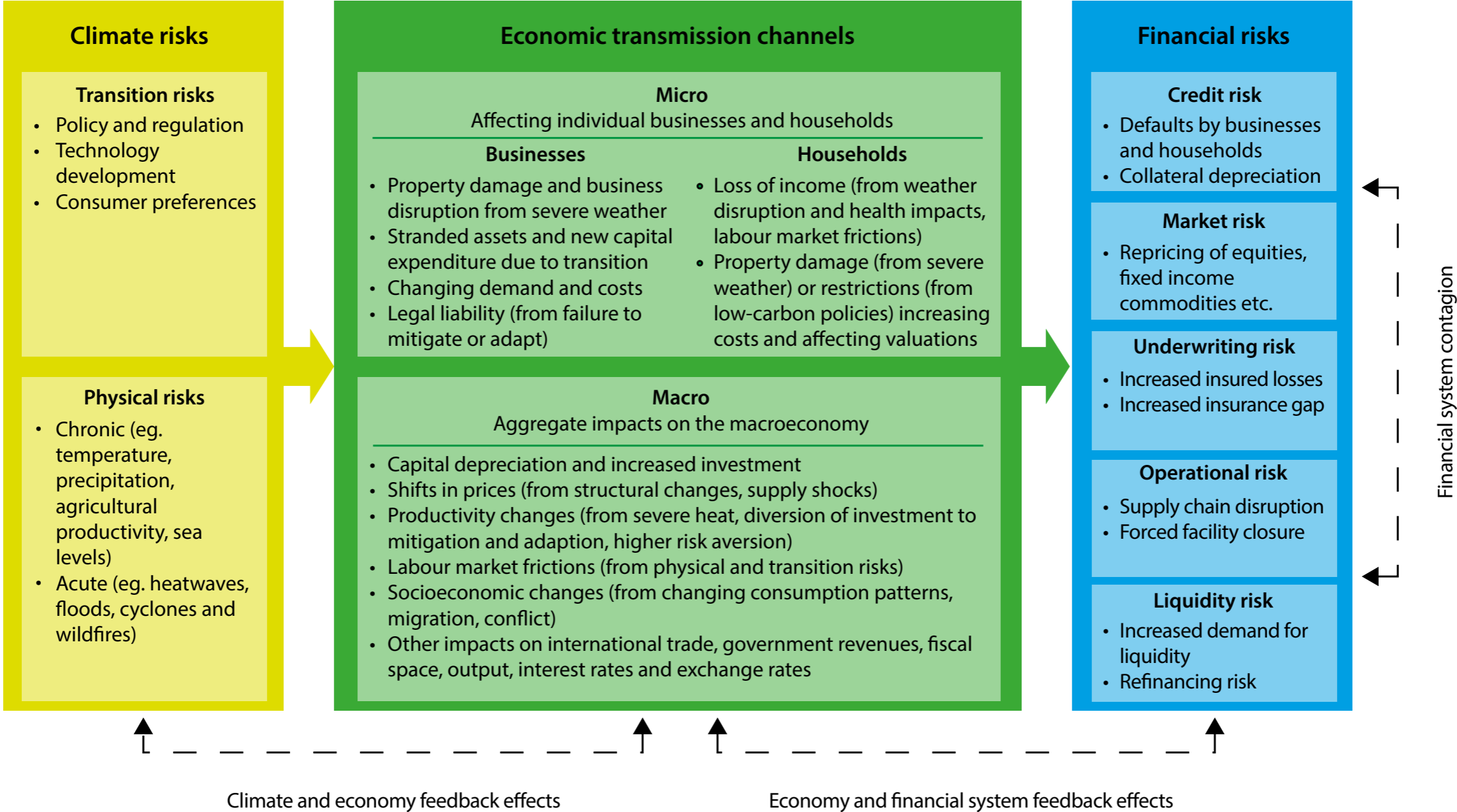
The risks from climate change are unprecedented. They cannot be assessed solely by looking at past data. And depending on our actions today, we could see fundamentally different future outcomes – from a hot house world with extreme physical risks, to futures where we limit the worst effects of climate change but with potentially high transition risks.

While it is certain that a combination of these risks will materialise, it is not clear which path we are on. To navigate these various future pathways, and to understand what future financial risks and economic costs we may see, central banks and financial regulators have turned to scenario analysis.

Scenario analysis is fiendishly complicated. Figure 1 highlights that the transmission channels from climate risks to economic and financial risks are numerous, with significant interdependencies. A holistic analysis therefore requires macroeconomic and top-down approaches to be complemented and augmented by granular and bottom-up risk assessments. A major challenge to doing this is that the prerequisite data and methodologies to translate climate outcomes into macroeconomic and financial risks are incomplete and inadequate. And of course the future path of climate risks themselves is subject to huge uncertainty. Any such exercise is complex and complicated.

Figure 1. Transmission channels

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NGFS Climate Scenarios for central banks and supervisors'

To support central banks, supervisors and the financial system with the assessment of these risks, and to bridge some of these modelling and data gaps, in 2019 we launched a project to co-design climate scenarios with a consortium of world-leading climate scientists and close to 60 other central banks and supervisors under the Macrofinancial workstream of the NGFS. In June of this year we published the most recent version of our scenarios⁵. As chair of this workstream, I am proud of the progress we have made in just a few years, and the lessons we have learned along the way. Let me share a few.

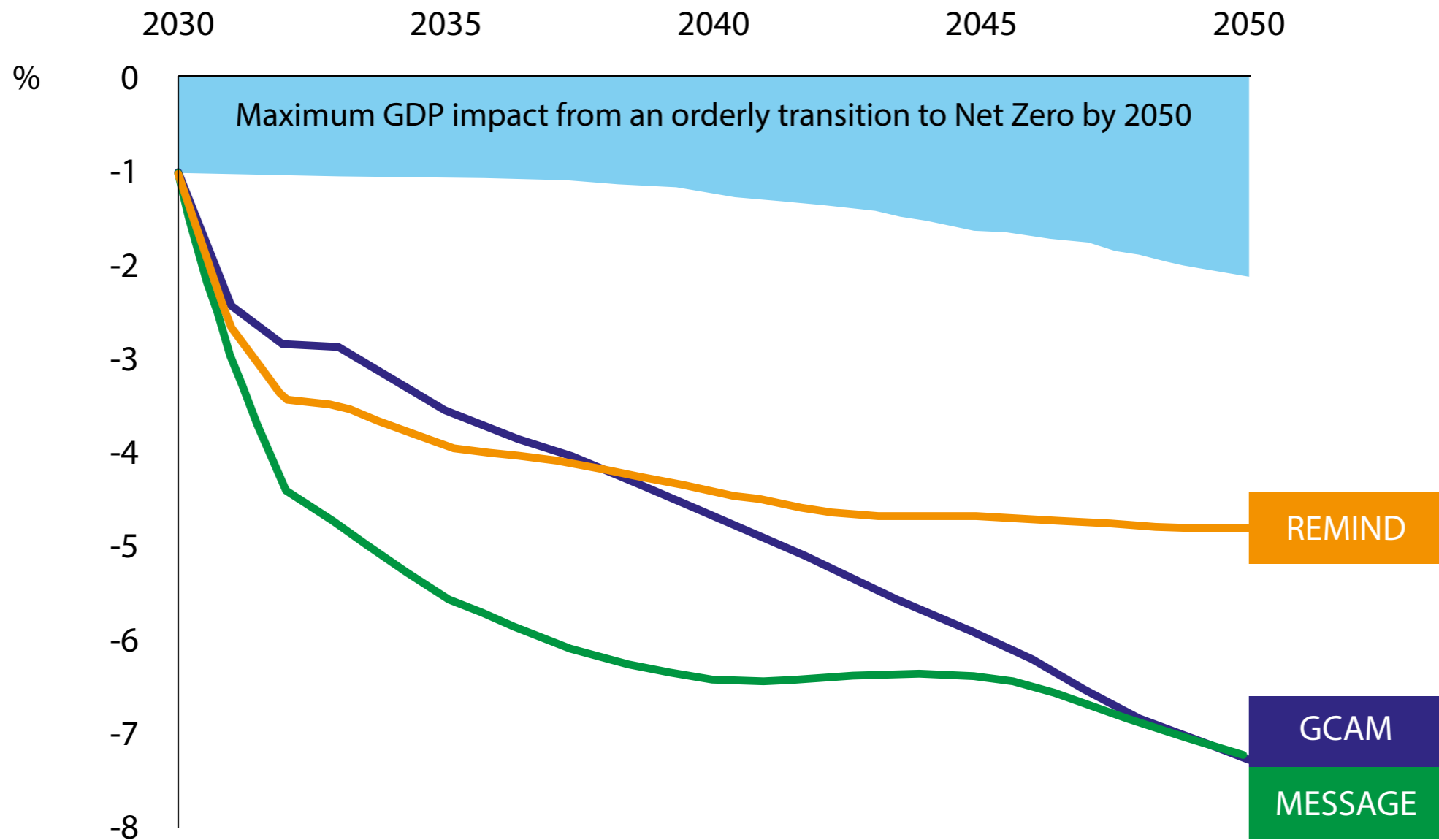
1. Lessons from designing the NGFS climate scenarios

Although we often emphasise the uncertainties inherent in climate projections, it is worth emphasising how much we already know. The scientific basis is unequivocal.

We also have a clear picture of where our emissions come from and how they can be reduced, so we know what the building blocks of the transition are – from increasing the share of renewables in the energy mix to more sustainable buildings and agriculture, alongside carbon capturing and offsetting where possible whether through new technologies or nature-based solutions like afforestation. A number of different types of policy measures can help us get there.

We have also learned that the cost to the economy in aggregate of getting to net zero need not be substantial. Our latest economic modelling shown in Figure 2 suggests that reaching net zero, if the transition is managed well, might have a small or negligible effect on economic aggregates such as GDP, unemployment and inflation. The Sixth Carbon Budget produced by the UK Committee on Climate Change estimates the net costs of the transition will be equivalent to less than 1% of GDP over 2020-2050⁶.

Figure 2. GDP impact from delaying the transition across models



Based on the NGFS scenarios 'delayed transition' and 'Net Zero 2050'. Modelled with NiGEM, using transition pathways from three integrated assessment models: GCAM, MES-SAGE-GLOBIOM, REMIND-MAgPIE.

But we also know that those costs depend on whether the transition is orderly or disorderly. And that it takes time to implement policy and for markets to adapt to the changes. That means that if meaningful action is delayed by another ten years, the transition would need to be much sharper.

The NGFS estimate that GDP in 2050 would be more than 5 percentage points lower than it would have been if we acted today – even before accounting for possible feedback loops, for example if losses in the financial sector amplify the slowdown in the real economy. And of course the longer we leave meaningful adjustment, the greater the physical risks, leading to higher costs particularly later in the century.

Third those impacts from physical risks will be significant (Figure 3). Analysis by the NGFS indicates that even if we limit the rise in global mean temperatures to 1.5 degrees, physical risks are likely to dominate the potential impacts of transition⁷. And if instead we continue on our current trajectory well above Paris goals, global losses just from the impact of physical risks on labour and agricultural productivity could be as high as 13% of GDP by the end of the century – and that is before accounting for sea level rise, more extreme weather events, food insecurity, migration and displacement of people⁸.

This number is therefore very much a lower estimate. And as high levels of warming are unprecedented, we should remain cognisant that we are unlikely to be able fully to capture the delicate balance between the climate, living conditions, ecosystems and the economy with the models at our disposal.

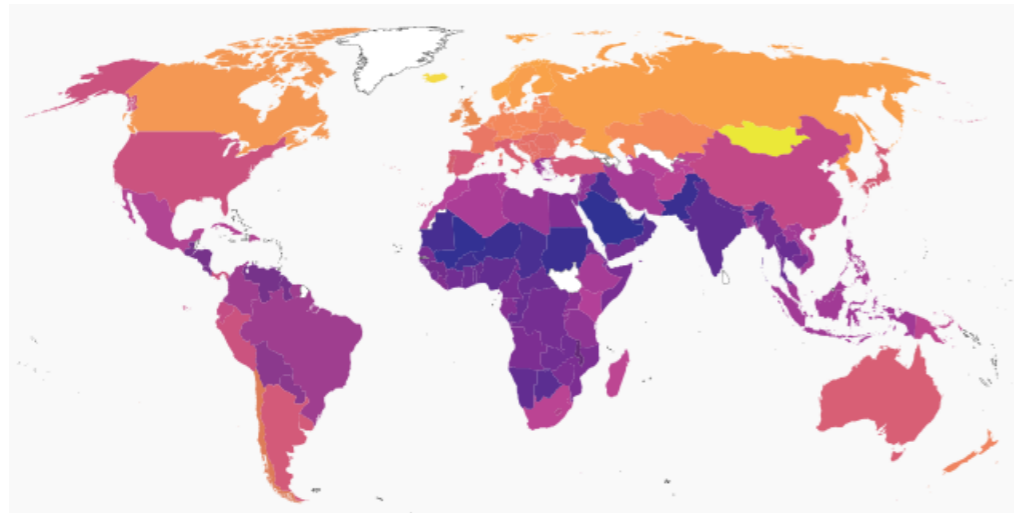
Clearly, investment is needed to help adapt to these inevitable physical changes, which in turn should reduce damages. The Global Commission on Adaptation estimates that \$1.8 trillion of global investment in adaptation this decade could generate \$7.1 trillion in net benefits⁹. In our focus on the transition to net zero, we must not forget the need to build resilience and to adapt to these physical risks.

Figure 3. Physical risk GDP losses

Physical risk GDP losses by country

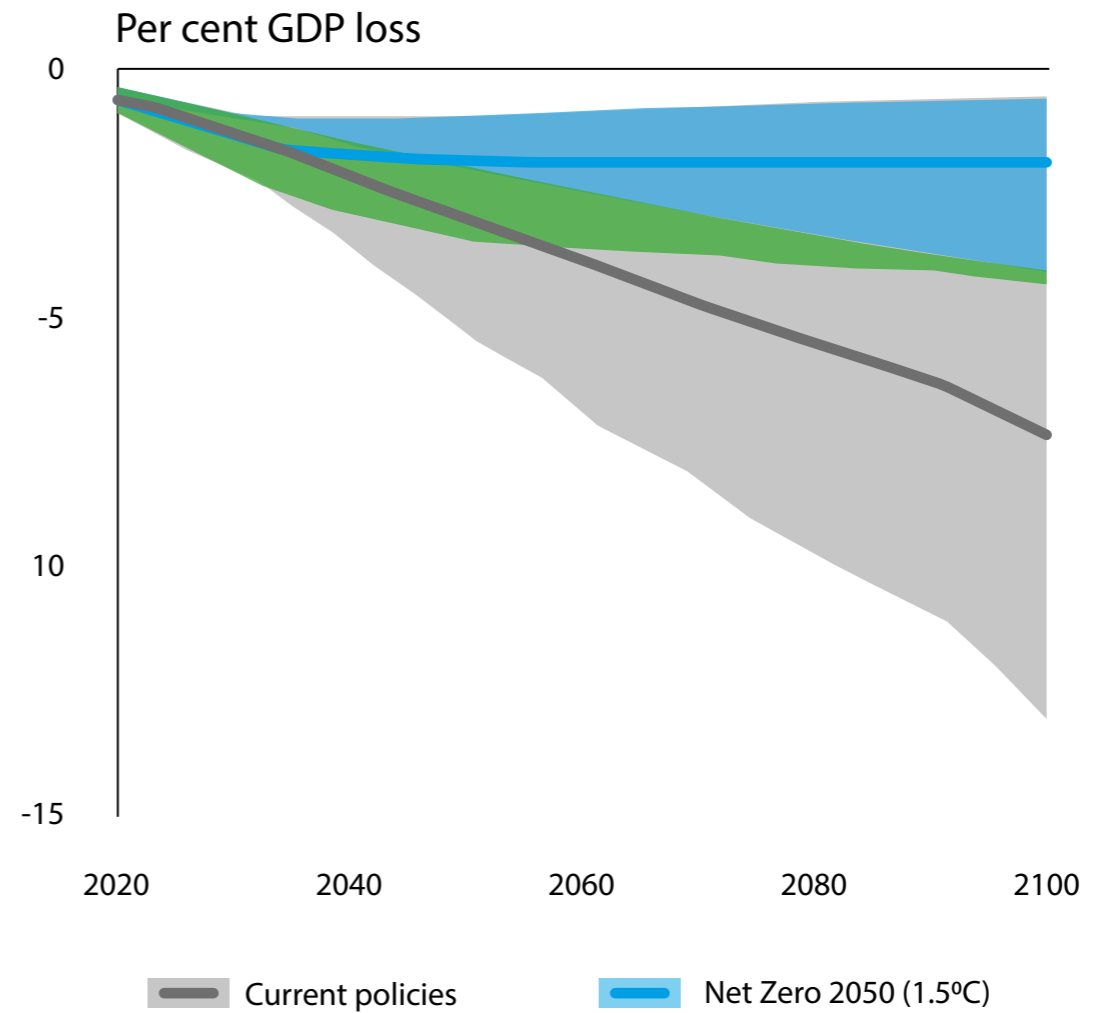
Current policies (95th percentile damages)

Per cent GDP loss relative to prior trends



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Physical risk GDP losses



Source: Calculations by PIK based on scenario temperature outcomes and damage estimates from Kalkuhl and Wenz (2020). Base year for warming is 2005.

Source: IIASA NGFS Climate Scenarios Database, REMIND model. 2005 used as the base year.

So what do I take from all this? The cold hard climate physics could not be clearer in underlining the importance of early action. And the returns to investment in mitigating and adapting to climate change now are high.

2. Lessons from applying climate scenarios: findings from the NGFS Scenarios in Action report

So far, I have spoken about some of the key lessons learned while designing the NGFS scenarios. I will now speak about what we have learned from applying these scenarios to macroeconomic and financial risk assessment.

Many central banks and financial supervisors are already using climate scenarios to assess the risks to their economies and financial systems. The NGFS published a report surveying the climate scenario exercises of 30 NGFS members.

At the moment, only four of these exercises have been completed and their results published, but things are developing rapidly in this field, with another 21 exercises scheduled to be completed within the next 12 months. It has been thrilling to see that the NGFS scenarios serve as a foundational component in the significant majority of these exercises.

Objectives

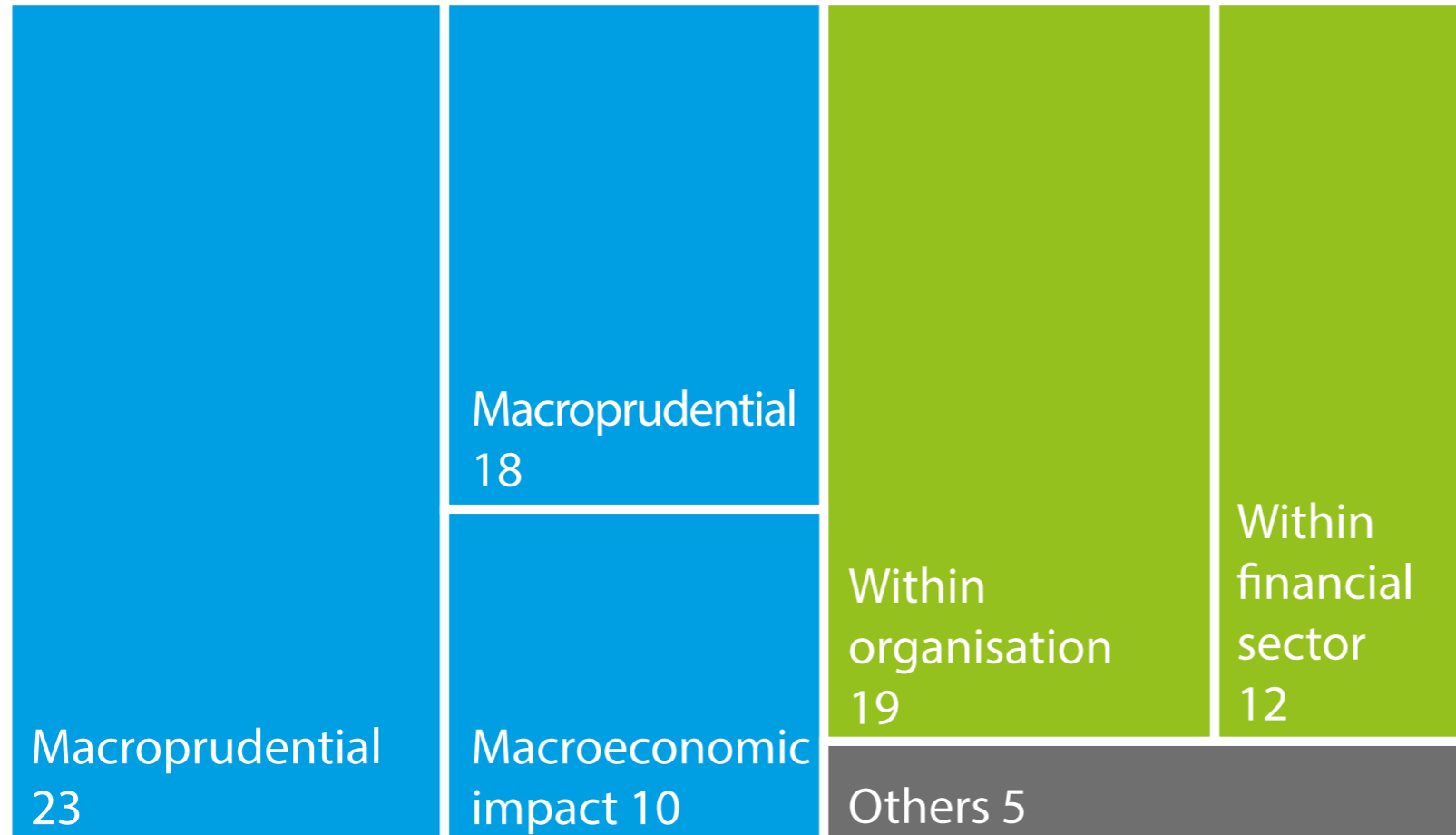
The objectives of the climate scenario exercises undertaken by NGFS members vary (Figure 4). While all exercises aim to assess risks, the focus of this assessment ranges from risks to individual institutions, to risks to the wider financial system, to risks to the broader economy.

Moreover, as most of us are doing this type of climate scenario analysis for the first time, it is often equally as important to promote an awareness of the risks and to develop capabilities for assessing these risks, as it is to quantify the risks – learning by doing you might say.

Figure 4. Objectives of climate scenario exercises

Assessing the impact of climate risk on the financial system and the economy

Developing capabilities



Many members attributed more than one objective to their exercises, hence why the number of objectives (87) is larger than the total number of members (30).

Scope

The scope of exercises varies as well (Figure 5). All exercises surveyed in the report cover the banking sector, and about half of them include additional financial firms such as insurers and pension funds.

All but one exercise includes transition risks, and about half of the exercises cover the physical risks from climate change. This might seem strange but there are two key reasons some exercises have chosen not to cover physical risks – firstly, transition risks are seen as a more pressing matter for certain sectors such as banking, and secondly, transition risks are comparatively easier to model.

However, a comprehensive risk assessment will require us to look at both types of risk. I expect this will increasingly happen as our methodologies for analysing these risks improve.

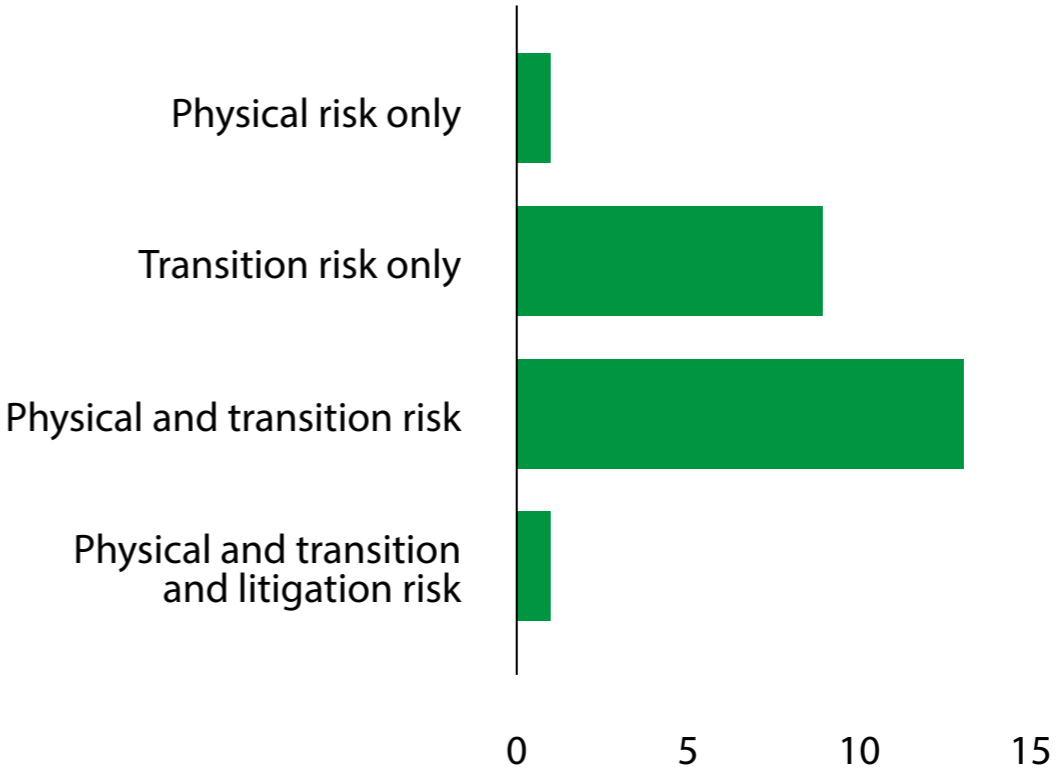
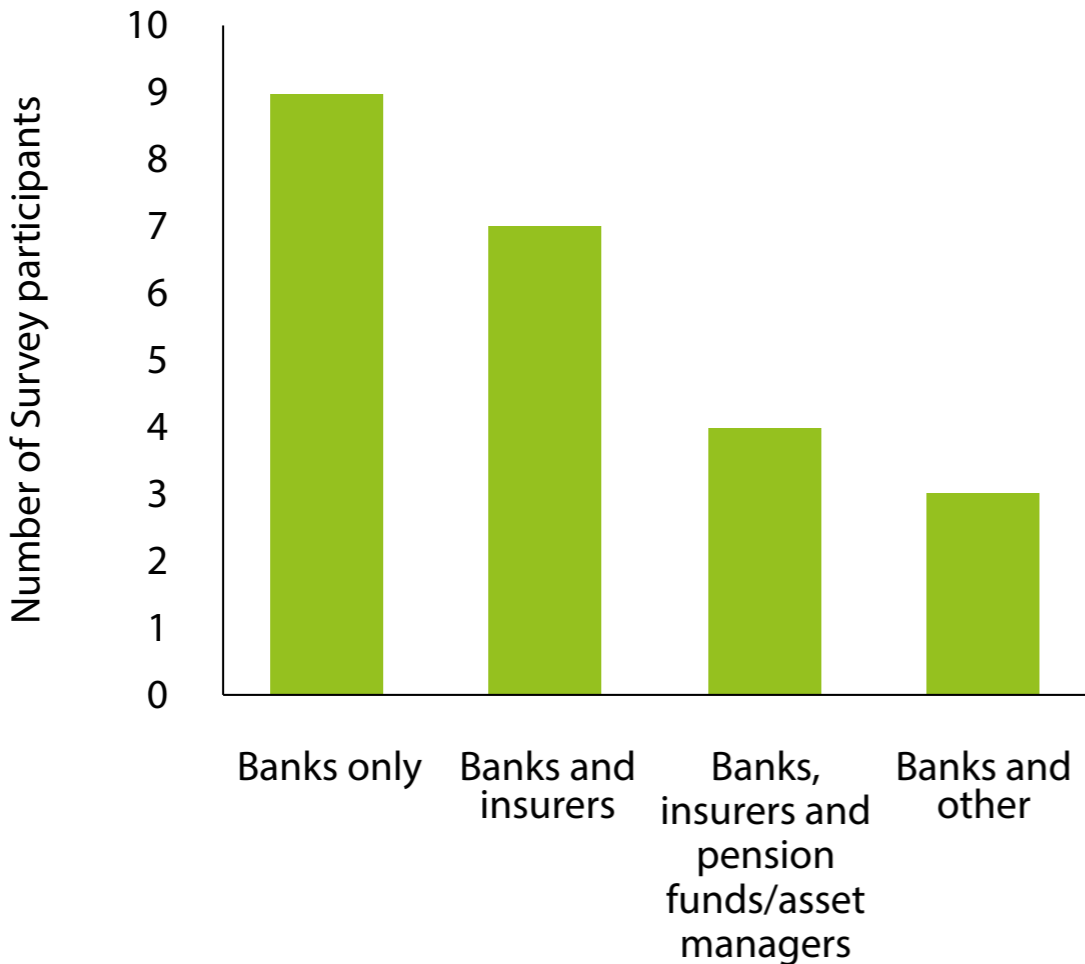
To date, only one of the exercises surveyed includes climate litigation, the Bank of England's own Climate Biennial Exploratory Scenario (CBES), reflecting the complexities associated with modelling this risk. Across the world, there are increasing numbers of climate-related cases¹⁰ being litigated.

The impacts of such litigation can pose material financial risks to firms and create uncertainty over their operating environment¹¹. This could have a material impact on the stability of defendant companies, creating risks for investors, insurers, and the wider financial system, so we need to continue to adapt future scenario analyses to capture as many of these interactions as possible.

Challenges

The report also highlights a number of challenges that central banks and supervisors encountered when applying climate scenario exercises.

Figure 5. Scope of climate scenario exercises



- First, immaturity in this complex field means further enhancements are needed. The NGFS scenarios are a critical component in the significant majority of the climate scenario exercises that we surveyed.

The scenarios have been designed to be flexible, and indeed, we are seeing NGFS members build on these in their own exercises by tailoring them to the specific needs of their jurisdiction. In the last two years we have made huge strides in adding country-level data for hundreds of variables which can support jurisdiction specific assessment. But even so more development is needed.

- Second, data challenges take time to resolve. Even though scenario analysis helps generate relevant data that can help build the full picture, it is a gradual process and getting the right data to undertake scenario analysis remains a key challenge.
- Third, uncertainties remain around the estimates of macroeconomic and financial impacts. Although we have a good sense of the direction of the impacts from climate change, there is still much uncertainty around their exact size and composition – and this begins with the underlying physics.

For example, projections of future temperature rises are subject to considerable uncertainty bands, especially in scenarios with high emissions¹². There's also uncertainty about the pace and composition of the transition. So it's important to make our methodologies robust considering multiple scenarios and outcomes rather than single estimates.

In light of these challenges, no members as of yet envisage specifically calibrating regulatory capital requirements on the basis of their exercise. However, some members expressed interest in this topic and indicated that they may include it as an objective for future exercises.

Technical design features

Technical design features can be useful in dealing with the challenges I just described. Let me draw out two points:

i. Firstly on the type of scenario exercise being undertaken.

Some climate scenario exercises are conducted entirely by the central bank or supervisor, where they use existing datasets at their disposal to make scenario-based calculations – often referred to as desk-based exercises.

Others have opted for an approach where financial firms themselves are responsible for calculating the scenario impacts, based on a scenario that the regulator has provided them with – similar to how we conduct traditional stress tests.

Exercises are split evenly between these two types, highlighting that each approach is useful for different reasons. If financial firms make the calculations, they are forced to collect relevant data and build up internal risk management capabilities and awareness of climate-related risks.

But this can make comparability tricky as firms will take different approaches. If the regulator leads the exercise, the methodology applied can be consistent across firms. This is also often a simpler and quicker approach.

ii. Secondly, on time horizons and assumptions.

Most exercises look at a time horizon of 30 years, consistent with the fact that most emissions reductions must take place over the next three decades to meet the Paris goals¹³.

Some exercises look further into the future to include the more extreme physical risks that could arise later in the century. There are also exercises that look at shorter horizons of just a few years.

An issue when looking at longer time horizons is that exposures change over time. Financial firms continuously adjust their exposures to manage risks while aiming to profit from new opportunities. If we assumed that they can do this perfectly, we would by definition find that the direct risks they face are very small.

But of course firms would continue to face indirect risks as temperatures rise – it is not possible to diversify away from exposure to the planet. And we know perfect management of even firms' own direct exposures does not always happen, especially in stress, as might occur with a sudden adjustment in asset prices – a so called climate Minsky moment. And we are of course interested in what would happen if firms failed to adjust their business model or manage the risks adequately.

To assess the full size of the risks, three quarters of climate scenario exercises assume that financial firms' balance sheets are frozen in time. This is a huge simplification but it allows the climate specific impacts through the course of the exercise to be more easily identified. Others have instead allowed for changes to balance sheet to be modelled, sometimes subject to restrictions.

Understanding these technical aspects of climate scenario exercises is crucial properly to appreciate and contextualise the results. The Bank of England is also dealing with these complex challenges and design choices through the CBES, which launched this summer, the results of which are due to be published next year.

3. The future of climate scenarios

As I hope you have appreciated, we have learned a lot from designing and applying climate scenarios. But this is just the beginning. There is more we need to do, iteratively adjusting the nuts and bolts in the models – and even when we think we have got it right, we will find further room for improvement.

Central banks and supervisors have a lot to gain from these improvements – as this will help us better understand how climate risks affect the financial system and the economic outlook in order to consider our potential policy responses. We will therefore continue to share our experiences, and plan to publish further reports in the future to summarise the progress we have made.

We will also continue to improve the NGFS scenarios themselves. We are working on adding more sectoral detail to the scenarios so the distribution of risk across the economy becomes more apparent, and to include more physical risks so the cost of inaction becomes clearer.

But we need your help too. Let me highlight a handful of areas where more research is needed, and where scenario analysis can be usefully applied.

First, on policy levers. Our NGFS scenarios use a shadow carbon price, which serves as a proxy for a range of different potential climate policies – whether carbon taxes, business regulation or investment in research.

In aggregate, climate policies will need to create the relative price shift that internalises the costs of emissions and drives an economy-wide shift to net zero. Our NGFS analysis suggests that these will need to add up to an equivalent global shadow carbon price of over \$150 a tonne within a decade if we are to reach net zero by 2050 in an orderly way. Estimates of the average global price of carbon today are nowhere near that¹⁴, meaning that investments being made today lack crucial pricing signals that could fundamentally change investors' decisions.

In this context, further research to anticipate the challenges and opportunities that come with different approaches to climate policy and carbon pricing, to further understand the right mix of policy tools to support a swift yet

smooth transition to net zero and to develop comprehensive frameworks to better capture the impact of this mix of tools on the economy, are essential.

Second, on macroeconomic implications, we have identified three key areas where we think there is a need for further work and research:

- further integrating climate and macro modelling – climate models typically don't model the economy in much detail, and macro models don't capture climate risks well, so we need to do more work on integrating models across the different disciplines if we are to do a better job of understanding what might happen?
- understanding and sizing different transmission channels and improving our understanding of how they interact? and
- going beyond the aggregate impacts to understand distributional implications, for example across sectors and geographies.

Finally, research around the monetary policy implications of climate change and the transition to net zero have only recently started to emerge.

We know that domestic and international climate policy will have an impact on inflation, growth, and labour markets¹⁵. It is also clear that the physical risks from climate change will impact macro variables – for example, changes in weather patterns and increased reliance on bioenergy could increase the volatility of food and energy prices, and hence the volatility of headline inflation rates¹⁶. And we know too that the impacts will become larger if we fail to act at all.

We also know that to meet climate goals, we need a structural shift across the economy. And that will affect expected long-run steady state variables, such as the natural rate of interest (r^*) and the natural rate of unemployment (u^*). All of which matter for monetary policy makers.

The unknowns I have just talked through – policy levers, macroeconomic impacts, and monetary policy impacts – are all ripe areas for further research.

These efforts will not only help central banks and supervisors, but will also ensure that the NGFS scenarios can continue to be used by financial institutions in the private sector, industry and policymakers for their own purposes. We will continue our dialogue with these stakeholders and take on their feedback as we determine where to take the NGFS scenarios next.

Conclusion

To conclude, climate scenario analysis is of fundamental importance in managing the risks from climate change, helping us to chart the course to net-zero and to drive different decisions today.

As stewards of the financial system, scenario analysis must remain a core component of the central bank and supervisory toolkit. Indeed, our supervisory work has also indicated that scenario analysis is an area where our regulated firms need to do more.

Our case study report shows the extent to which these scenarios are being applied. And our international engagement this year, including through the NGFS, the G7, the G20 and the FSB, has shown us that scenario analysis is becoming an increasingly important tool for academia, financial institutions, businesses and policymakers around the globe.

The science tells us we are fast approaching a point of no return for the planet. That means we all need to work together to understand the risks, develop the analytical capabilities, and formulate the solutions.

It's an ambitious ask but humanity is best placed to achieve the impossible when there is a will and a way. Let's get to work. ■

Sarah Breeden is Executive Director, UK Deposit Takers Supervision, at the Bank of England

Endnotes

1. *IPCC 'AR6 Climate Change 2021: The Physical Science Basis'*
2. *UNFCCC 'Nationally determined contributions under the Paris Agreement'*
3. *IPCC 'AR6 Climate Change 2021: The Physical Science Basis'*
4. *Options for greening the Bank of England's CBPS discussion paper*
5. See *NGFS Scenarios Portal*
6. *Climate Change Committee 'The Sixth Carbon Budget: The UK's path to Net Zero'*
7. *This is true for an orderly transition. In a very disorderly scenario, transition risks will outweigh physical risks.*
8. See *Quiggin, et al 2021* for an overview of how these additional risk factors might play out.
9. *Global Commission on Adaptation 'Adapt now: A global call for leadership on climate resilience'*
10. For example, see *Milieudefensie et al. v Shell* or *Neubauer et al v Germany*
11. *S&P Global Ratings, 2021: Climate Change Litigation: The Case for Better Disclosure and Targets*
12. *IPCC 'AR6 Climate Change 2021: The Physical Science Basis'*
13. *IPCC 'Global Warming of 1.5 °C' report*

14. IMF 'A Proposal to Scale Up Global Carbon Pricing'

15. NGFS 'Climate Change and Monetary Policy: Initial takeaways'

16. Batten, S et al 'Climate change: Macroeconomic impact and implications for monetary policy'

I am grateful to Maria Pardo, Zane Jamal and Edo Schets for their assistance in drafting these remarks. This article is based on a [speech](#) given at the MIT Golub Center for Finance and Policy 8th Annual Conference



The green transition, finance and biodiversity: aim high, shoot higher

René Karsenti and Apostolos Thomadakis argue
that financing the energy transition requires a
comprehensive shift in how the financial system works

The urgency to succeed in financing the energy transition and reorienting private capital to sustainable investments requires a comprehensive shift in how the financial system works. The role of major market participants, investors, and policymakers in facilitating this shift is essential. To develop more green and sustainable economic growth, there is a need to:

1. broaden access to the market through innovation and diversification;
2. further develop global standards and taxonomies;
3. enhance disclosure and reporting;
4. fully incorporate fintech and digitisation;
5. fully address biodiversity and nature-related risks

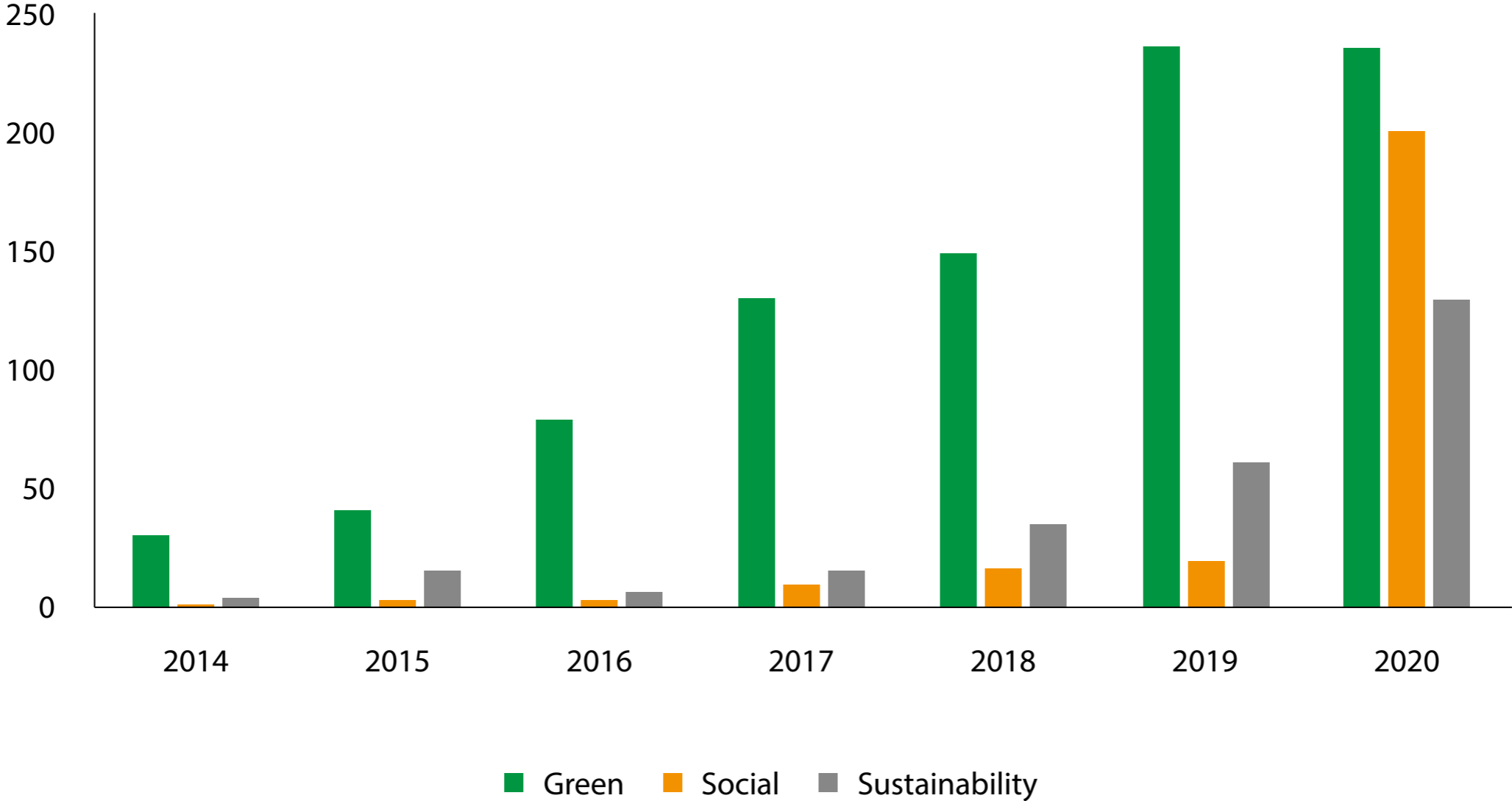
Beyond its quasi-moral obligation, mobilising finance for the energy transition is a historic opportunity, especially for the EU to act and lead as a true pioneer, that should not be missed.

Fifteen years ago, green, social and sustainability bonds (or sustainable bonds, collectively) were non-existent, while the green issuance volume was still a miniscule share of the bond market. Institutions such as the European Investment Bank (EIB), the World Bank Group (WBG), the International Capital Market Association (ICMA), and the International Finance Facility for Immunisation (IFFIm), have been trailblazers and put forward several significant initiatives.

As a result, building on such and other subsequent initiatives, the market has grown exponentially and moved from an aggregate issuance of €35 billion in 2014 to €568 billion in 2020 (see Figure 1). Today, the total value of outstanding sustainable bonds is at €1.6 trillion¹.

Figure 1. Global issuance of green, social and sustainability bonds (€ billion, 2014-2020)

www.worldcommercereview.com



*Note: The process followed by the CBI to classify a green bond as eligible covers the following steps: i) identification of climate- themes and self-labelled debt; ii) screening sectors and green credentials to determine if the proceeds will finance eligible green expenses/assets/projects/activities; iii) evaluating the use of proceeds threshold. For more information on the Green Bond Database Screening Process, see [here](#).
Source: Climate Bonds Initiative.*

In the shadow of the pandemic

The COVID-19 pandemic has caused colossal damage since the beginning of 2020. It has been estimated that the cumulative cost to the global economy in 2020-21 would be over €10 trillion². More importantly, it has pushed hundreds of millions of additional people into poverty across the world, while it has disrupted progress towards achieving the United Nations (UN) Sustainable Development Goals (SDGs)³.

The decade ahead promises to be exciting, with new tools, participants, practices, and standards coming to the fore that will help us to navigate the climate transition

But, at the same time, it made clear the important role that capital markets play in intermediating capital to rebuild shattered economies. Indeed, the pandemic has served as an accelerant for growth in the sustainable bond markets. Sustainable bond issuance totalled around €411 billion in the first half of 2021, nearly a 60% year-on-year growth from H1 2020⁴.

In particular, social issues have gained momentum and emerged as a key instrument in financing a post-COVID 'sustainable recovery'. This segment represented 36% of the total sustainable bond issuance in 2020, up from 6% in 2019.

This is a remarkable development since the creation of the first IFFIm Vaccine Bond in 2006. Although many were concerned that the focus on social bonds would detract from progress in the green bond market, in fact the complete opposite has been the case.

Green and environmental considerations have been hard-wired into the countries' post-COVID programmes, both on the funding and disbursement side. What's also noticeable is that more than 95% of the sustainable bonds issued in 2020 reference ICMA's Green and Social Bond Principles⁵.

Despite these positive developments, more needs to be done. Below we identify five key areas in which renewed focus should be given. For the remainder of this particular piece we will concentrate primarily on the fifth and final area.

- Broaden the market through innovation and the diversification of market participants and products in the green and sustainability space⁶.

- Develop global standards further and ensure taxonomies are as harmonised as possible – in close consultations with market players – to avoid fragmentation.
- Enhance disclosure in reporting by issuers and investors, including on their climate transition strategy to generate even more confidence and robustness⁷.
- Incorporate fintech and digitalisation as the main driving forces for the development of capital markets⁸.
- Fully address biodiversity and nature-related risks, which has been identified as one of the top five risks in terms of likelihood and impact in the coming 10 years⁹.

Assessing the risks

To effectively address biodiversity, it is important to first distinguish nature-related risks from climate change-specific risks, and then to find ways to properly measure them. Nature-related risks (encompassing biodiversity loss and ecosystem degradation) and climate-related risks, are both essential components for the accurate assessment of environmental risks.

Although they are highly interconnected, at the same time they are distinct from each other. Nature-related risks broadly refers to the risks to an organisation posed by the linkages between its activities and the natural world¹⁰. These can be shorter-term risks, as well as longer-term risks arising from its impact and dependency on nature.

On the other hand, climate change risks can be categorised into two broad categories, those risks related to the physical impacts of climate change (eg. acute risk, chronic risk), and risks related to the transition to a lower-carbon economy (eg. policy and legal risks, technological risks, market risks, reputational risk)¹¹.

However, some of these risks have been carried over into nature-related risks – namely physical (eg. the loss of mangrove swamps), transition (eg. the closure of soft drinks plants in India due to their impact on water

shortages), and litigation (eg. bond investors taking legal action against a Californian energy utility company for misrepresenting the risks of wildfires).

Moving into the measurement of such risks, Gross Domestic Product (GDP) has so far failed to clearly capture the depreciation of changes in biodiversity¹². Nevertheless, according to the World Economic Forum (WEF), half of global GDP in 2019 was moderately or highly dependent on natural capital¹³.

Although the depreciation and loss of natural capital has been a primary source of 'economic growth', it has not been taken into account in the calculations. Thus, there is need to capture the true value (or 'accounting prices')¹⁴ of natural capital. This will allow for accurate measurements of the financial costs and risks and avoid further rapid destruction of our common biodiversity.

Developing comprehensive risk measures beyond the impact on GDP, are critical for market participants in their investment decisions. Banks and investors may be adversely affected by climate change risks, for example by holding the sovereign bonds of countries that are highly dependent on the over-exploitation of natural resources. In a case like this, the risk is under-priced by the market and needs to be clearly assessed and reported.

There is also need for a new set of international impact-weighted accounting standards, similar to the introduction of the international accounting standards after the 1929 Great Depression.

In essence, a standardised tool to measure the net impact that companies have on both the environment and people. More generally, although metrics that incorporate nature loss into risk models already exist¹⁵, there is no single and widely accepted method for measuring biodiversity foot printing. Risks are far from negligible.

A 2018 assessment exercise found that 13 of the 18 sectors in the FTSE 100 (at that time having a total of approximately €1.4 trillion in net market capitalisation) have a high dependence on natural capital (including assets such as forests, water, fish stocks, minerals, biodiversity and land)¹⁶.

This poses significant challenges to achieving the sustainable development objectives and poverty reduction.

Global commons – a radical proposition?

The long-term objective is to bring aggregate demand in line with aggregate supply; meaning that global demand must equal the biosphere's ability to meet the supply on a sustainable basis. This so-called 'impact equation' illustrates how the biosphere can heal itself over a set period¹⁷.

But the current rate of depletion, driven by activity to create physical and human capital, threatens our fundamental life support system – the natural environment.

Perhaps a more visionary – and at the same time controversial – proposal for preserving natural capital, calls for the creation of a global Commons Fund (Dasgupta, 2021)¹⁸. Such an initiative would require an international organisation to monitor and manage forms of natural capital as global public goods.

This would be similar to the way the World Bank advances the cause of global economic development, and to the International Monetary Fund (IMF) when it comes to the rescue during instances of financial instability.

Global commons are like the Seven Seas – no one pays for their use as long as access to them is free. Such a rather controversial proposal might essentially entail the introduction of a new form of rent, to be collected through a

global organisation. The money raised would pay the compensation required to prevent further deterioration of the natural world.

However, this should not be perceived as an additional taxation to financial preservation, but instead as a way in which the global commons could (themselves) generate the funds needed to restore natural capital (ie. the air, water and land).

Conclusions

In 2015 Mark Carney – at that time Governor of the Bank of England – warned about “*the tragedy of the horizon*” and highlighted the important role of finance in accelerating short- and long-term climate change¹⁹.

Progress in green and sustainable finance has been impressive since then, while the COVID-19 pandemic has proven its importance going forward.

The decade ahead promises to be exciting, with new tools, participants, practices, and standards coming to the fore that will help us to navigate the climate transition. The future of finance should be green and sustainable.

But to achieve this, it needs to be mindful of its environmental and social impacts, invest in the future, and also protect the ecosystem, and save lives. Let’s not miss the opportunity to make a real and lasting impact. ■

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Director General of the European Investment Bank (EIB) and former Chairman of the European Capital Markets Institute (ECMI) Board, and Apostolos Thomadakis is a Researcher at ECMI and CEPS

Endnotes

1. Based on data from the [Environmental Finance Bond Database](#), accessed on September 9, 2021.
2. See IMF (2020), [“World Economic Outlook Update: A Crisis Like No Other, An Uncertain Recovery”](#), June, International Monetary Fund.
3. Latest estimates put the number of newly poor people as a consequence of COVID-19 in 2020 to rise to between 119 and 124 million. See WB (2021), [“Global Economic Prospects”](#), June, World Bank.
4. See the [Climate Bonds Initiative’s Sustainable Debt Market Summary for H1 2021](#).
5. See [Green Bond Principles](#) (GBP) and [Social Bond Principles](#) (SBP).
6. The last few months have proved to be a period of remarkable innovation, with the launch of the ICMA’s [Sustainability-Linked Bond Principles](#) last June and the [Climate Transition Finance Handbook](#) in December.
7. There is a need for a new set of international Impact-weighted accounting standards, similar to the introduction of the international accounting standards after the 1929 Great Depression. This would be a standardised tool to measure the net impact that companies have on the environment and on the people.
8. A striking commonality between FinTech and sustainability is the need for common standards and harmonisation. FinTech could be used to develop common platforms, particularly in the sustainable finance sector for oversight, to facilitate comparability, and provide dynamic insights into environmental, social and governance (ESG) performance and reporting. For data providers, regular and more frequent ESG reporting is paramount to harness analytics and create greater transparency.
9. See WEF (2020), [“The Global Risks Report”](#), 15 January, World Economic Forum. Moreover, it has also been advocated by market participants and investors through the United Nations’ [Principles for Responsible Investment \(PRI\)](#), as well

as the international alliance Act4Nature, while it is one of the six environmental objectives under the EU Taxonomy which is central to the EU's Biodiversity Strategy 2030. Other important initiatives towards this direction include: the Natural Capital Financial Facility (NCFF), a partnership between the EIB and the European Commission which has already resulted in the EIB issuing a Sustainability Awareness Bond with a biodiversity theme in early January, the Taskforce on Nature-related Financial Disclosures (TNFD), the Finance for Biodiversity (F4B) which proposes a dedicated international Nature and Climate Sovereign Bond Facility, the Biodiversity Finance Initiative (BIOFIN), and the Sustainable Blue Economy Initiative. More recently, it was released in the UK as part of the Dasgupta Review on the Economics of Biodiversity, commissioned in 2019 by HM Treasury.

10. See the TNFD (2021), *"Nature in Scope: A Summary of the Proposed Scope, Governance, Work Plan, Communication and Resourcing Plan of the TNFD"*, June, Taskforce on Nature-related Financial Disclosures.

11. See TCFD (2017), *"Recommendation of the Task Force on Climate-related Financial Disclosures"*, June, Task Force on Climate-related Financial Disclosures.

12. See Dasgupta (2021), *"Economics of Biodiversity: The Dasgupta Review"*, February, HM Treasury.

13. See WFE (2020), *"Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy"*, January, World Economic Forum.

14. A capital good's accounting price refers to the contribution an additional unit of it would make to the flow of social benefits.

15. Such as the Exploring Natural Capital Opportunities, Risks and Exposures (ENCORE) tool, developed by the Natural Capital Finance Alliance (NCFA), or the Integrated Biodiversity Assessment Tool (IBAT).

16. This is based on NCFA's ENCORE database.

17. See footnote 11.

18. Such a proposal might be carried by the UK to the 26th United Nations Climate Change Conference of the Parties (COP26) taking place later in November, and promoted more widely.

19. See *"Breaking the Tragedy of the Horizon – Climate Change and Financial Stability"*, speech on 29 September 2015.

This article was first [published](#) by the European Capital Markets Institute. ECMI is managed and staffed by the Centre for European Policy Studies (CEPS) in Brussels.

Power to the employees

CONTINUOUS IMPROVEMENT

Employees have greater power than ever before.
Jonathan Sharp says companies must reinvent
themselves, adapt and empower their employees

The global pandemic has caused a paradigm shift in employees having more power with employers than ever before. After working at home for the last eighteen months they have experienced more freedom and more of a work/life balance and now want choices on how, when and where they work. Companies must invest in their employees by putting them first and understanding their journey within the company. It is time to re-invent the now and the future for success in retaining and attracting talent.

What do employees expect?

It looks like remote working is here to stay and research from Insights and Analytics Data confirmed that 69% would prefer to continue working remotely. However, Microsoft revealed that 67% of people desired more time in person with their teams.

The answer is hybrid working so employees and companies can benefit from people working remotely and, in the office, resulting in the best of both worlds. Going forward it won't be about working from home and in the office but working from anywhere.

Companies need to recognise that the days of 9-5, rigid scheduling of lunch breaks and coffee breaks are over. This workplace regime has been set since the 1800s, so it is a refreshing and well overdue change that employers need to embrace.

However, it is not just about retaining existing employees and providing them with a work/life balance and different working options but also about attracting talent.

Talent revolution

The pandemic has resulted in a talent revolution and in 2020 according to Microsoft 40% of people are planning to

leave their current employer and remote job postings increased more than five times on LinkedIn. This seismic shift has occurred due to several reasons and one of them being the new demands of employees for remote working.

The talent revolution is a huge challenge that companies will need to face. Workers are now presented with more opportunities with more companies offering remote working and 29% of employees stated they are more likely to leave their job if their employer wants them in the office full time (McKinsey). Therefore, companies need to offer employees hybrid working as an option to attract talent.

The pandemic has humanised the workplace and accelerated changes that are revolutionary forcing companies to respond and listen to their employees' needs

Companies will need to overhaul their strategy and focus on how they attract, retain, engage, and develop people and this will be achieved by creating a dynamic culture, fostering team relationships and trustworthy leaders.

Social capital has been threatened during COVID and must be addressed to re-build connections with people, so they feel a sense of belonging to their teams and company. This can be achieved by re-designing the office to create collaboration spaces for employees to work together.

Putting people first

Companies need to re-invent themselves for now and the future. Accenture revealed that 78% of CEOs said business reinvention is required and businesses need to put people first and foremost, followed by processes and technology. The pandemic has humanised the workplace and accelerated changes that are revolutionary forcing companies to respond and listen to their employees' needs.

As well as hybrid working and creating more of a work/life balance they want valuable training and development, flexibility, job satisfaction and clear expectations set out. The talent revolution should drive companies to create an organisation where people want to work and aren't tempted to leave. This often results in a complete overhaul of your vision, mission, and strategy; the world has changed and so should you.

During the pandemic a lot of employees have not only been physically isolated but isolated in terms of belonging, and not feeling one of the team. Companies now need to re-create the trust and sense of belonging to the organisation and to also re-build social capital.

Your people are your best currency, so approach them with the same diligence of understanding that you do with customers by segmenting them into groups so you can deliver a more personalised approach with them to meet

their expectations and discover what support they require. By taking care of your people, you can boost growth by up to 20% (Accenture).

Ask and listen to what your employees need and understand their role and journey within the company. Discover where they like to work and how they feel it is beneficial to them, what processes they think need re-vamping or introducing that will empower them and what technology they require to facilitate their job.

Empowering with technology

During the pandemic companies have accelerated digital transformation at great speed from deploying remote working solutions and automation solutions. Now eighteen months from the start of the pandemic and with the fact that remote working is here to stay companies need to review how to optimise their remote workforce with conferencing and collaboration solutions.

Digital parity is important to ensure that everyone has access to the technology they require, and all employees have the same. It is vital to ensure that everyone who is remote or adopting hybrid working has access to a reliable broadband connection and now is the time to consider the benefits of cloud technology.

IDC revealed in its 2020 survey that more than 35% of organisations would move to the cloud because it is cost-effective, augments business continuity and provides flexibility to add on technology and applications when required.

Questions we should be asking are – how do we connect people to technology and build new skills? It is the people that bring the creativity and innovation around how we can use technology to make decisions and transform business.

Companies should work closely with employees to also evaluate what processes work and what don't. How can they be improved with the use of automation technology that will relieve contact centre agents from the mundane daily tasks that could be dealt with by an automation solution so they can focus on higher value tasks?

The objective should be to create leaner and more agile processes to improve effectiveness, communications, productivity, and customer service.

Power to the people

By empowering your employees and putting them first, creating an inclusive and diverse culture, leading with technology, and developing skills you will create an environment where everyone feels valued and as a result your business will flourish.

The time is now for companies to re-invent themselves, adapt the new workplace and ways of working, discover new offerings and opportunities. The pandemic has provided a fresh start for you to change the narrative. ■

Jonathan Sharp is a Director at Britannic Technologies



Unique network, outstanding talent

Despite a turbulent jobs market, the demand for senior roles has remained high. With decades of experience behind them, InterExec is continuing to help its clients secure roles that would be difficult to find alone

The pandemic has seen massive fluctuations in the jobs market, affecting a wide range of industries, disciplines and territories. At the senior end of the market, however, there has been surprisingly continuous demand across both industry and geography, for top talent.

It's not quite business as usual. In this post pandemic world, corporates want and need to expand their top talent to turn around, recover and continue the growth of their organisations.

Companies like InterExec, a London-based consultancy working with C-suite senior executives across all major business sectors, are ideally placed to help. The transition from one organisation to another brings with it significant prospects of both short and long-term benefit, but demands focus and commitment to achieve the best result.

InterExec facilitates that process, working with clients to make crucial decisions about their goals, when and how to move role, and how best to present themselves to the marketplace. Typically, a senior executive seeking a new role will have limited access to sufficient senior contacts in the recruitment market.

It might seem straightforward to find roles at the bottom end of the executive market through selective channels such as advertisements, job boards and websites, as well as via their own personal networking. It's much trickier at the top end – for roles with salaries in excess of £200,000 – where the market is unadvertised and where personal introductions and contacts are essential.

In this 'hidden' market, it is almost impossible for executives to get a comprehensive view of relevant opportunities and an unbiased view of their prospects. We specialise in assisting busily employed senior executives who want to make a move but do not have the time or market access to conduct an effective search.

Future Choice, a system we developed over the last 30 years, enables the individual to identify their needs and skills. This way, drawing on our extensive knowledge of the market, we can work together to identify the positions that meet these prerequisites, whether they are financial in nature, or relate more broadly to job satisfaction.

With a global network of leading search consultants and over four decades' experience, we are well placed to ensure that clients are presented with a strong range of options, whatever their field.

InterExec staff – a combination of former company directors and executive search consultants – have daily access to thousands of the most influential people in the senior executive market, providing up-to-the-minute intelligence that allows them to plug into up to 90,000 unadvertised vacancies a year.

*The world is small at the highest levels of business
and executives must tread carefully*

We are regularly adding to this network, broadening the reach of our searches to encompass roles in nations around the globe, across multiple disciplines and sectors.

Market knowledge

The entire consultation process can be completed in little more than four hours, with search consultants working at a time to suit the client wherever they are in the world. By keeping the process as streamlined as possible and minimising interruption to normal workflows, we enable executives to stay focused on their current role while setting the stage for the next phase of their career.

We then use our market knowledge to identify the people to whom confidential approaches can be made, to source relevant unadvertised opportunities.

For executives seeking their next new challenge, confidentiality is crucial. The aim is always to minimise unnecessary market exposure while maximising a client's range of options when it comes to changing roles. The world is small at the highest levels of business and executives must tread carefully. Our processes guarantee absolute discretion.

Whether the client is seeking full-time executive employment, interim management, non-executive, consultancy/ portfolio roles or employment in a PE/VC environment, the channels to market are very similar.

In our talks to the marketplace on behalf of the client, we work hard to fully brief those working on behalf of prospective employers so as to minimise the amount of time the client might need to spend at interview.

Some people have a very clear idea of their objectives in a job transition, and some are more open-minded as to where they should best go for the future. Either way it is crucial that the client's target roles be achievable, based upon their expertise and prior experience, and that the way we present the client to employers enhances their prospects.

Standard procedure includes verifying clients' qualifications, references, identity, skills, achievements and entitlements – because all this information is set out in advance of our conversations with those looking to fill particular roles, time is saved for all involved and the best result can be achieved. The unique InterExec process and network has proven to be a powerful asset to senior executives seeking their next challenge. ■

Kit Scott-Brown is the Chairman at InterExec

Pivoting towards an innovative executive education ecosystem

Nowadays, when you can seemingly learn anything online for free, how can business schools best prepare the next generation of future-focused leaders? Jordi Diaz and Daphne Halkias investigate

It is no secret that as our economy changes, so do the demands of our workforce. Tesla CEO Elon Musk, during a conversation at the Satellite 2020 conference earlier this year, said colleges 'are not for learning', but rather a place to have fun. Musk tells us we can learn anything online for free.

Now, prominent companies such as Google and Apple are hiring employees who have the skills required to get jobs done, with or without a degree. Google, Apple, and IBM do not require applicants to have a college degree to land a job. Google recently launched a new selection of courses for the [Google Career Certificate](#), a six-month programme that prepares participants for in-demand jobs.

Without the in-demand skills needed to land jobs that are sprouting globally because of the fourth industrial revolution, those with only a four-year or even a year-long course of study leading to a classical master's degree will soon be all but excluded from these opportunities.

Today's most relevant and utilised provider for executive education programmes for reskilling/upskilling has appeared outside the business school itself. The industry sector has stepped in where business schools lack readiness and reparation for the future of work.

The pandemic has accelerated trends such as working and studying from home, offering the perfect conditions for low-end and new-market disruptive innovations to happen, and transforming from an industry of two main educational stops (bachelor's degree and MBA) to lifelong learning scenarios with multiple and constant stops.

In the post-COVID-19 era, many industry leaders and scholars label business schools as irrelevant executive education providers for today's labour market. For business education providers to recapture the 'skills' provider role

from in-house corporate programmes will take more than adjusting to automation, remote working, and artificial intelligence.

Reskilling (learning new skills to do a different job) and upskilling (teaching and learning additional skills for one's present job) of business professionals require effective partnerships between education providers and industry. Project management, business process, communication data, and digital design are business enablers' skills that turn theoretical knowledge and skills into practice.

Tesla CEO Elon Musk, during a conversation at the Satellite 2020 conference earlier this year, said colleges 'are not for learning', but rather a place to have fun

Reskilling and upskilling programmes in post-secondary education require a three-step process that incorporates (i) identification of which skills are needed for coping with the new business reality of the organisation, (ii) a clear recognition of the gap between the skills of today's workforce versus the new business model, and (iii) a selection of partners that will support an academic institution's reskilling and upskilling effort as a lifelong learning journey.

Business schools need to develop a new curriculum as part of a multidisciplinary, geographically dispersed team of academic and industry experts. Optimal team-based blended instructional design, like optimal blended education, can find the right balance between team members' ability to create context, introduce themselves to others, and be encouraged in doing so.

Where do business schools' executive education programs find themselves today at a time of great transition not only in the workplace but through society at large? For the most part, business schools still function through a twentieth-century executive education ecosystem on what and how they teach, how they are governed, and how they engage their faculty and other key stakeholders.

Currently, employers see a lack of readiness for business school graduates to properly prepare the present-day workforce for disruptive events such as a pandemic, disrupted job architecture across industries, and the skills employees need to survive given today's changing workforce requirements.

This outcome can be seen in how large and small corporations have taken it upon themselves to develop their own in-house executive education ecosystems to meet the pressing demand of a skilled workforce for today's market demands.

Business leaders find that the COVID-19 crisis, changing technologies, and novel working methods have pushed forward a new way of running corporations for long-term sustainability and profitability. Society is no longer asking simply for leaders and managers who can 'run the world' but for insightful, connected, and empowering agents and ambassadors who create change in the world themselves.

Business schools need to build corporate programme partnerships under the frame of an entirely new business education ecosystem model. Promising partnerships that support the education-industry cooperative business model with common goals have begun launching, such as [The City University of New York](#) and IBM partnership supporting business students in data science and analytics and urban sustainability.

The business school-industry model pivots over five support beams: it is omnichannel, it is co-developed by educators and corporate clients, it includes educational platforms as part of the delivery, it differs between low-cost online and high-end in-person options, and it focuses on skills building and credentialing rather than just knowledge transfer.

The common goal of business school-industry partnerships is to develop a strong bond among the partners for knowledge, technology, and organisational transfer to support digital skills development. Developing both global and local strategies with the cooperation of business schools and regional industries can offer a vision of a future-focused workforce through careful consideration of five inter-related elements:

- Thriving in the digital-first future will require new capabilities.
- Shaping real-time business capabilities is made possible through learning in the flow of work.

- Co-creating with industry partners is critical for success.
- Co-creating with alternative educational providers will accelerate the response.
- Reskilling will also need to be about social responsibility for both business leaders and educators.

Today's business schools must strategically engage others in innovative education ecosystems by committing to experimentation, innovation, and industry partnerships. Academia needs to be prepared to surrender its monopoly on having all the answers about education.

Today, a world in which people expect a constant change of jobs coincides with a mismatch between employees' skills and those that employers seek. This blurred context between work and skills can be bridged by generating an amplified new executive education ecosystem of academic alternatives, including degree, credit, certificate, boot camp, skill-building program, internal training, and external partnerships that will aid business schools dynamically re-renter the executive education market.

The opportunity to be proactive in the reskilling revolution is calling us. Are we, as business educators, ready to listen? ■

Jordi Diaz is the Dean of EADA Business School (Barcelona, Spain) and the Director of the Executive Academy, and Daphne Halkias is a Professor at École des Ponts Business School in Paris

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International trade, global supply chains and monetary policy

Silvana Tenreyro says global supply chains can improve a country's productivity and income. But the benefits they bring are not evenly spread across sectors

will talk about international trade, global supply chains and their implications for monetary policy in the UK. I will first discuss some of the reasons for international trade, and how the development of global supply chains has increased the scope for trade.

In the context of recent disruptions to global supply chains, I will then examine some past crises affecting trade volumes and compare these to the trade disruptions during the pandemic. I will finish by explaining what I think this means for monetary policy and setting out how I see the current economic outlook. I will make three key points:

- International trade brings benefits in the form of higher productivity and increased average incomes. The development of global supply chains has allowed further gains to be realised. While in the past there have been questions over whether trade and global supply chains also have costs by increasing income volatility, recent evidence suggests that trade can also reduce income volatility by allowing countries to diversify their risks. Trade and supply chains have also proved resilient in the face of crises.
- Recent disruption to global supply chains has arisen because of an unprecedented combination of a strong rotation in global demand towards some sectors – mostly goods, and away from others, mostly services – and a variety of reductions in supply, particularly affecting a few critical inputs. The rotation in demand reflects changes in consumption patterns brought on by the pandemic, which made some types of consumption less desirable, given the associated health risks.

It has also been influenced by the large fiscal programs in place in a number of economies. Many of the reductions in supply have also been COVID-related, with lockdowns taking place across the world, while several other disruptions have been idiosyncratic.

- In the UK, the economy has not yet recovered to the employment and output trends we would have seen without the pandemic. At the same time, a range of temporary factors have been pushing CPI inflation above target, and will continue to do so over the coming months.

Some of these, such as base effects and the direct impact of energy price rises, are short-lived, and monetary policy can do little to offset them: much of the effect of policy would not come until after their impact had faded; more important will be any indirect effects of energy prices on real incomes or production costs. The effects of supply chain disruption should also be temporary, and unwind as supply of some goods increases, and as demand rotates back towards pre-COVID consumption patterns.

The current supply chain disruption will also ultimately be temporary. For some products, disruption and its effect on inflation are likely to dissipate quickly as firms find new suppliers or current ones are able to expand

The speed of this rotation is a key uncertainty, and will be related to the evolution of the pandemic around the world. In the UK, domestic cost pressures will depend on the evolution of the labour market now that the furlough scheme has ended. My policy votes will aim to strike a balance between these different effects and risks while bringing inflation back to target sustainably.

Trade and global supply chains

Global supply chains have been dominating the news agenda. Just as the global financial crisis brought the financial system to the attention of the general public (as well as many economists), so too has the pandemic moved the workings of modern supply chains from the background to the front page. But while the focus on these complex production networks is new, many of the debates hark back to some of the oldest questions in economics: the benefits and potential costs of international trade.

International trade affects the daily lives of almost everyone in the world. In the UK, with around one-third of the consumer price index basket consisting of imported goods and services, our typical supermarket basket would look very different without it. Trade brings many benefits.

By allowing different countries to specialise in products they can produce more efficiently, it increases average productivity and incomes. We can also purchase more varieties of the same products: French and Italian cheeses to supplement British ones, for example.

And international trade integration can boost the productivity of UK firms – irrespective of whether they trade directly¹ – in several different ways: firms learn from best practices abroad and adopt new technologies developed elsewhere², and greater international competition favours more productive firms.

The development of global supply chains – production processes that use intermediate goods and services sourced from other countries – are a natural extension of this logic. A large share of trade has always consisted of inputs used in production, as opposed to imported final goods and services.

But in recent decades, global supply chains have continued to grow in importance. This reflected large reductions over time in the cost of transporting goods, initially through industrialisation.

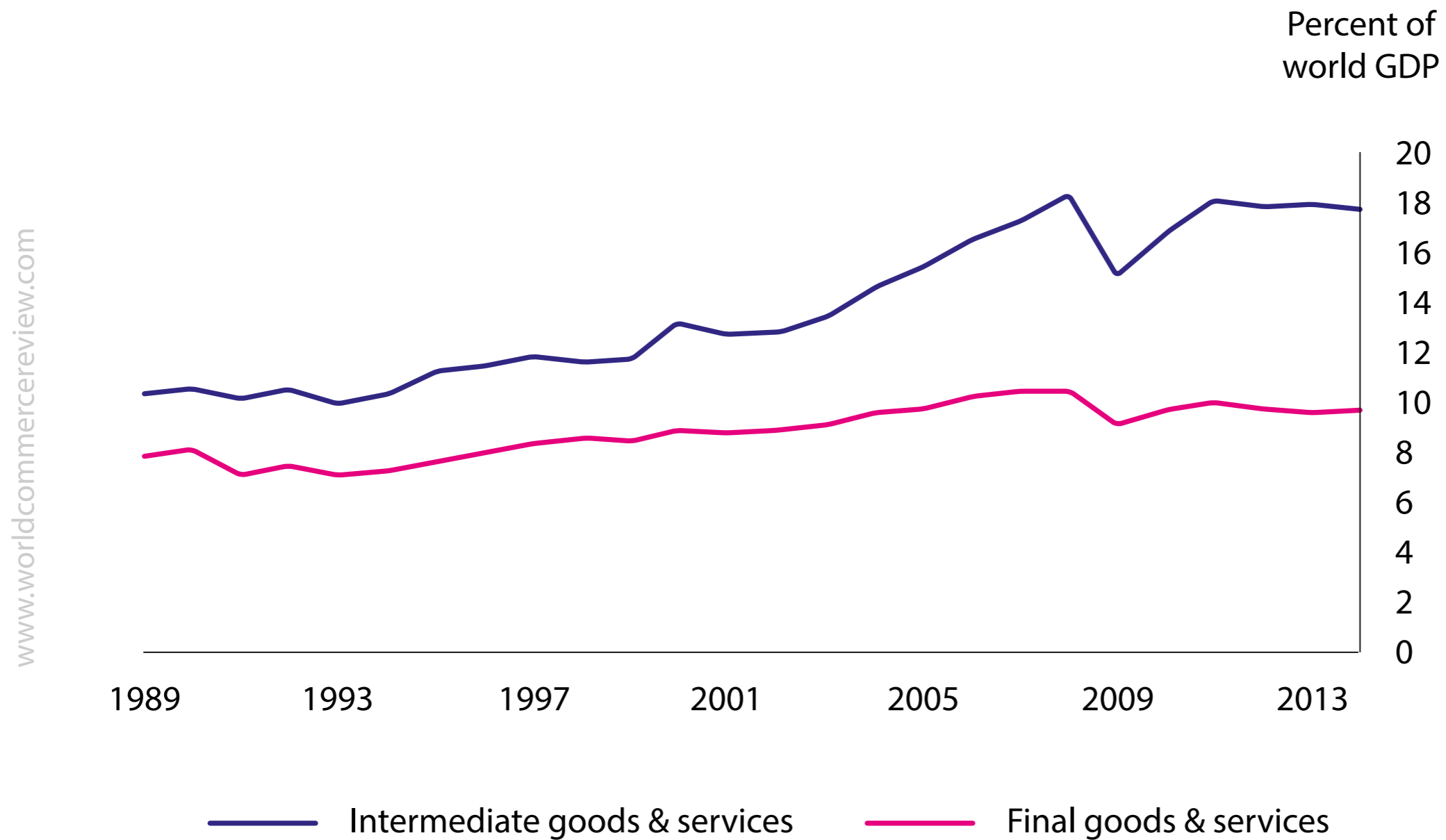
More recently, progress in information and communications technology has made it easier to transport ideas, thus enabling the coordination of work at a distance³. As a result, supply chains have also become longer and more complex, with stages of production offshored or unbundled across various firms located in different countries.

As a concrete example, all you have to do is look down at your smartphone; from design to delivery, our mobiles have been designed and constructed using the flow and exchange of know-how and parts and components produced and assembled across multiple borders.

To measure the increased importance of supply chains in international trade, there is a range of different metrics we might consider. Chart 1 shows that as a share of world GDP, intermediate input trade had increased far faster over the 20 years to 1990 than trade in final goods and services.

We might also want to know about how exposed different countries are to each other, either to measure risks and vulnerabilities, or to trace out how shocks in one region may transmit to others. These bilateral exposures are more complex to quantify.

Chart 1. Trade in intermediate and final goods and services



Source: Carney (2017), using data from Johnson and Noguera (2017), Powell (2016), World Input-Output Database (2016 release) and BIS.

For example, we might think of a British car, say a Mini, as being produced in Plant Oxford in the UK, because that is where final assembly happens. But by 2016, over half of the parts used in cars assembled in the UK are produced abroad⁴.

Even taking these inputs into account would miss links in the network, however, since each input may be produced using sequences of inputs from elsewhere: the engine could contain cylinders from Germany, containing pistons from China, and so on.

To try to capture the indirect links in the network, in Caselli *et al* (2020), we build a quantitative model of trade with global supply chain networks for all countries using data from the 1970s to the 2000s. The model allows researchers to trace how economic shocks in one or more countries (or sectors) transmit across other countries and sectors in the network, and to study quantitatively how that transmission has evolved over time, as countries and supply chains became more integrated⁵.

A more recent paper by Baldwin and Freeman (2021) proposes a measure of foreign input reliance based on gross, or cumulative trade⁶. This index gauges the total potential exposure to shocks emanating from abroad. Disruption to production or shipping from one country, due to a COVID lockdown, for example, is likely to affect the total value of goods produced or shipped, irrespective of the source of the inputs⁷.

Both papers stress that the substitutability between different intermediate inputs as well as the possibility to diversify suppliers will influence how a shock in one country affects its trading partners, a point I will come to discuss below.

As global supply chains have expanded the scope for international trade, many of their benefits correspond closely to those from trade in general. Supply chains allow even more specialisation, again increasing productivity and average incomes. Lower cost or higher quality inputs, and a greater variety of inputs can do the same.

Supply chains also offer more possibilities for productivity gains from learning and technology spillovers: between importers or exporters and their suppliers or buyers, including via activities like the sharing of blueprints or managerial practices⁸.

So trade and integrated global supply chains bring benefits in the form of higher national income. An important caveat is that these benefits may not be evenly distributed across societies, unless governments use the gains from trade to compensate any workers or consumers who lose out.

That said, if giving up globally integrated trade makes the overall level of aggregate income smaller, these losses often tend to fall on the lower part of the income distribution. From an aggregate perspective, given the disruption we have seen to supply chains in recent months, it is also important to assess whether there are other potential costs or risks.

One possibility is that while trade and supply chains raise the level of income in an economy, they could also make it more volatile. This was once a widely held view by economists, based on the idea that increased specialisation in one sector, which goes hand in hand with international trade, increases the exposure to shocks to that sector⁹.

For example, the UK has long specialised in the export of financial services, which means that trade is likely to be disproportionately affected by shocks to the financial sector, as occurred during the 2007-08 global financial crisis.

My own research has highlighted that there is an offsetting effect, however, which means that trade can actually reduce income volatility, and typically has done so in the past. In Caselli *et al* (2020) we explain how higher trade integration allows countries to rely on a more diverse set of suppliers and buyers. This reduces the domestic economy's exposure to shocks to any single producer or country that they trade with.

If the supply of labour falls in the UK, for example, this has a smaller effect on our UK car manufacturer than it would for a firm with a less diverse supply chain, since the shock has no direct effect on the cost of its imported inputs. Other recent studies echo these conclusions.

For example, recent work by Bank of England economists¹⁰ concludes that a blanket reduction in supply chain integration can be economically costly while not significantly reducing economic volatility; and that reshoring production would increase aggregate volatility by reducing source diversification¹¹.

This diversification channel also allows countries to pool technologies, as we saw in the recent example of vaccine development. Only a small number of countries witnessed the successful development of COVID vaccines, but a much larger number have been able to benefit from their discovery.

How do the recent supply chain disruptions, which have dominated news cycles, fit into this framework? We have seen widespread supply shortages, bottlenecks and transport disruptions over the past year.

Some of the causes have been idiosyncratic – such as the grounding of the Ever Given ship in the Suez Canal in March. Have these highlighted additional risks or fragilities in global supply chains that negate some of their benefits?¹²

While this is possible, as I will come on to discuss, many of the disruptions have been directly or indirectly related to COVID. As a shock that has been global in nature, it seems likely that there are limits to how easily its effects can be diversified away. To get some indication of how, and how quickly, such global shocks to supply chains might unwind, we may be able to learn from similar examples in the past.

Past supply chain crises

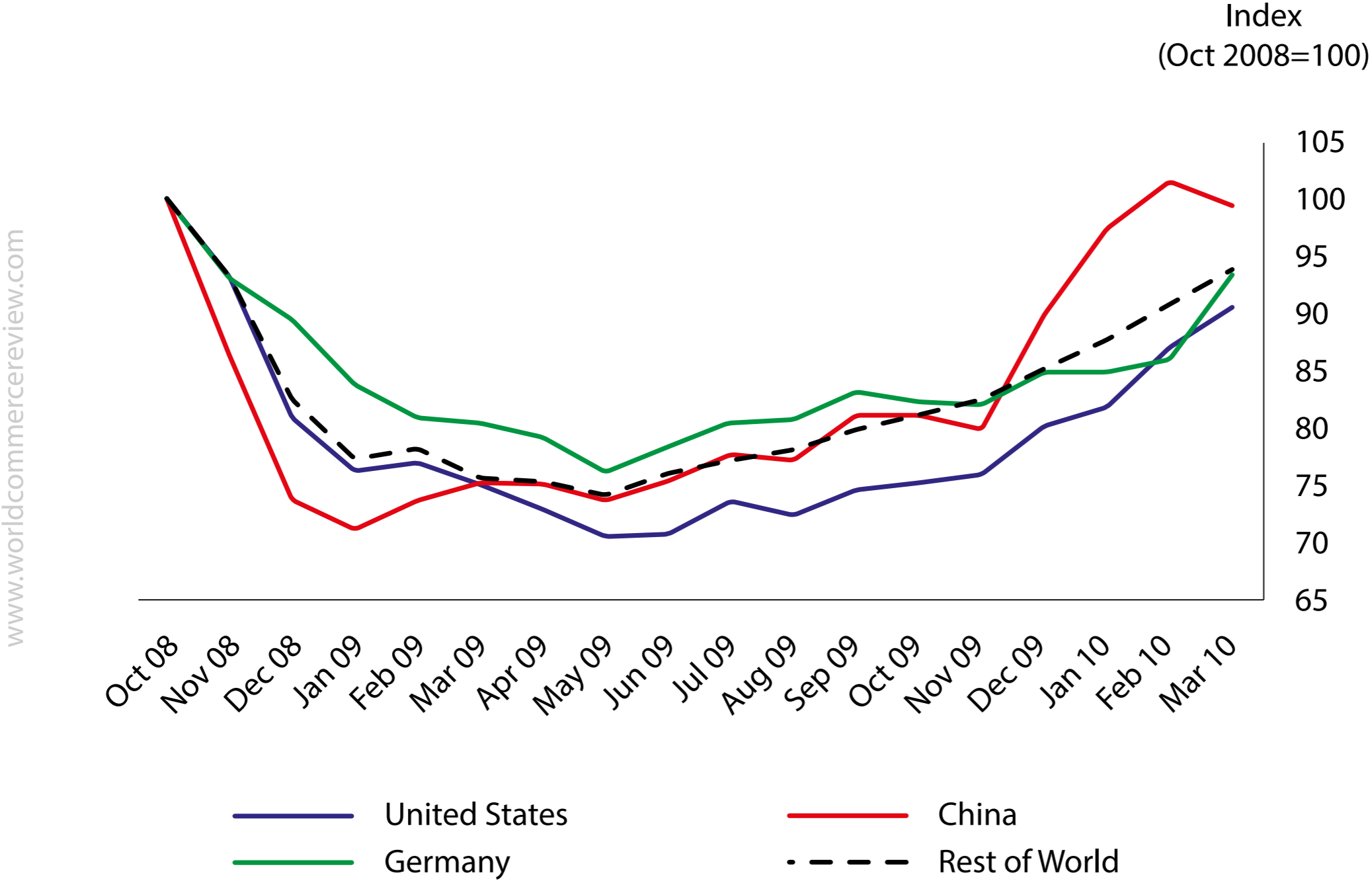
I will now turn to how supply chains have behaved during previous crises. Doing so suggests that supply chain trade can be resilient in the face of large, synchronised shocks. It can also help mitigate crises emanating from large supply disruptions in one region. However, there are no perfect parallels to the effects of COVID on the global economy, so there are limits to how far we can read across from previous examples.

The world experienced a similar global trade disruption following the 2007-08 global financial crisis. This has been termed the Great Trade Collapse, and as with the financial crisis itself, it simultaneously affected countries worldwide.

Chart 2 shows that the size of the collapse was on a massive scale – comparable to that seen over the past 18 months – and that it affected large GSC hubs (US, China, and Germany) similarly to the rest of the world. It was driven in large part by the fall in global demand following the financial crisis, which impaired demand for tradeable goods. In turn, this led to a reduction in supply chain volumes as intermediates demand also collapsed¹³.

Perhaps encouragingly for the current situation, trade rebounded to its pre-crisis level quickly after the financial crisis (Chart 2). To the extent that there are similarities, this swift recovery might give us comfort that even when there is a global shock affecting supply chains, it can reverse relatively quickly.

Chart 2. World goods trade, sum of exports and imports



Source: CBP World Trade Monitor.

At a macroeconomic level, large-scale policy stimulus after the financial crisis helped reverse the fall in demand for tradeable goods, with a consequent increase in supply chain trade.

Many studies even suggest that supply chains helped mitigate the scale and persistence of the overall trade collapse, as supply chain relationships tend to be highly resilient due to the fact that buyer-seller networks are hard to break. During the financial crisis, firms tended to maintain trading relationships (albeit at a much lower scale), allowing them to quickly rebuild volumes as demand recovered^{14, 15}.

Looking to other, more geographically-concentrated disruptions, such as the 2011 Tōhoku earthquake, reveals similar responses. Recent work by Freund *et al* (2021) zooms in on automotive and electronics sector trade after the earthquake, and provides evidence that intermediate imports were significantly less affected compared to final goods imports. As such, their analysis provides further evidence that global supply chain links are more difficult to untangle after a crisis than the import of final goods.

These past examples suggest there are some grounds for optimism about the resilience of supply chain relationships in the wake of the COVID pandemic, and about how quickly large global shocks can be reversed¹⁶. But although also global, the COVID shock has differed from the global financial crisis a decade ago.

The main difference is that although it had some supply elements, the financial crisis was primarily a large fall in demand below supply, including a reduction in the demand for tradeable goods.

In contrast, a connecting theme of recent supply disruption has been demand running ahead of supply for some products or sectors. This has had some demand-side causes: COVID has caused a material rotation of demand

towards goods, and away from services where health risks are higher, which has increased demand for tradeable goods above their pre-COVID levels, as illustrated by trends in global shipping volumes (Chart 3).

Goods demand has been further boosted by large fiscal policy stimuli in advanced economies, particularly in the US. It has also had some supply-side causes: lockdowns and other health restrictions have impeded production or transportation in some regions, while the spread of COVID has led to isolation or health-related reductions in labour supply in others.

And adding to these factors, a number of idiosyncratic and unrelated shocks to goods supply (eg. multiple extreme weather events occurring during the pandemic, or the grounding of the Ever Given) have contributed further to global imbalances in the goods sector.

A second difference is that the effects of the financial crisis were felt simultaneously around the world, while the COVID shock has been less synchronous. The spread of the virus has waxed and waned at different rates in different regions (Chart 4).

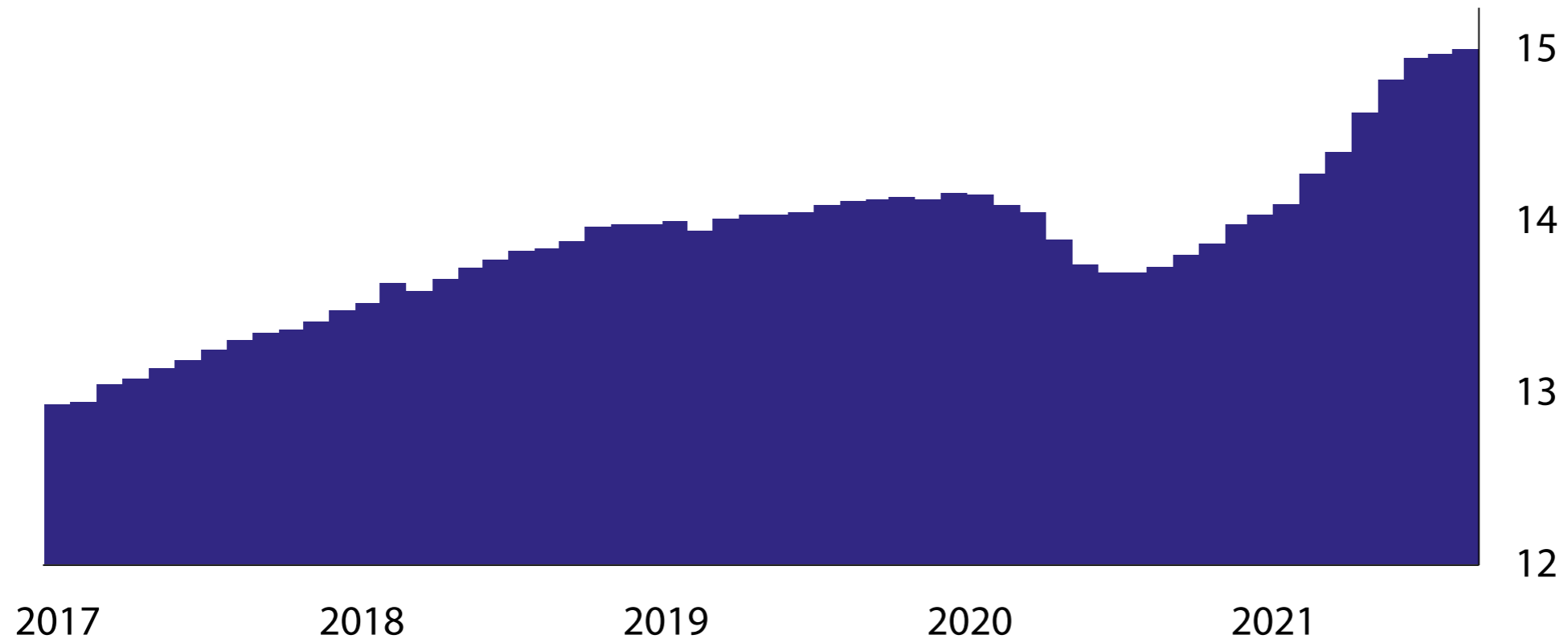
Partly as a result, lockdowns and other public health interventions have also differed across locations across time. The relatively lower synchronicity during the pandemic has in all likelihood helped cushioning the impact of the COVID shock, as some countries were able to resort to imports from less affected regions abroad, and thus mitigate the impact of some products' shortages in their domestic economies.

However, the nature of the shock and the disparities in timing may have posed challenges to some supply chains. It is typically easier to recover demand than it is to increase capacity, as has been required for some goods and

Chart 3. Global shipping container volumes

Million TEUs shipped per month
(12-month rolling average)

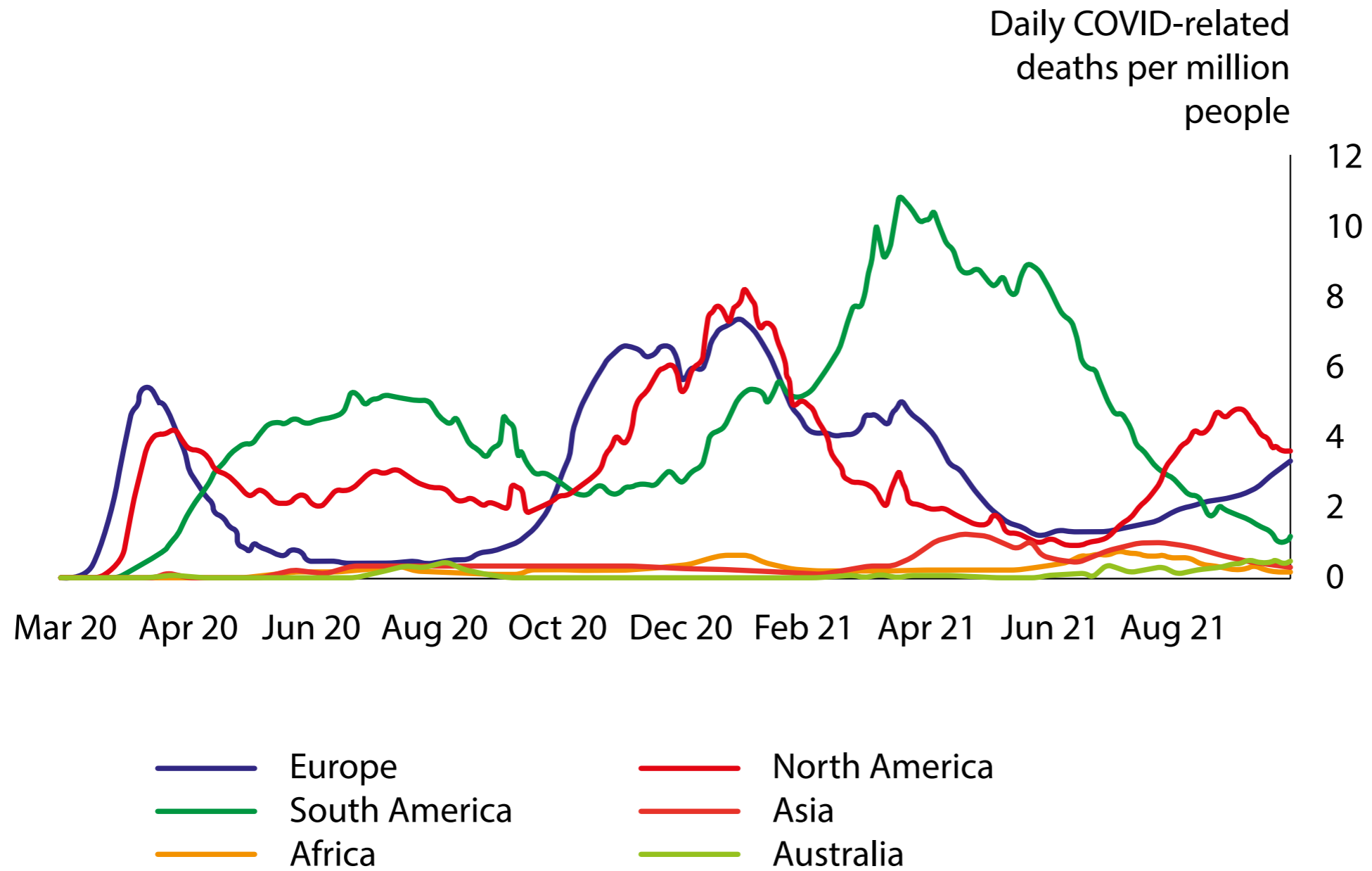
www.worldcommercereview.com



Source: Container Trades Statistics.

Chart 4. COVID deaths per million people

www.worldcommercereview.com



Source: Our World in Data.

inputs; furthermore, in long multinational supply chains, the way COVID has led to a series of regional supply and transportation disruptions may have had a somewhat more persistent impact than a single, large shock.

Supply chains during the pandemic

In light of the unique nature of the challenges during COVID and the recovery, with a battery of different shocks affecting supply chains at different times, it is tempting to ask whether it has been an exception to the usual benefits of trade.

The disruption has intensified calls for 'reshoring' production networks – aiming to reverse some of the supply chain integration we have seen in recent decades by increasing firms' reliance on domestic suppliers. The question these calls raise is whether countries would have been able to tackle the COVID shock better without trade and global supply chains.

If we were to imagine such a scenario, it seems unlikely that the absence of global supply chains would have been beneficial. Given the link between trade and the level of income, a more closed economy would have initially faced a far more difficult task, with fewer resources available to help maintain incomes of workers and businesses most affected.

Lockdowns abroad would not have affected production or supply chains domestically, but domestic lockdowns would have had a far larger effect¹⁷. So although the timing would have been different, it is not obvious that the overall shock would have been smaller. In fact, the volatility induced would likely have been larger, since the smaller scale of domestic production in a closed economy would have made it impossible to shift to substitute suppliers. Losing just a few workers due to an event like an outbreak in a given plant could mean losing the entire production line of certain inputs or foods.

Indeed, a number of the specific shocks and bottlenecks that are currently impacting output in the UK are at least partly domestic in nature, albeit we are seeing similar effects in many other economies. Shortages of truck drivers, for example, have been impacting logistics in the UK, most notably the supply of petrol. While this shortage has several discrete causes, it is difficult to see how any of them would be addressed with less international trade¹⁸.

If anything, it seems plausible that by enabling more diversification, supply chain trade could have mitigated the overall impact of the shock. Where producers had substitute suppliers in different regions, the asynchronous nature of lockdowns and other impacts of the pandemic may have enabled them to continue production when a supplier in one region was unable to satisfy demand.

Clearly there are areas where diversification has been more difficult: we have seen a range of transport bottlenecks, reflected, for example, in increases in shipping costs. And, echoing the financial crisis, the opacity of many production networks means that beyond their direct suppliers, it is not always clear to firms how diversified supply chains for different products are.

Fundamentally, many of the current disruptions seem to simply reflect unusually large imbalances between supply and demand for some products and from some locations. COVID and its spread are the proximate cause of most of these imbalances.

While there may be limits to the benefits of supply chain-driven trade in the face of such shocks, reshoring production in response would be a risky strategy, which would almost certainly lower incomes on average, without necessarily providing any benefits in terms of lower volatility, or more resilience in response to supply shocks.

The debate is an important one to continue, however, and is linked to that on how policy can enhance the resilience of supply chains, for example by better understanding their associated risks¹⁹. With a higher risk of climate-related extreme weather events in future, it may be that shocks to supply chains become more frequent in the coming years²⁰.

Supply chains and monetary policy

So far I have described what global supply chains are and why they have come to be so important to international trade, as well as some of their benefits and potential costs. But in the capacity in which I am speaking today as an MPC member, the most pressing concern is the implications of global supply chains for monetary policy.

There are two different categories of effects. The first consists of the various long-run impacts supply chain integration may have had on the structure of the UK economy and the consequences for monetary policy.

These impacts, including on the slope of the Phillips curve, and the degree of output volatility, have been covered extensively by former Bank of England colleagues, so I will not focus on them today²¹. Instead, I would like to discuss the implications of global supply chain impacts on the near-term UK and global inflation outlooks.

In the near term, the persistence of current supply-chain disruptions is a key source of uncertainty for the inflation outlook. If the effects of supply-chain disruption on CPI inflation are short-lived, then attempting to use monetary policy to offset them would only serve to add additional volatility, since the effects would be fading by the time policy was having a major impact on inflation²².

Where the temporary effect is on the level of prices, rather than its rate of change, inflation, then the disruption we are currently seeing would have a disinflationary impact as we progress later into our three-year forecast.

If, in contrast, supply-chain disruption were to have a more persistent impact, it would play a larger role in my assessment of appropriate monetary policy. By simultaneously pushing down on output while persistently increasing inflation, it would create a trade-off between the MPC's objectives, which policy would have to manage.

The MPC will be giving its collective assessment of the effects of supply chain disruption, alongside the other factors influencing its inflation forecast, in the November Monetary Policy Report. But for my own part, I would like to explore some of the factors that may determine how quickly disruptions will unwind for specific products.

I will do so by using, as case studies, two of the most prominent examples of goods subject to disruption over the past 18 months: semiconductors and personal protective equipment (PPE)²³.

Case-study A: semiconductors

Semiconductors are a crucial input to a large number of industries, including cars and consumer electronics²⁴. Although the semiconductor industry accounts for a small share of GDP, many upstream buyers rely on semiconductors with no substitutable alternatives. As a result, a global shortage of semiconductors during the pandemic has had disproportionately large economy-wide effects²⁵.

The shortage has been due to both demand and supply factors. On the demand side, a range of goods have benefitted from a rotation away from some services, owing to higher COVID risks in the latter. But within that, demand for electronic devices has been particularly strong among individuals working or learning remotely.

When lockdowns ended, there was also a sharp recovery in the demand for motor vehicles, given both pent-up demand and a COVID-induced preference shift from public towards private transport, as well as a secular shift

towards electric vehicles, which use more chips. Both factors have boosted demand for semiconductor inputs, leading to sharp rises in sales (Chart 5).

On the supply side, global semiconductor production was hit by a number of idiosyncratic shocks. These included winter storms and power outages in manufacturing plants in Texas, a fire at one of the largest semiconductor factories in Japan and a drought in Taiwan²⁶. Although semiconductors production increased over 2020, delivery times are higher than pre-COVID, while import prices have picked up (Chart 6).

The supply of semiconductors is typically slow to adjust to large shifts in demand. The manufacturing process is complex²⁷, and lead times – the wait between order and delivery – are long²⁸. The industry operates at large scale, is capital intensive, and requires significant R&D expenditure.

As a result, significant investment is required to increase capacity. Given the increase in demand, new manufacturing facilities are under construction, but will take some time to come online and to be scalable. Moreover, even with increased production capacity, it will likely take time to fulfil current backlogs which have accumulated during the shortages.

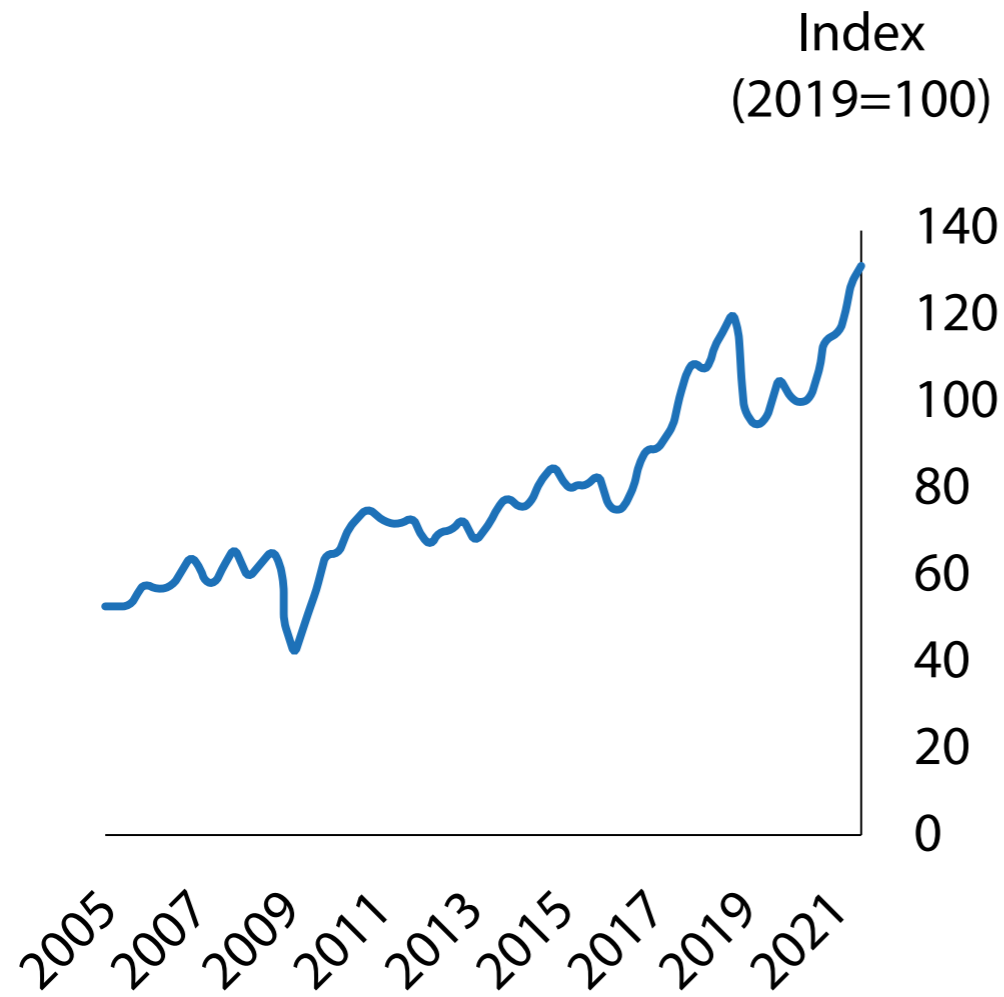
Case-study B: personal protective equipment (PPE)

PPE is a collective term used for wearable equipment and gear that protects users from hazards. As a key form of protection from COVID, the pandemic has led to an extraordinary increase in global demand for PPE, of which face masks have of course been the most visible type²⁹.

This steep increase is clear in Charts 7 and 8, which show the example of US imports of masks, respirators and medical gowns. This spike in demand was also present in the key supplier of PPE – China, reducing net exports to

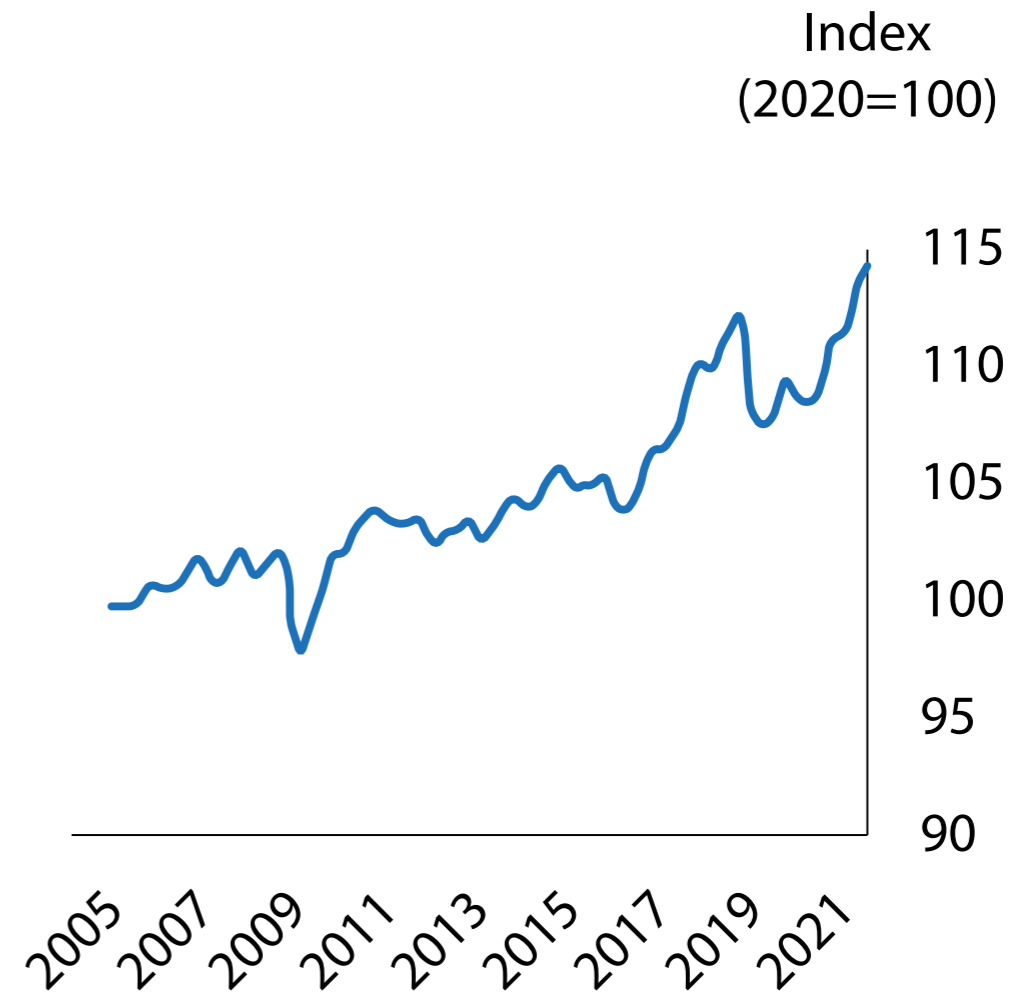
Chart 5. World semiconductor manufacturers' sales, 3 month rolling average

www.worldcommercereview.com



Source: Semiconductor Industry Association via Refinitiv Eikon.

Chart 6. US semiconductor import prices



Source: Refinitiv Eikon.

Chart 7. US imports of medical gowns

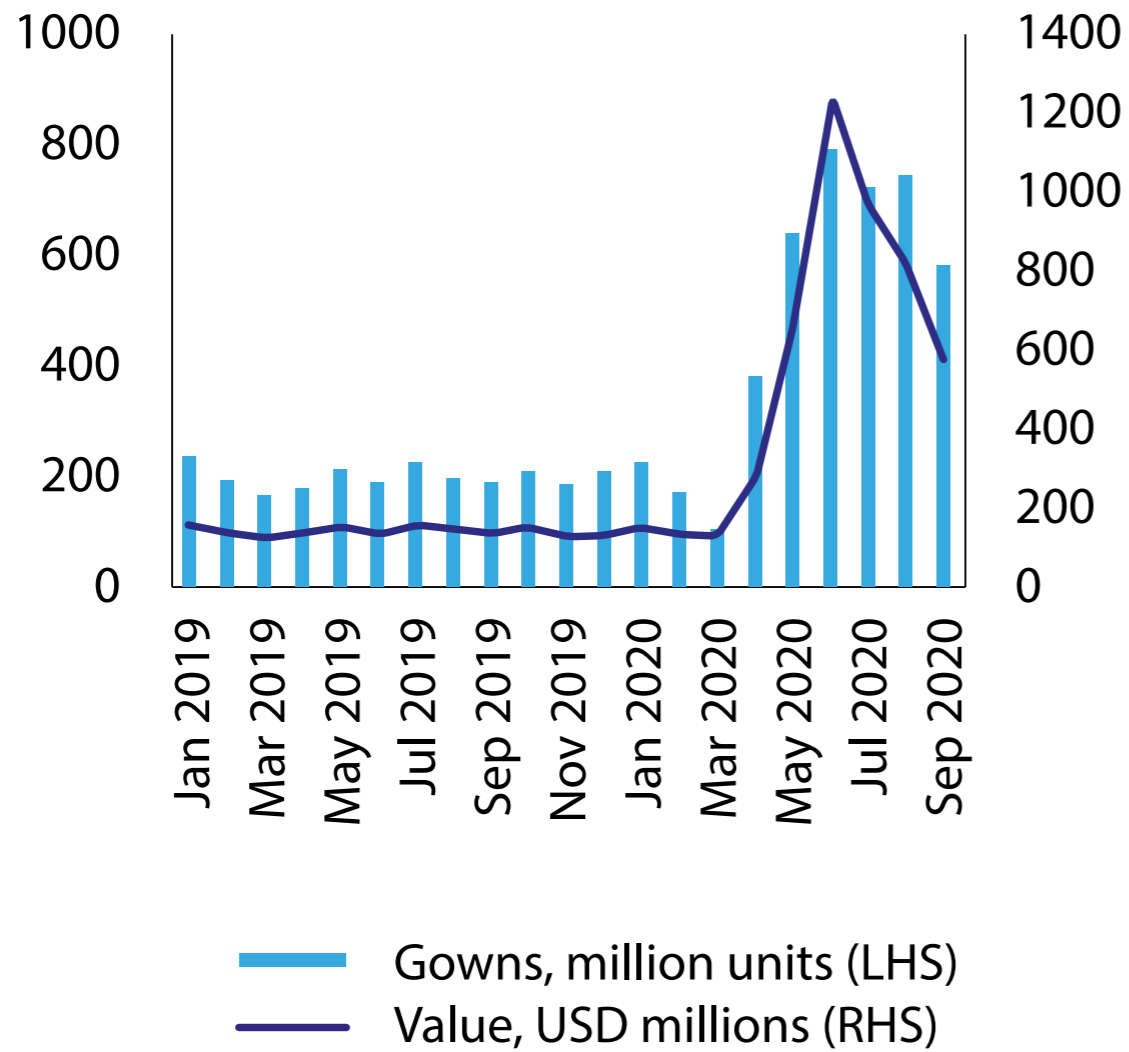
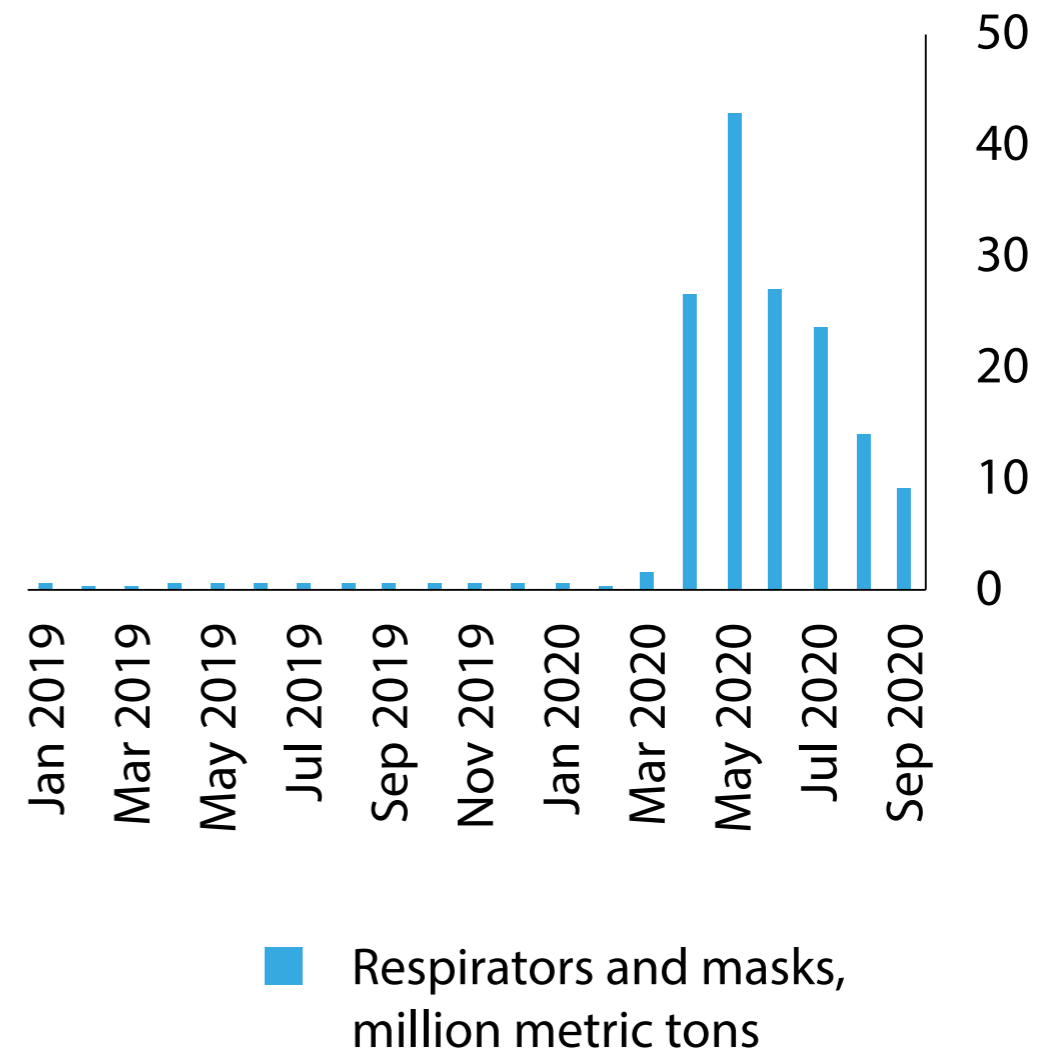


Chart 8. US imports of respirators and masks



Source: US International Trade Commission.

Source: US International Trade Commission.

the rest of the world, while some countries also applied restrictions on PPE exports. At the same time, supply was disrupted by lockdowns and factory closures worldwide.

The combined effects of a rapid increase in demand alongside supply restrictions were amplified by the fact that the industry holds low inventories. So available stocks were drawn down quickly when demand outstripped supply.

Production of PPE is typically high volume, low value and low profit margin, in part because the main buyers are cost-sensitive healthcare facilities. To keep costs low, PPE suppliers tend to use 'just-in-time' inventory management, leaving supply vulnerable to shocks.

Although the acute phase of the pandemic saw shortages for many types of PPE, some of these supply-chain issues were solved fairly quickly as firms were able to increase production. As products with a relatively simple production process, it was also easier for firms to convert production or switch to substitute suppliers of some types of PPE than would be the case for semiconductors.

Nonetheless, issues with some types of PPE persisted longer due to difficulties in sourcing inputs and the time and cost of bringing new capacity to market³⁰. An important consideration was that with much of the increase in PPE demand expected to be temporary, the return on any investment in capacity is uncertain.

Lessons

Extrapolating from the case studies back to the macroeconomy, one can infer that as supply disruptions feed through into price increases, supply can and will adjust in response. But the speed of that adjustment, and so the persistence of the price increases, is likely to vary across products.

For simpler, more homogenous goods such as PPE, where there are many suppliers and limited market power, supply may be able to adjust relatively quickly. For more complex goods such as semiconductors, some disruption may persist into 2022.

In determining the macroeconomic effect, the adjustment of relative demand for different products seems likely to be more crucial still. Even for goods such as PPE where supply can adjust more quickly, firms will be less inclined to do so if the increase in demand is expected to be temporary.

For items such as semiconductors, a fast rotation in demand back towards pre-COVID patterns has the potential to ease disruption more quickly than an expansion in supply. If so, there may even be the possibility of the price of semiconductors falling back, if a reduction in demand meets greater supply.

One source of the rotation will be as a response to price changes – as the global prices of goods subject to disruption rise relative to other goods and services, relative demand is likely to respond.

These demand patterns have also been closely tied to the evolution of COVID, both in the UK and around the world. When virus spread has increased, mandated or voluntary social distancing has led consumers to substitute away from riskier, high-contact services towards goods.

As a result, the prospects for a rapid rotation back towards services, and so the persistence of supply chain disruption, will also greatly depend on how the pandemic evolves over winter and beyond.

Current outlook

COVID initially had a disinflationary impact on the UK and the global economy, as weaker domestic and global

demand led to declines in wage and price pressures³¹. In contrast to the initial year of the pandemic, the uneven recovery is likely to create a temporary trade-off, which monetary policy will need to navigate.

Disinflationary pressures have given way to inflationary ones, while output remains a normal-sized recession below its pre-COVID level, and further still below its medium-run trend. As I have discussed, this tension stems partly from the various disruptions and bottlenecks currently affecting global supply chains, which are leading to temporary negative supply shocks in the UK.

These disruptions have been driven in large part by the effects of COVID and the subsequent recovery on both supply, and on the balance of demand between goods and services.

In the near-term, the inflation side of the trade-off will also be exaggerated by a number of temporary factors, which may not be informative about how prices are likely to change in future. In particular, base effects from weak prices a year ago have been pushing up on recent inflation outturns³².

And while inflation is likely to increase further over the next few months, a large part of this increase will come from the direct impact of higher energy prices. Increases in the level of energy prices are not typically a sign of future energy price inflation, so these tend to only have one-off impacts on the level of CPI.

Monetary policy cannot offset these effects on inflation, which are driven mostly by global factors, because the level effects tend to drop out of the inflation calculation before policy can have much impact.

It will of course be important to remain vigilant in case of any second-round impacts of higher energy prices: these include the reduction in households' real income, which could weigh on demand and future inflation; and any

impact of higher energy prices on firms' production costs, which they may ultimately pass through to consumer prices.

The current supply chain disruption will also ultimately be temporary. For some products, disruption and its effect on inflation are likely to dissipate quickly as firms find new suppliers or current ones are able to expand.

For others, where supply is slower to adjust, the rotation of demand from goods back towards services should help ease pressure on supply chains. In either case, responding to short-lived effects on inflation would only be likely to impart additional volatility.

While my expectation is that the effects of supply chain disruption will be short-lived, a non-negligible risk is that the switch from goods back towards services is more protracted, leading to a longer period of supply disruption and inflationary pressure.

Given the close relationship between the composition of output and COVID risks and restrictions, it is likely that the epidemiology of the pandemic across the globe will be crucial in determining whether this risk crystallises.

The other major uncertainty for the UK inflation outlook at present is the evolution of the labour market, where there are two-sided risks. Given the near-term outlook for headline inflation, there is a possibility that higher inflation or higher inflation expectations begin to feed through into higher wage demands.

The effects of inflation expectations on wage bargaining can be difficult to gauge, so I will be paying particular attention to direct indicators of wage pressures, including our best assessment of underlying wage growth, settlements data, and information from the Bank's Agency network.

The opposing risk is that the end of the furlough scheme in September leads to a loosening in the labour market and a moderation in wage pressures. A large number of workers need to be reabsorbed into the labour market over the coming months, some of whom will flow into unemployment.

The literature on unemployment benefits, which are comparable in effect to the furlough scheme, would suggest that furlough has been boosting underlying wage growth. Its withdrawal could put this process into reverse.

Along with my colleagues on the MPC, I will be weighing up these different risks ahead of our November *Monetary Policy Report*. At the time of our August forecast, I expected that if the economy were to evolve as in our forecast, some modest tightening, broadly in line with our conditioning path, would be required to achieve the inflation target sustainably.

Since then, we have had large upside news for near-term inflation from energy prices, an effect which should fade quickly. We have also seen a moderation in recent GDP growth, which looks set to continue as we enter the winter months, affecting supply as well as demand.

Higher energy prices may reduce households' real incomes and depress spending, with additional risks stemming from the prevalence of COVID in the UK, and falls in income for any furloughed workers who move out of employment.

Overall, I judge that the balance of this set of news is unlikely to have a large effect on the amount of tightening required over the next few years. The August forecast was conditioned on market expectations of a gently rising path for Bank Rate, gradually unwinding the relatively small amount of monetary policy stimulus added since the onset of COVID³³.

They were also consistent with evidence that the medium-run equilibrium interest rate remains low, and is likely to be so for some time. The precise path policy takes towards that equilibrium rate will partly depend on how the risks I have highlighted evolve.

As always, my votes on any future policy changes will depend on incoming data and my assessment of the economy at the relevant MPC meetings. Uncertainty over the effects of the furlough scheme should be resolved over the coming months, which should help paint a clearer picture of the position of the labour market.

We will also continue to learn more about the persistence of disruptions to global and domestic supply chains and their impact on the UK inflation outlook. ■

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Endnotes

- 1. Specifically, firms which source from upstream industries that export, as well as supply to downstream industries that import, boosts the productivity of purely domestic firms through learning channels (Merlevede and Theodorakopoulos, 2021; Blalok and Veloso, 2007).*
- 2. Caselli and Wilson (2004) show that imports of high-tech capital are a main source of TFP growth and technological development across countries.*
- 3. Baldwin (2016).*
- 4. SMMT (2016), quoted in Bailey, D and De Propris, L (2017).*

5. *The quantitative model can be used to carry out different scenario analyses, shocking different parts of the system; it is available on request from the authors.*
6. *This measure differs from more standard GVC measures, which focus on value added trade, and hence where work is carried out.*
7. *One finding from this metric is that all major manufacturing producers are highly dependent on China, with between 6% and 23% of their manufacturing output relying on Chinese inputs. See also Caselli et al (2020), which explores how much of the rise of China in the international trade scene has affected patterns of transmission and volatility across countries. While the Baldwin and Freeman (2021) metric is particularly relevant when thinking about shocks from the COVID pandemic, the authors also stress that the specific metric used to assess vulnerabilities should depend on the risk being evaluated.*
8. *See Halpern et al (2015), Topalova and Khandelwal (2011) and Taglioni and Winkler (2016) for more discussion of these channels.*
9. *See Newberry and Stiglitz (1989).*
10. *D'Aguanno et al (2021).*
11. *Similarly, academic work, which gained traction at the onset of the pandemic, examines the international transmission of supply chain shocks due to COVID-19. Using a large-scale general equilibrium model with many countries and sectors, the paper's authors ultimately conclude that reshoring production will not make countries more resilient to shocks – it would simply concentrate risk to the domestic economy. In addition, similar points are made by Koren and Tenreyro (2013) who examine diverse sources of energy as a volatility dampener, as well as Javorcik (2021) who underscores that the recent pandemic has highlighted firms' need to diversify their supplier base to protect against disruptions which may be concentrated to one supplier/geographic location.*
12. *For governments, there are a separate set of considerations about reshoring production on national security or critical infrastructure grounds, which I do not discuss here*
13. *See Baldwin (2009) or Domit and Shakir (2010) for detailed analyses.*

14. See Antras (2020).

15. This is true in aggregate, but also at the firm level. For example, various academic studies that use detailed firm-level data on European customs transactions show that GSCs and production network structures indeed played a minor role in the collapse; rather it was trade volumes – rather than trade relationships surrounding individual product lines – which mostly adjusted (Bricogne et al 2012; Behrens et al 2013).

16. Indeed, while it is still too early to see these effects in disaggregated data, world goods trade mostly rebounded to pre-crisis levels in the 11 months following the lowest troughs in April 2020. This suggests that, by and large, global supply chains were agile and adaptable. However, there remain some specific bottlenecks in the more recent part of the pandemic.

17. This sentiment has been echoed in various academic studies, for example Bondio et al (2020) and Eppinger et al (2021).

18. See Bailey (2021) for a summary of these causes.

19. For further discussion, see D'Aguanno et al 2021.

20. A point made recently by Javorcik (2021).

21. See Carney (2017). Aquilante et al (forthcoming) looks at the impact of global supply chain integration on the UK Phillips Curve and finds that a higher imported-intermediate goods share from emerging market economies results in a flatter Phillips Curve for the period of 2000 to 2014.

22. Given empirical evidence that policy lags to inflation are faster than they were in the past, discussed in Tenreyro (2019), this may not be the case for slightly more persistent shocks.

23. See Bown (2021) for a discussion of the PPE supply chain during the pandemic.

24. Semiconductor-based components are used intensively in communications, computing, healthcare, military systems, transportation, clean energy, and countless other applications.

25. Semiconductors are materials that find widespread use in the electronics industry thanks to their useful electrical properties – such as showing variable resistance, passing current more easily in one direction than the other, and

reacting to light and heat. They could be described as critical inputs, as in the O-ring theory of Kremer (1993): they are key components in memory chips, microprocessors and integrated circuits.

26. Semiconductor producers use large volumes of ultra-pure water to remove impurities.

27. Manufacturing takes place in highly specialised fabrication plants called foundries. The process is highly automated, very energy-intensive and involves many steps.

28. Fabrication takes on average 11-13 weeks to complete.

29. Outside of the pandemic context, PPE includes a broad set of garments intended for industrial as well as healthcare applications. These range from head, eye and face protection to protective clothing and footwear, hand and arm protection, respiratory protection, hearing protection, fall protection, and others. PPE finds extensive application in industries where injuries can result from contact with physical, chemical, biological, mechanical and radioactive substances, such as the chemical industry, oil and gas, construction, pharmaceutical, healthcare and manufacturing.

30. Based on data from the Get US PPE initiative, N95 respirators, disinfecting wipes, surgical masks and face shields were the most requested types of PPE in the US between March 2020 and June 2021.

31. This was also in line with historical experience from past pandemics, as discussed in Tenreyro (2020).

32. Although the 12-month CPI inflation rate was 3.1% in September, part of this increase has reflected a recovery from low levels of prices a year ago. As a rough metric of the size of these effects, over a longer period, the 24-month CPI inflation rate is only 1.8% at an annualised rate, although this figure is likely to increase further over the next few months.

33. Fiscal policy played the major role in offsetting the economic effects of the pandemic, while monetary policy played a relatively smaller part. Bank Rate was cut by 65 basis points, which was smaller than the typical cut in past (smaller) recessions. The MPC also increased the stock of QE, but in my view, its primary effect was to prevent yields from rising in the face of market DYSFUNCTION, rather than providing additional net stimulus relative to pre-COVID. (The additional net stimulus vis-a-vis January 2020 imparted by QE, measured as the change in long yields relative to January 2020, was more limited and hence so was the net boost to activity or inflation relative to January 2020.) Despite the much larger size

of the fall in activity, the overall monetary stimulus was therefore relatively small when compared to shallower recessions in the past.

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A liberal perspective on trade and development

Inequality and poverty remain a global reality. Edwin van de Haar considers the benefits of free trade to Sub-Saharan African development

The liberal tradition in political thought is by no means unified. The original ideas developed in the (Scottish) Enlightenment, most importantly by David Hume and Adam Smith, have been modified extensively. This has led to different definitions and practical applications of individual freedom, the core idea of liberalism, but also of most other ideas associated with the liberal tradition¹.

Regardless of this proliferation, the wide liberal support for free trade and globalization as a means to alleviate poverty and foster human development more broadly has been rather constant, although the ideal of trade free from all government interference has never been within reach.

With the World Trade Organization in a shambles, the increase of bilateral and regional trade treaties which often hamper free trade more than fostering it, and a general anti-liberal sentiment across the globe, the liberal ideals may not be a very popular at present.

However, this does not say anything about their empirical or moral validity. Liberal recipes to fight poverty and to foster development still work and need support, both through domestic and international policies.

Global inequality

In international relations inequality is the norm, in many different fields. Often this is not problematic in liberal eyes, as long as individuals get the chance to use their talents in the way they see fit. Grave hindrances, for example caused by a lack of basic needs and insufficient protection of classical human rights should be removed, as they often make individual flourishing impossible.

In contrast to what is often thought, liberals are convinced it is possible for all countries to implement policies that foresee in these basic liberal preconditions. Most often, bad circumstances don't just happen to countries, nor

should they be seen as the inevitable result of regrettable historical events such as slavery, imperialism, let alone the alleged detrimental effects of capitalism.

As Lomasky and Téson show, the fate of the inhabitants of developing countries lies not in the hand of failing rich countries, but are mainly due to poor domestic policies, lack of, or failing, domestic institutions and a no respect for classical human rights, such as freedom of opinion, right to property, or a free press².

Liberal recipes to fight poverty and to foster development still work and need support, both through domestic and international policies

Evidence

Of course, this is a broad topic, which can be approached from many angles. In this short piece, the focus is on the above-mentioned classical liberal rights and measures, but also includes broader topics such as governance and the development of human capital, in Sub-Saharan Africa.

This is made visible through an – admittedly - rough measure: the outcomes and ranking of countries in a number of well-known and internationally respected indexes. These indexes compare countries on domestic policies.

A presentation of this kind has to be treated with caution. Methodologically, the indexes are different and a comparison is not always easy or fully warranted. Definitions and operationalizations differ, just like the way results are aggregated into (final) scores.

Nevertheless, these indexes provide a useful indication of good policies from a liberal view. Especially for the countries of Sub-Saharan Africa, which mostly contain low-income countries. Contrary to some assumptions that is no barrier for some governments to implement different policies. Being a low-income country does not automatically lead to bad policies!

Indexes

Given space limitations, the five indexes are introduced by a broad outline. Please use the references for further information. For practical purposes 5 indexes are used, published in 2018 and 2019.

- Since the 1970s, Freedom House has published the *Freedom in the World Index*, which determines how individual rights and liberties are applied and protected, on the basis of 25 indicators. It groups countries in

'free', 'partly free' and 'not free'. The top 5 free countries in Sub-Saharan Africa are Ghana, Botswana, Namibia, Benin and Senegal³.

- The *International Property Rights Index* is published by the American Property Rights Alliance (PRI), expressing the degree of protection of property rights, both material and intellectual, per country.

The PRI emphasizes that property rights are also human rights, and that they are essential for economic and social development. In 2019 Rwanda (42nd), South-Africa, Botswana, Ghana, Burkina Faso and Tanzania (73rd) were the highest ranking Sub-Saharan countries⁴.

- Transparency International publishes *The Corruption Perception Index*, ranking countries to the degree there is corruption and fight corruption, surveyed among businesspeople and experts. Corruption undermines the trust people have in the political and social-economic systems within societies.

In the ranking, Sub-Saharan Africa is perceived as the region with the most corruption, still the countries that score best are Seychelles, Botswana, Cape Verde, Rwanda and Namibia⁵.

- The *Ibrahim Index* measures the governance of African countries, defined as 'the provision of political, social and economic public goods and services that every citizen has the right to expect from their government, and that a government has the responsibility to deliver to its citizens'. In the overall governance category, we find Namibia, Botswana, Ghana, South Africa and Rwanda⁶.
- The World Bank publishes the *Human Capital Index*, which focuses on different indicators, such as infant

mortality, life expectancy, and the chances on education for girls and boys. Countries that score best are Zimbabwe, Gambia, Ghana, Namibia, Botswana and Senegal⁷.

This leads to the following summary:

Index	Top
Freedom in the World	Ghana, Botswana, Namibia, Benin, Senegal
International Property Rights	Rwanda, South Africa, Botswana, Ghana, Burkina Faso, Tanzania
Transparency International	Seychelles, Botswana, Cape Verde, Rwanda, Namibia
Ibrahim	Namibia, Botswana, Ghana, South Africa, Rwanda
Human Capital	Zimbabwe, Gambia, Ghana, Namibia, Botswana and Senegal

Botswana, Namibia and Ghana, especially, succeed in implementing relative liberal policies, with South Africa, Senegal and Rwanda following their lead. It must be noted that a position on an index is always relative. None of the Sub-Saharan countries are in the absolute top, although some score surprisingly high.

Also, this is not to claim these are countries without problems, or that they are liberal countries, let alone liberal-democratic ones. Their absolute rankings do not warrant such a suggestion. It does indicate that being a low-income country does not need to be a barrier to implement relatively liberal policies, which provide individual

citizens more (social-economic) opportunities than is the case in other Sub-Saharan countries. Hence, the liberal emphasis on domestic policies is fully warranted.

Liberal international policies

Liberals believe domestic policy is most important to promote development. Still, the perennial practice in international relations also is: what can other countries do in support of this?

The short liberal answer is one of restraint: stay clear, do not (militarily) interfere, be modest about the possible success of 'helping', while ensuring the best global economic conditions.

The latter is done through ensuring free trade, which is also the foreign economic policy liberals are most strongly associated with. The popularity of free trade has known its high and low tiding, ever since the Ancients⁸.

Therefore, the current low esteem of free trade is nothing new. There have always been people who distrust trade, for economic, political or moral reasons⁹. On the other hand, there are also too many liberals who have claimed way too much on behalf of free trade, especially its peace-enhancing effects, which are erroneous¹⁰.

The lack of support for trade still deserves to be fought. Friedrich Hayek and Milton Friedman, to name two great thinkers, have shown the importance of continuing to argue against the topical grain.

The evidence continually shows the superior results of even relatively free trade, which has real effects for the improvement of the life of (poor) people. Countries that are committed to free trade become richer and are able to create more possibilities for (economic and human) development.

Columbia University's Arvind Panagariya is just one of the many who found clear evidence for that. In his book *Free Trade and Prosperity* he shows that developing countries have enormously profited from the recent wave of increasingly free world trade¹¹. The World Bank is even clearer:

Trade is an engine of growth that creates better jobs, reduces poverty, and increases economic opportunity. Recent research shows that trade liberalization increases economic growth by an average by 1.0 to 1.5 percentage points, resulting in 10 to 20 percent higher income after a decade. Trade has increased incomes by 24 percent globally since 1990, and 50 percent for the poorest 40 percent of the population. As a result, since 1990, over one billion people have moved out of poverty because of economic growth underpinned by better trade practices¹².

Yet, in contrast to Richard Cobden's famous argument, it must be acknowledged free trade is no panacea. Domestic policies are needed to see that trade benefits find their way to the wider population. Also, when some groups are out-competed at the world market, they (temporarily) need domestic support. Still, the less than perfect trade arrangements of the last decades have had enormous positive effects on development.

Foreign aid

By way of a closing remark, in contrast to trade, governmental development aid is not supported by liberals. It still largely is, as Lord Peter Bauer had it, "*bringing money from the poor in the rich countries, to the rich in the poor countries.*"

The research of his modern day successors, most notably William Easterly and Dambisa Moyo, largely confirm this¹³. The structural effects of governmental foreign aid are minimal and often detrimental, resulting in 'aid addiction' in the receiving countries.

Liberals have the same doubts about the structural effects of aid by private donors such as NGO's (positive local effects are possible, for example in health care or education). Yet as long as these private donors do not use public money, this remains a case between donor and recipient. However, in liberal eyes it fails as an international policy to foster development.

Conclusion

Inequality and poverty remain a global reality, which can have detrimental effects to the development of individuals. Liberals think this should change, but emphasize this is mainly done through improved domestic policy in low-income countries based on proven liberal principles.

This is not just theory, it is a real possibility, as the some of the countries in Sub-Sahara Africa show. The best way the world can assist in this process is to provide truly free trade, while abandoning governmental foreign aid. Global development is too important to not make the effort. ■

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A photograph of a red combine harvester in a green field at dusk. The harvester is in the background, and the foreground is filled with green crops. The sky is dark with some clouds.

COVID-19 and food insecurity in Africa

The pandemic has derailed gains made to achieve food security. Conrad van Gass and Joseph Upile Matola look at the role of free trade in developing African agriculture and building resilience

How the COVID shock has impacted Africa's food security

The COVID-19 shock has derailed gains made towards achieving food security in Africa and around the world. An assessment by the World Food Programme (WFP) indicates that in 2020 COVID-19 may have added up to 132 million undernourished people in the world¹.

In Africa, where the number of undernourished people is growing faster than in any other region of the world, it was estimated to have reached more than 250 million undernourished people as the pandemic compounded the effects of climate shocks and conflicts which were already causing hunger in many parts of the region².

The further WFP reports that the proportion of Africa's population that is food stressed (ie. all income used in purchasing food) increased from 10.2% in 2019 to 13.3% in 2020 and only partially recovered to 12% in 2021 (Figure 1).

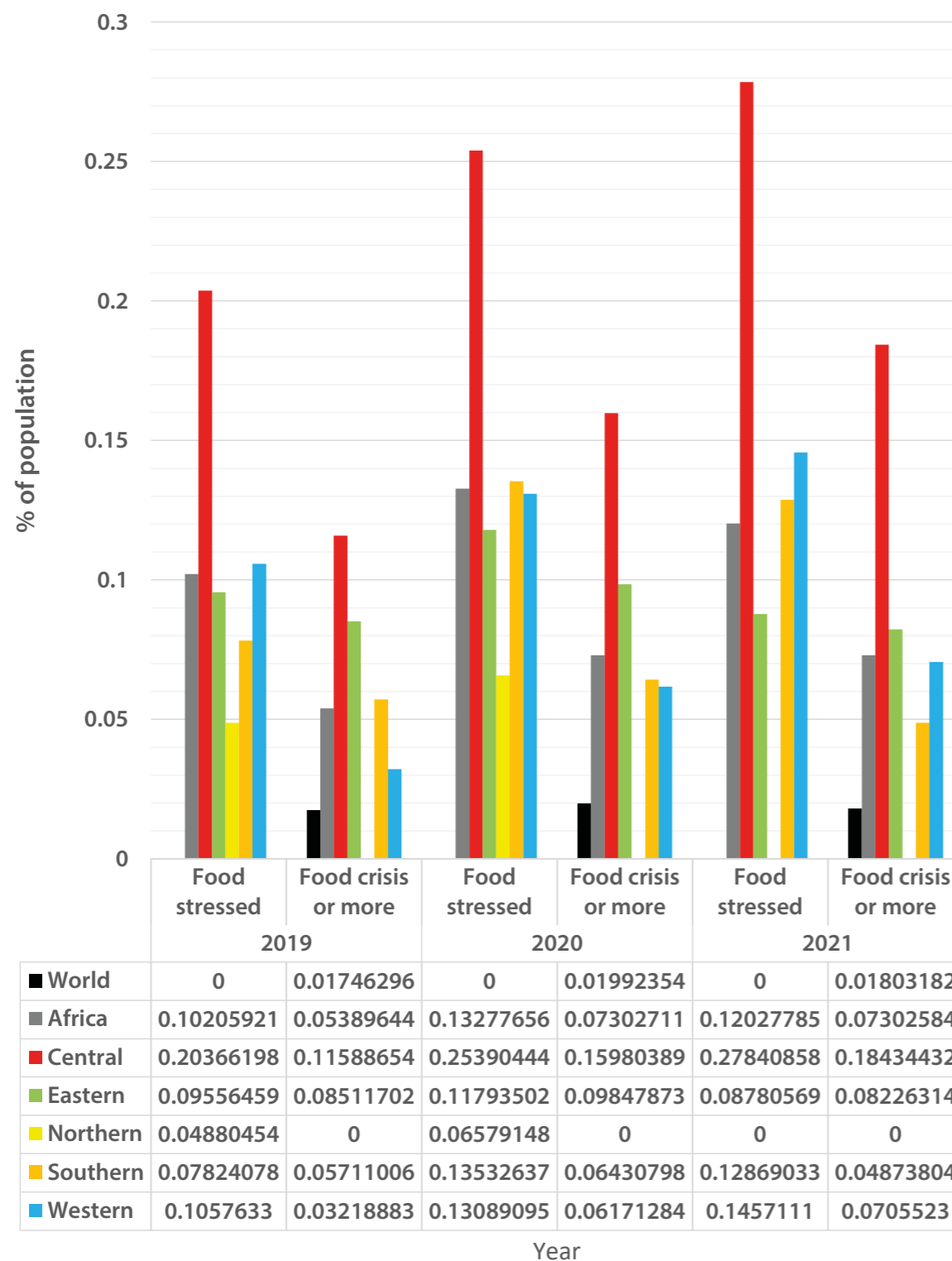
Additionally, the proportion that is in food crisis – those selling core assets for food – and in food emergency or catastrophe increased from 5.4% to 7.3% following the COVID shock³.

This threatens to push these households into long-term poverty and ongoing food insecurity.

Within Africa, upper-middle income countries including South Africa and the Maghreb nations proved most vulnerable to COVID-shock induced food insecurity, as their economies faced recessions of 6 to 9 percent in 2020.

These more diversified, industrialised economies are more tightly linked into global supply chains and hence more widely and deeply impacted by trade disruptions. South Africa faced 25% food stress and 16% food crisis, well above the African average.

Figure 1. Proportion of population by food security status in African regions, whole of Africa and the world



Source: Own calculations from World Food Programme, Global Report on Food Crises 2021

This can be attributed to the relatively greater vulnerability to loss of formal sector employment (85% of the labour force) and lack of access to productive agricultural land.

Lower-middle income economies such as those from the East African Community, Nigeria, Benin, and Senegal, were less severely impacted by the COVID shock. Most of these economies decelerated significantly in 2020, many recording low growth.

Removing the trade restrictions within the continent through well-functioning AfCFTA will [...] facilitate the development of the African agriculture sector and improve the continent's food resilience in the process

Since employment status in these countries is much more skewed towards informal and domestic employment which on average constitutes 85% of the labour force, the impact on poverty and food insecurity was less severe, albeit on a much broader base of structural income poverty, compensated though by a more widespread access to land use rights.

The level, rise and degree of food insecurity is most pronounced in Africa's poorest regions, notably Central Africa. Some of these areas are prone to extreme weather events particularly in the Sahel, others are caught in intermittent civil and border war eruptions (DRC, Horn of Africa, NE Nigeria) and all have been exacerbated by disruptions of regional supply chains from the core, middle-income agricultural and industrial economies.

The suppression of domestic protectionist impulses

Access to fertile, rural, agricultural land is an important factor in enabling resilience to the effects of economic disruptions on food security. Agricultural production (and trade) is one of the few sectors that grew during the COVID shock of 2020 in Africa.

Consumer demand for food is income inelastic and was therefore sustained, whilst some suppression of aggregate demand was redirected into agricultural commodities.

On the supply-side, extreme weather events are the main determinants of food output in the region and these have subsided since 2019.

However, with other regions within the continent facing COVID induced food insecurities, the role of intra-continental free trade becomes more prominent to facilitate reallocation of food from those that have it in abundance to those that need it.

Without free trade, consumer and producer choices are narrowed due to lack of diversification of sources and markets. In Malawi for instance, food production in 2020 registered a 5.1% increase yet the government maintained its maize export ban which had been in place since February 2018 to enhance its own food security.

This, coupled with low domestic prices offered to farmers, has introduced market inefficiencies that result in income losses for the farmers, and have contributed to food insecurities on a continental level as countries that needed Malawi's surplus maize could not access it.

Free trade also increases competition and suppresses monopolistic pricing behaviour which can run contrary to government impulses to streamline internal operations by limiting the number of public or private actors to whom it grants monopoly and monopsony rights.

The African Continental Free Trade Agreement (AfCFTA), which was launched in 2018 and became operational in 2021, is designed to promote intra-African trade and industrialisation on the continent, which will help address the continent's food security issues.

However, recessions are often used to justify protectionist impulses and the current crisis provides a test of commitment by parties to the agreement. Compared to the previous global food crisis of 2007-08, cereal export quotas by major food-exporting nations and additional sanitary and phyto-sanitary (SPS) standards, were few and limited in duration.

Several major nations including Nigeria, South Africa and Egypt released cereal reserves, but Algeria, Angola, Mali and Sudan imposed export restrictions to replenish their stocks, whilst Malawi retained its 2018 export ban. South

Africa exempted basic foodstuffs from both import duties and VAT, and duties were suspended by Morocco, Kenya, and Chad. In general, recognition of the pro-cyclical consequences of beggar-thy-neighbour policies prevailed⁴.

Building resilience through free trade negotiations

AfCFTA negotiations have made some progress which promises enhanced resilience to future food shocks that will affect the continent. As of October 2021, 38 of 55 member countries had deposited their ratifications, and 41 had submitted their tariff schedules.

Negotiations on rules of origin (RoO) and tariff reduction schedules for trade in goods are ongoing, albeit delayed due to COVID-19 disrupting negotiations.

Rules of origin for trade outside existing regional agreements are being negotiated sector by sector starting with agricultural products which has been completed, and subsequently moving to agro-processed goods which have more complex origination rules to determine the degree of local or African content eligible for preferential tariffs⁵.

The tariff offer received from the Southern African Customs Union (SACU) as Non-Least Developed Countries (NLDCs), abides to a 5-year phase out of tariffs on non-sensitive goods covering 80% of product lines. Offers from the East African Community (EAC), Central African Economic and Monetary Union (CEMAC), and Economic Community of West African States (ECOWAS) respectively cover 71%, 100% and 90% of product lines, with tariffs phased out over 10 years⁶.

Northern Africa and the remainders of Southern and Eastern Africa have still to determine their tariff offers. This is due either to their immaturity as Preferential Trade Areas (rather than customs or monetary unions), or (b)

their overlapping membership of the larger free trade agreements including the Southern African Development Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA).

Where tariff offers are not forthcoming, individual countries continue applying their agreed Most Favoured Nation (MFN) rates applicable as of May 2019.

The AfCFTA will likely have less preferential common external tariffs (CET) on agricultural imports from the rest of the world. The CETs already set by the various Regional Economic Communities (RECs) reflect an agricultural development policy priority in the Least Development Country (LDC) groupings to protect domestic food producers with high import tariffs (usually between 25% and 45% of value) and exclusion from tariff offers through declaration as sensitive goods.

Exceptions are made for cereal staple imports from the rest of the world where food crises, emergencies or catastrophes are more prevalent. Trade protection of agricultural producers is less apparent in SACU where tariff barriers are more likely on highly processed, beneficiated or manufactured items.

With intra-African food trade lower than 0.5 percent of GDP (Table 1), the AfCFTA is poised to increase food trade volumes and therefore improve Africa's resilience to food shocks. Africa's total food trade deficit against the rest of the world equalled 1.18% of its GDP in 2020.

Removing the trade restrictions within the continent through well-functioning AfCFTA will replace some of these imports from the rest of the world with intra-African trade. This will facilitate the development of the African agriculture sector and improve the continent's food resilience in the process.

Table 1. Intra-African trade in food

% of GDP	Food imports 2020		Food exports 2020	
	World	Africa	World	Africa
Africa	2.81%	0.46%	1.63%	0.45%
Eastern	2.27%	0.66%	1.43%	0.50%
Central	3.00%	0.50%	0.15%	0.06%
Northern	3.78%	0.24%	1.94%	0.30%
Southern	2.04%	0.80%	3.07%	1.17%
Western	2.49%	0.37%	1.19%	0.34%

Source: UNCTADstat

The ensuing stages of trade liberalisation within AfCFTA involve acting on the information received from complaints about non-tariff barriers. Whereas international SPS and technical barrier to trade standards can serve as benchmarks, the institutional capacity to monitor and implement may be less credible.

This can be tackled through focused aid-for-trade schemes aimed specifically at developing these capacities, notably Simplified Trade Regimes with reduced RoO and PSP requirements for low value consignments.

These enable legalisation of informal cross-border trade, arguably the most effective market-based mechanism for redistributing food.

African governments must also ensure that trading rules extend to all policies intended to ensure domestic food security, that may blur the boundaries between support and [contestable] protection. These include domestic agricultural input subsidies and export quotas to restore food banks.

Furthermore, there are several agricultural development policies that include local content and ownership requirements, government procurement of food through preferred suppliers, surtaxes on imported foods, and government owned distribution channels that open themselves to dispute resolution. ■

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The Global Gateway: a real step towards a stronger Europe in the world

Disappointment at the lack of fresh cash from EU global connectivity strategy is short-sighted. Simone Tagliapietra says Europe supports global development more than any other country in the world

On 1 December 2021, the European Union unveiled the [Global Gateway](#), its plan to support infrastructure development around the world. This would mobilise €300 billion between 2021-2027 for connectivity projects, notably in the digital, climate and energy, transport, health, education and research sectors.

The rationale behind this initiative is clear: the world needs major infrastructure investments. The World Bank [estimates](#) that to achieve the goals of climate and environmental protection, universal access to energy, water and sanitation, greater mobility, and improved food security, the world must invest around €1.3 trillion per year in infrastructure.

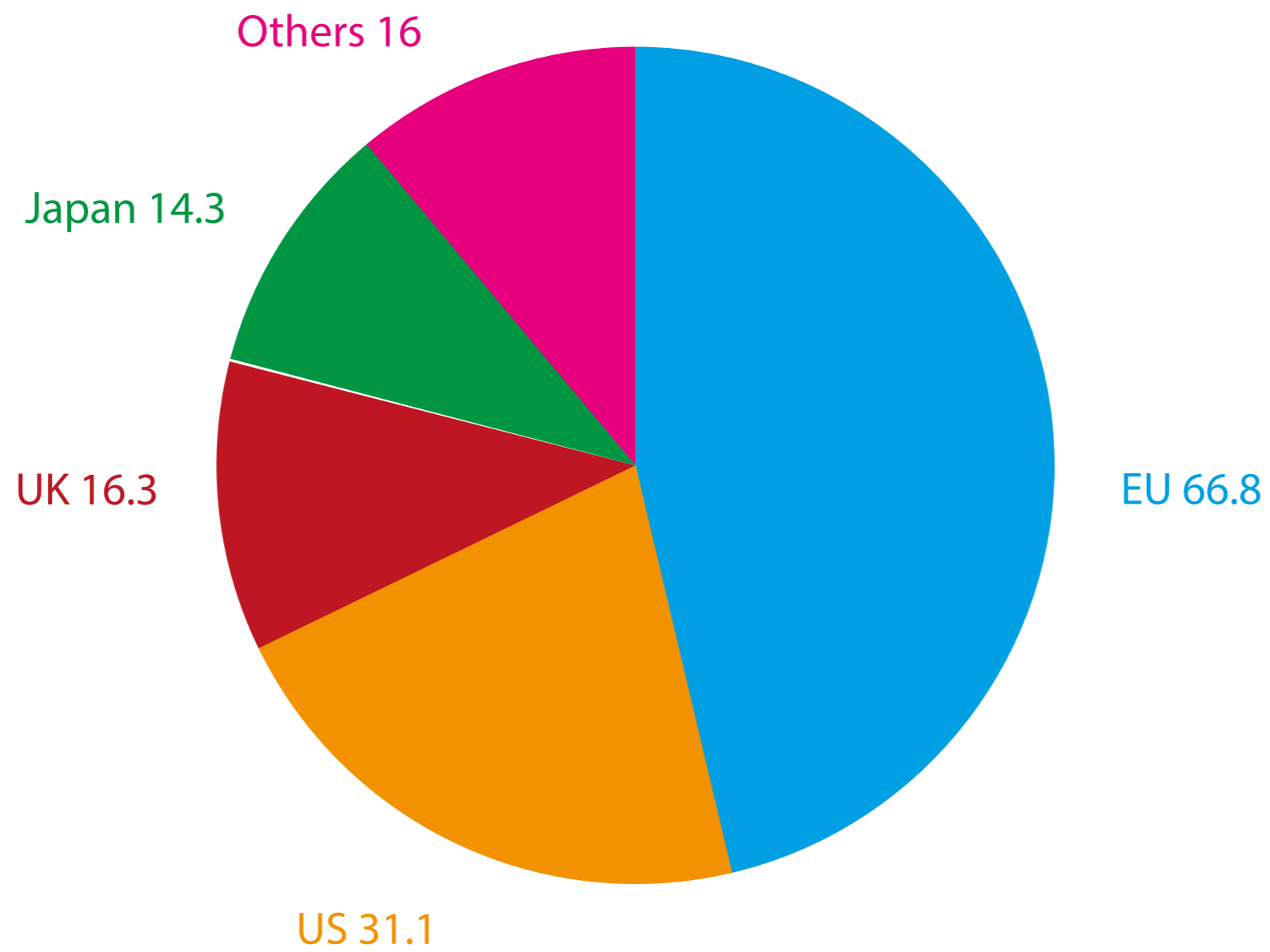
Alternatives to the Belt and Road Initiative

China understood the strategic importance of global infrastructure development when it launched the Belt and Road Initiative in 2013. To provide an alternative to the Chinese approach to global infrastructure development, some G7 leaders committed in June 2021 to *“a values-driven, high-standard, and transparent”* set of infrastructure partnerships: the US’s [Build Back Better World](#), the UK’s [Clean Green Initiative](#) and the EU’s Global Gateway.

The European Commission pitched the Global Gateway as *“a template for how Europe can build more resilient connections with the world”*, but critics quickly attacked the initiative, claiming it represents a repackaging of existing instruments rather than fresh EU cash.

However, this view misses the point. The EU and EU countries are already the world’s leading providers of official development assistance (ODA). In grant equivalent (a methodology in which only the grant elements of loans are reported, instead of their full-face values), Europe disbursed [€66.8 billion in 2020](#), 46% of world’s total (Figure 1). What Europe really needs is not new resources, but to use existing ones more strategically.

Figure 1. Official Development Assistance (ODA) in grant equivalent in 2020 (in billions of euros)



Source: Bruegel from OECD.

To further put things into perspective, between 2014 and 2018 the EU and EU countries provided around €350 billion in ODA grant equivalent, while the Belt and Road Initiative (BRI) – against which the Global Gateway is being compared – provided around €200-€400 billion in loans, according to different estimates of the American Enterprise Institute and UNCTAD. Given that a grant represents a much bigger financial contribution than a loan, Europe's role as a donor is thus more significant than that of China or any other country.

In geopolitical terms, the Global Gateway can help the EU better position itself in the global infrastructure and connectivity race

Reducing fragmentation in EU global action

The problem is that EU action in the field is fragmented into countless initiatives, undertaken at both EU and national levels. As [clearly outlined](#) by the High-Level Group of Wise Persons on the European financial architecture for development, this has led to overlaps, gaps, inefficiencies and lack of geopolitical stance.

The EU has recently taken two steps to reduce this fragmentation and increase the coherence of its external action.

1. It has combined its funding for the neighbourhood and international development into a unique instrument, the Neighbourhood, Development and International Cooperation Instrument (NDICI), endowed with [€79.5 billion](#) for the period 2021-2027.
2. It has launched the 'Team Europe' package, which combines resources from the EU, EU countries, the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD), to provide around [€40 billion](#) to partner countries to deal with the health and socio-economic consequences of the pandemic.

The Global Gateway, which will also be delivered via [Team Europe initiatives](#), represents another important step in this process of consolidation of Europe's development finance, and an important one because of its focus on the strategic issue of infrastructure development and connectivity.

The real question will be how well strategic coordination between EU countries and EU institutions and financial institutions will work. The attempt to improve that coordination is positive, but whether it will succeed remains to be seen.

On the grants-versus-loans discussion, it is also important to flag that the loans provided in the framework of the BRI have often contributed to economic instability in the initiative's partner countries. There is evidence that BRI lending practices have increased indebtedness to alarming levels in some partner countries.

Even before COVID-19, the World Bank [estimated](#) that nearly a third of the initiative's partner nations were at high risk of debt distress. BRI doubtless represents one of several factors behind this debt pressure, but there are [clear examples of its megaprojects](#) having significantly worsened the macroeconomic situation of several countries, including Djibouti, Kyrgyzstan, Laos, Maldives, Mongolia, Montenegro, Pakistan and Tajikistan.

A [working paper](#) analysing the financing of 100 Chinese projects overseas highlighted that *"cancellation, acceleration, and stabilization clauses in Chinese contracts potentially allow the lenders to influence debtors' domestic and foreign policies."*

The Global Gateway in numbers

€300 billion: this is the overall investment that the initiative seeks to mobilise between 2021 and 2027. Lack of fresh EU funds aside, there is scepticism about the ability of EU guarantees to really crowd-in private investment. This represents a classical criticism of EU guarantee schemes, where the leverage effect is generally between 10-15.

For instance, the Juncker Plan sought to leverage €315 billion of private investments on the basis of €21 billion of EU guarantees (a factor of 15), while the investment framework of the recently launched NDICI seeks to leverage €500 billion of private investments on the basis of €53 billion of EU guarantees (a factor of 10). In comparison to these crowding-in factors, the expected leverage factor of the Global Gateway is a lot smaller: the EU component is foreseen to mobilise €135 billion of private investment on the basis of €40 billion of EU guarantees (a factor of 3.4) (Box 1).

Box 1. The financial structure of Global Gateway

Global Gateway aims to mobilise infrastructure development investments of up to €300 billion in the period 2021-2027. This sum is composed of:

- €135 billion in investment foreseen under the European Fund for Sustainable Development plus (EFSD+), where the EU provides €40 billion in guarantee capacity – of which €26.7 billion via EIB and €13 billion via a EFSD+ new window dedicated to Global Gateway, targeting national financing and development finance institutions.
- €18 billion in grants under other EU external assistance programmes.
- €145 billion in planned investments by EU countries' financial and development finance institutions.

Existing programmes such as the Pre-Accession Assistance (IPA) III, Interreg, InvestEU and Horizon Europe will also be used to mobilise resources under Global Gateway.

To add to this financial tool kit, the EU is exploring the option of creating a European Export Credit Facility to complement existing credit arrangements by EU countries and increase its overall firepower in this area.

Source: Bruegel from the European Commission.

This looks reasonable, as what private investors want before they invest in developing countries is just political risk insurance. After all, the [World Bank](#) and [other development banks](#) have always made an extensive use of guarantees to mobilise private-sector resources for development projects.

In this respect, the Global Gateway, with its focus on limiting risks of debt distress in partner countries, seems to provide a more reliable alternative for global infrastructure development.

First, as already mentioned, the EU funding model is a mix of grants, soft loans and guarantees aimed at crowding-in private sector investments, while the BRI exclusively focuses on loans.

Second, the EU requires partner countries to adhere to the rule of law, upholding high standards of human, social and workers' rights, as well as a respect for international norms and standards of intellectual property. This contrasts with China's lending practices, where contracts often include stabilisation clauses challenging human rights and sustainable development policies.

Lending contracts of both the China Development Bank and the China Eximbank include [stabilisation clauses](#) that *"create carve-outs within the rule of law, limit the borrower's self-governance, and potentially block state-of-the-art environmental, public health, labor, and other potentially vital and popular regulations."* This might also help explain why the BRI is [perceived negatively](#) in certain countries.

Beyond money: focusing on expertise and technical support

It is also important to underline that the Global Gateway has a strong focus on expertise, alongside financial assistance. This is important, because creating an enabling environment to attract investment in partner countries with support for reform of regulatory frameworks, or technical support for the development of infrastructure

projects, is important to ensure the scale and long-term durability of development actions, beyond individual infrastructure projects.

Global and domestic benefits

Infrastructure investments are the material way of turning sustainable development goals into practice. Climate action requires renewable energy plants, power grids and electric vehicle charging infrastructure, in the same way that health requires hospitals, education requires schools or connectivity requires ports. By promoting Europe's values in the world, the Global Gateway can thus also become the export arm of a new EU industrial policy.

It can help meet the EU's international pledges, such as on climate finance, by supporting partner countries in the implementation of their sustainable development agendas. It can enable EU industry to enter new growing markets, a win for EU industrial policy. On top of this, it can help economic development in the EU's partner countries, providing an invaluable foreign policy dividend for the EU.

In geopolitical terms, the Global Gateway can help the EU better position itself in the global infrastructure and connectivity race. Rule-based cooperation focused on a clear set of priorities represents an attractive alternative to the BRI in several partner countries, starting in Africa.

By scaling up cooperation on economic and social infrastructure projects, the EU thus has an opportunity to promote its values and vision of sustainability in a way that is tangible and long-lasting. The main challenge will be to align all European players to cooperate and share these strategic goals. ■

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Big tech reset?

EU court dismisses Google appeal. Renaud Foucart believes the knock-on effects from this ruling could be enormous as tech giants consider their business models

Google is being fined €2.4 billion (£2.1 billion) for hindering competition in the EU after a 2017 decision has been [upheld on appeal](#) by the general court of the European Union. This is a saga dating back over 15 years, in which the European Commission has been accusing the tech giant of using its search results to give preferential treatment to its comparison shopping service over those of competitors.

The fine, of which a share will directly go [to the UK](#) by virtue of the EU withdrawal agreement, is also a vindication of the long fight against big tech by competition commissioner Margrethe Vestager. She suffered a crushing defeat in July 2020 when the [same court overturned](#) a €13 billion fine imposed on Apple for an elaborate – but legal – tax avoidance scheme.

But this time, the tide has turned and the message is clear: the regulators will not allow Google and its fellow tech giants to steer consumers towards their own products. They may now have to re-think their entire business models as a result. The internet as we know it – in which most services are free to use but consumers pay by giving away their private data – may come to an end.

The case against Google

[Everything started](#) in 2005 when a British couple, Adam and Shivaun Raff, developed Foundem, a new service for comparison shopping. Google had its own comparison service named Froogle (now Google Shopping), although by its [own admission](#) in 2006 in an internal document, it *“simply doesn’t work.”*

Foundem found itself demoted from Google’s search results. Unless you specifically searched for it, it would only appear after several pages of browsing. Without consumers redirected from the dominant search engine, Foundem never really took off.

Having suspected that Google was restricting competition, Adam and Shivaun Raff attempted to convince the company to allow them some visibility. In 2009, they gave up and brought a complaint to the European Commission against Google for abuse of dominant position.

Over the years, several other comparison services such as Expedia and Yelp joined the complaint. They had also attempted to compete with Google, only to see their websites suddenly relegated to the bottom of the search results by the dominant search algorithm.

... the general court's verdict is likely to remain the guiding principle for the years to come, with major consequences for consumers

Then Google competitors in other markets started accusing the American company of anti-competitive practices. **One complaint** was about Google forcing the pre-installation of free Google software on Android phones, for example. **Another** was about Google forcing advertisers to use the company's services if they wanted to take out ads on YouTube. In all, Google is fighting a **long series** of similar cases on appeal against the commission.

This is where Google's fine over Froogle becomes really serious. It is far from being the largest imposed by the European Commission, but it may be the most consequential because the upcoming appeal cases are likely to use this one as a precedent.

Big tech and consumer rights

Internet companies like Facebook and Google get their revenue by monetising the data of their customers to show them search and display advertising that is relevant to them. They build an estate of companies – for example Google Search, Google Maps, Google Shopping and YouTube – and try to make sure that when consumers leave one service they stay in the estate.

The estate of Google is called Alphabet, and **80%** of Alphabet's revenue comes from Google ads. The problem arises when a company like Google tries to keep consumers on their estate by hindering competitors.

Google and other tech giants know almost everything about us because they gather information from so many different sources. The logic of the current judgement is that those sources should work as separate entities.

In the future, your Google Maps or flight comparison experience may not use the information Google owns about you, or alternatively the company would have to share the data with competitors.

At the same time, Google may not be able to pre-install any of its services on Android phones, and may be forced to give consumers a fair choice of alternatives to Gmail, Maps or YouTube.

This case also confirms divergent approaches to competition policy in the EU and US. The main objective of competition policy, both in the US and Europe, is to protect consumers.

But in the US, the competition authorities concluded [in a similar case](#) in 2013 that the behaviour of tech giants does not hurt consumers. [Their intuition](#) was that what makes Google rich is what makes consumers happy, that consumers do not mind handing their personal data to this company as they get tailored advice in exchange.

Of course, it may seem that consumers do not care about giving away privacy simply because they are not aware of how much Google knows, and of how much money they make out of their data. For instance, when people started to notice that what is now called Meta, the estate of Facebook, was looking for ways to earn money from WhatsApp users, [it caused](#) quite a stir.

European regulators have taken a radically different approach. Their reasoning dates back two decades, since they [first fined Microsoft](#) for pre-installing Media Player and Internet Explorer with then-dominant operating system Windows 95.

The same essential objection has now been applied to Google. By blocking competitors from entering the market, consumers lose the benefit of potential innovations. [With that logic](#), we enjoy the free services of Google simply because we have no idea how much better the alternatives could be if they got a chance to develop.

The general court of the European Union has vindicated the view of the European Commission that Google's behaviour is anti-competitive. Google may try to appeal to the European court of justice, but the general court's verdict is likely to remain the guiding principle for the years to come, with major consequences for consumers.

If tech giants cannot earn money from their current business model, they may have to find other sources of revenue, either charging directly consumers or by creating a [more transparent system](#) in which consumers are aware of the value of their data and sell it freely.

Whether the US will follow suit, and with whom the UK will choose to align if antitrust policies start to diverge radically across the Atlantic, are now the next big questions. ■

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The dangers of unregulated AI



Over the last decade, AI has made great advances. Daron Acemođlu argues that current AI technologies are more likely to generate various adverse social consequences, rather than the promised gains

Artificial intelligence (AI) is often touted as the most exciting technology of our age, promising to transform our economies, lives, and capabilities. Some even see AI as making steady progress towards the development of 'intelligence machines' that will soon surpass human skills in most areas.

AI has indeed made rapid advances over the last decade or so, especially owing to the application of modern statistical and machine learning techniques to huge unstructured data sets. It has already influenced almost all industries: AI algorithms are now used by all online platforms and in industries that range from manufacturing to health, finance, wholesale, and retail. Government agencies have also started relying on AI, particularly in the criminal justice system and in customs and immigration control.

In a recent paper (Acemoglu 2021), I argue that current AI technologies — especially those based on the currently dominant paradigm relying on statistical pattern recognition and big data — are more likely to generate various adverse social consequences, rather than the promised gains.

These harms can be seen in product markets and advertising, in terms of inequality, wage suppression and job destruction in labour markets, and in the broader societal effects of AI in the context of social communication, political discourse, and democracy.

AI, control of information, and product markets

In all of these cases the main problem is not AI technologies per se but the way that leading firms, which have an overwhelming effect on the direction of AI technology, are approaching data and its use. Take the use of machine learning and big data methods in advertising and product design. Although, in principle, these methods can benefit consumers – for instance, by improving product quality and enabling customisation – they can ultimately have various adverse effects on consumer welfare.

To start with, firms that acquire more information about their customers may use this knowledge for price discrimination, potentially capturing more of the rents that would have otherwise gone to consumers. In an oligopolistic market, harvesting of consumer data can relax price competition as well.

Intuitively, this can happen when price discrimination by a firm that has superior knowledge makes its core clientele less attractive to other businesses, encouraging them to raise their prices. This upward pressure on prices would, of course, further damage consumer welfare.

... the current problems of AI are problems of unregulated AI, which ignores its broader societal and distributional consequences

Other uses of these new techniques could be even more detrimental to consumers. For one, online platforms may come to control excessive amount of information about their users, because when they buy or acquire the data of some users, this also provides information about other users.

This type of 'data externality' is more likely to arise when users directly reveal information about their friends and contacts, or when they are sharing information correlated with the information of others are in the same narrow demographic group.

Data externalities can contribute to too much data being concentrated in the hands of companies, with adverse implications for privacy and consumer surplus (Acemoglu *et al* 2021b).

Even worse, companies can use their superior information about consumer preferences to manipulate their behaviour (eg. Zuboff 2019). Behavioural manipulation is not common in models in which consumers are fully rational.

However, it is quite likely when consumers do not fully understand how much new data collection and processing methods used to track and predict their behaviour.

The basic idea of such manipulation was understood by legal analysts of antitrust, such as Hanson and Kysar who observed that *"once one accepts that individuals systematically behave in non-rational ways, it follows from an economic perspective that others will exploit those tendencies for gain"* (1999: 630).

Indeed, advertising has always involved some element of manipulation. However, the extent of such manipulation may have become amplified by AI tools. There are already several examples of AI-based manipulation.

These include the chain store Target successfully forecasting whether women are pregnant and sending them hidden ads for baby products, or various companies estimating 'prime vulnerability moments and advertising for products that tend to be purchased impulsively during such moments.

They may also include platforms such as YouTube and Facebook using their algorithms to estimate and favour more addictive videos or news feeds to specific groups of users.

AI and labour market inequality

The effects of AI-based technologies in the context of the labour market may be even more pernicious. Labour market inequality has increased in the US and several other advanced economies, and much evidence suggests that this is caused in part by rapid adoption and deployment of automation technologies that displace low and middle-skill workers from the tasks they used to perform (Acemoğlu and Restrepo 2021).

Such automation and its adverse inequality consequences predate AI. Nevertheless, Acemoğlu *et al* (2021a) find that the acceleration of AI in the US since 2016 has targeted automation and has had similar effects to other automation technologies.

AI and extensive use of data are likely to multiply automation possibilities, and thus can exacerbate the inequality trends the US and other advanced economies have experienced over the last several decades.

In principle, automation can be efficiency-enhancing. However, there are also reasons to expect that it can take place inefficiently. An important reason for this is the presence of labour market imperfections, which increase the cost of labour to firms above its social opportunity cost.

Under this scenario, firms will automate in order to shift rents away from workers to themselves, even when such automation reduces social surplus.

Other uses of AI can have even more powerfully negative consequences. These include the use of AI and workplace data in order to intensify worker monitoring. Once again, when there are worker rents (either because of bargaining or efficiency wage considerations), greater monitoring can be beneficial for firms in order to claw these rents back from the workers.

But with the same reasoning, such rent-shifting is socially inefficient and excessive – at the margin, it is a costly activity that does not contribute to social surplus but transfers it from one set of agents to another.

AI, social discourse, and democracy

AI-based automation can have other negative effects as well. Although it is not likely to lead to mass unemployment anytime soon (and disemployment effects from other automation technologies have so far been modest), worker displacement has various socially disruptive effects.

Citizens with lower attachments to jobs may participate less in civic activities and politics (Sandel 2020). Even more importantly, automation shifts the balance of power away from labour towards capital, and this can have far-ranging implications on the functioning of democratic institutions.

Put differently, to the extent that democratic politics depends on different labour and capital having countervailing powers against each other, automation may damage democracy by making labour dispensable in the production process.

AI's effects on democracy are not confined to its impact by automation. One of the domains that has been most radically transformed by AI so far is communication and news consumption, especially via the products and services offered by various social media platforms.

The use of AI and harvesting of user data have already changed social discourse, and existing evidence is that they have contributed to polarisation and diminished the shared understanding of facts and priorities that is critical for democratic politics (eg. Levy 2021).

As Cass Sunstein anticipated 20 years ago, *"fragmentation and extremism... are predictable outcomes of any situation which like-minded people speak only with themselves."* He stressed that *"without shared experiences, a heterogeneous society will have a much more difficult time in addressing social problems"* (Sunstein 2001: 9).

Indeed, AI-powered social media appears to have contributed both to this type of fragmentation and extremism on the one hand, and the spread of misinformation on the other (eg. Vosoughi *et al* 2018).

A problem of direction of technology

The tone of this essay so far may create the impression that AI is bound to have disastrous social consequences, and that I am staunchly against this technology. Neither is true.

AI is a promising technological platform. The problem lies with the current direction in which this technology is being developed and used: to empower corporations (and sometimes governments) at the expense of workers and consumers. This current approach is a consequence of the business practices and priorities of the corporations controlling AI, and in the incentives that this creates for AI researchers.

Take social media. A major reason for the problems I emphasised is that platforms are trying to maximise engagement by ensuring that users are 'hooked'. This objective is rooted in their business model, which is centred on monetising data and consumer traffic by advertising. It is further enabled by the fact that they are unregulated.

The same is true when it comes to the negative effects of automation. AI can be used for increasing human productivity and for generating new tasks for workers (Acemoğlu and Restrepo 2018). The fact that it has been used predominantly for automation is a choice. This choice of the direction of technology is driven by leading tech companies' priorities and business models centred on algorithmic automation.

The more general point is that the current path of AI empowers corporations at the expense of workers and citizens, and often also provides additional tools for control to governments for surveillance and sometimes even repression (such as new censorship methods and facial recognition software).

Conclusion: the need for regulation

This reasoning leads to a simple conclusion: the current problems of AI are problems of unregulated AI, which ignores its broader societal and distributional consequences. In fact, it would be naïve to expect that unregulated markets would make the right trade-offs between societal ills and profits from monopolisation of data.

This perspective also suggests that the problem is not just one of monopoly power. If there were more than a few large tech companies, there is no guarantee that they would have different business models and different approaches to AI.

Hence, anti-trust is not the most potent, and certainly not a sufficient, tool for dealing with the potential harms of AI. Instead, policy should focus on redirecting technological change away from automation and harvesting of

data to empower corporations and towards those that create new capabilities and opportunities for workers and citizens.

It should also prioritise the systematic regulation of collection and harvesting of data and use of new AI techniques for manipulating user behaviour and online communication and information exchange.

Given the pervasive nature of AI and data, I would also suggest a new regulatory approach, which can be termed a 'precautionary regulatory principle': ex-ante regulation should slow down the use of AI technologies, especially in domains where redressing the costs of AI become politically and socially more difficult after large-scale implementation.

AI technologies impacting political discourse and democratic politics may be prime candidates for the application of such a precautionary regulatory principle. To the extent that (excessive) automation and its social consequences would also be hard to reverse, so is the use of AI for automation and labour market monitoring. ■

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Biometric technologies at work: a proposed use-based taxonomy

Technology may not have a significant negative impact on the quantity of jobs, but it certainly transforms them. Mia Hoffmann and Mario Mariniello consider the implications for productivity and workers' quality of life

Executive summary

Biometric technologies have in principle the potential to significantly improve worker productivity, security and safety. However, they are also a source of new risks, including exposure to potential personal data abuse or the psychological distress caused by permanent monitoring. The European Union lacks a coherent regulatory framework on the mitigation of risks arising from the use of biometric technologies in the workplace.

We propose a taxonomy to underpin the use of artificial intelligence-powered biometric technologies in the workplace. Technologies can be classified into four broad categories based on their main function: (1) security, (2) recruitment, (3) monitoring, (4) safety and wellbeing. We identify the benefits and risks linked to each category.

To be more effective, EU regulation of artificial intelligence (AI) in the workplace should integrate more detail on technology use. It should also address the current scarcity of granular data by sourcing information from users of AI technologies, not only providers.

There is an untapped potential for technology to address workplace health hazards. Policymakers should design incentive mechanisms to encourage adoption of the technologies with the greatest potential to benefit workers.

Artificial intelligence users, in particular bigger companies, should be required to assess the effect of AI adoption on work processes, with the active participation of their workforces.

1 Introduction

Traditionally, the analysis of the impact of technology on labour markets has focused on measurement of the quantitative effects on aggregate employment. Researchers often ask whether technology will create more jobs than it will destroy, or which jobs are more exposed to the risk of disappearing because machines will replace humans.

But a parallel question is becoming increasingly pressing. Technology may not have a significant negative impact on the quantity of jobs available to humans, but it certainly transforms them, changing how jobs are performed, with implications for workers' quality of life and for productivity. Hence the focus shifts from a quantitative to a qualitative perspective.

Addressing this has become even more pressing in the wake of the COVID-19 pandemic, which has pushed companies to increase their adoption of digital technologies, with varying impacts on the wellbeing of workers (for example, during the pandemic investment by employers in monitoring and surveillance software has increased significantly; see Kropp, 2021; Mascellino, 2020).

Meanwhile, the disruptive potential of the pandemic has provided employers with an opportunity to introduce new work processes and redesign workplaces to address long-standing issues, such as workplace health hazards, that technology can help deal with.

We focus on artificial intelligence (AI)-powered biometric technology used in the workplace. Biometrics refers to the automated recognition of a person based on their physical and behavioural characteristics (Sabhanayagam *et al* 2018; Sundararajan and Woodard, 2018).

Identity recognition includes identification ('Who are you?') and verification ('Are you really who you say you are?'). But the use of AI-powered biometric technologies in the workplace can go well beyond recognising identity.

For the purposes of this Policy Contribution we define biometric technologies as AI technologies that rely on biometric data to derive inferences about the individual whose data is collected. Such inference can include individuals' moods, their level of concentration, their health or personality.

Even when the purpose of such soft biometrics is not to identify individuals, their deployment still has far-reaching implications for workers and workplaces, not least with respect to privacy (McStay, 2020).

Interest in using technology to monitor and control what workers do is booming; COVID-19 and the shift to remote work have exacerbated this

The global biometrics market is growing fast. Estimates from 2019 expected global revenues to almost double within the next four years, and reach \$55.42 billion in 2027 (Figure 1). This data includes the use of biometrics across all domains, including law enforcement and in customer-centric applications.

Comprehensive data on the use of biometric technology in workplaces is scarce, a problem that should be addressed by policymakers. Because the adoption of new technologies in the workplace has significant potential to affect workers' wellbeing, a first key step is to improve the ability of public authorities to accurately monitor this phenomenon as it unfolds.

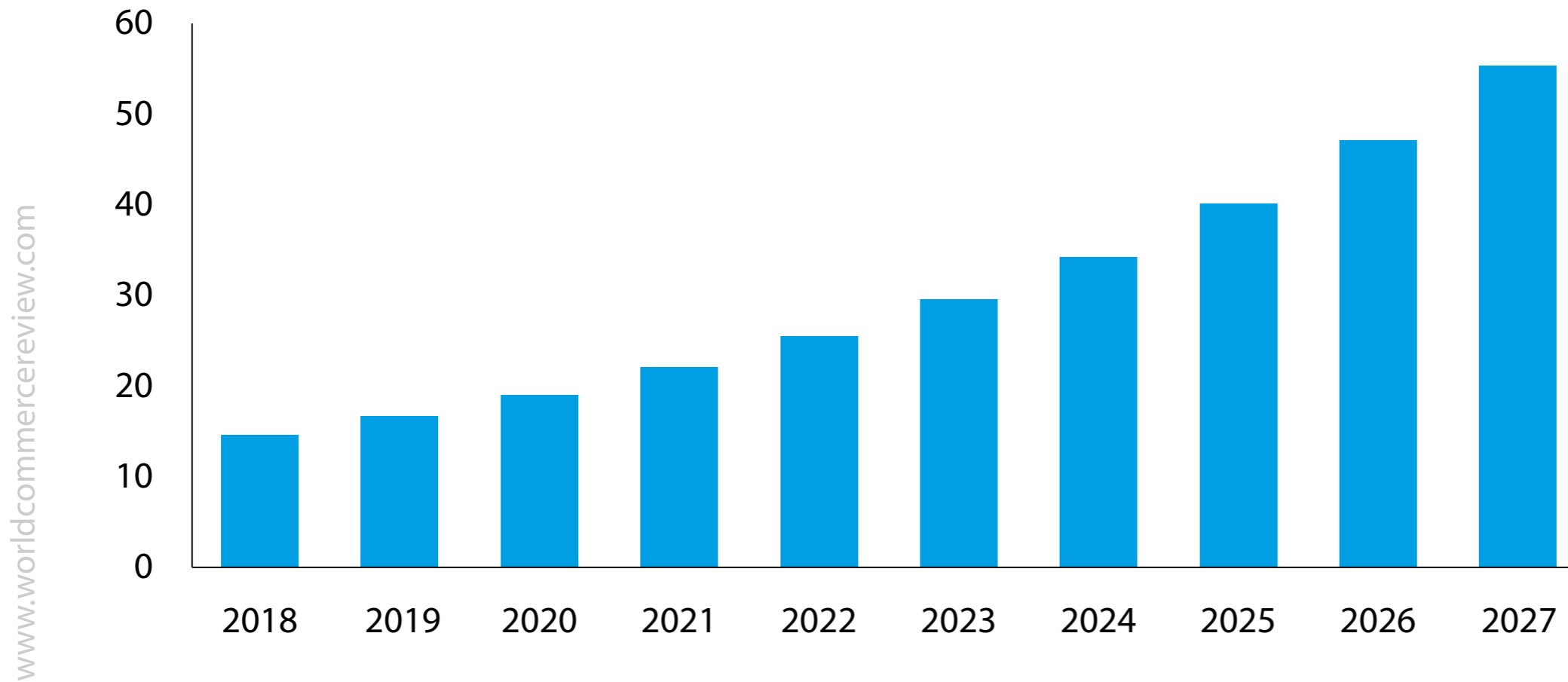
According to one survey (European Commission, 2020), 42 percent of enterprises in the EU use at least one kind of AI technology, but information is lacking about whether the AI technologies are applied to employees or customers, and no distinction is made between biometric and non-biometric systems¹.

Analysis by individual technology shows that those that can be classified as biometric technologies are among the less-utilised: natural-language processing (speech recognition, machine translation or chatbots) has been adopted by only one in ten firms, while 9 percent of enterprises use computer vision (visual diagnostics, face or image recognition), and the use of sentiment analysis (analysis of emotion and behaviour) is even rarer, at 3 percent².

A few sectors, including social work, education and real estate predominantly adopt AI systems related to biometrics, but overall adoption levels are very low. Skill shortages, both in the labour market and internally, represent major obstacles to the adoption of AI technologies in general.

However, for the adoption of sentiment analysis, reputational risks and lack of citizen's trust represent significant adoption barriers. These barriers are not considered very problematic for other technologies.

Figure 1. Global biometric technology market revenue in \$ billions, 2018-2027



Note: Values from 2020 on are forecasts.

Source: Bruegel based on Statista, <https://www.statista.com/statistics/1048705/worldwide-biometrics-market-revenue>

The increasing interest of regulatory authority in these markets is therefore not coincidental. The European Union, for example, has been increasingly active in recent years in attempting to define a legal framework to mitigate the risks of abuse arising from advanced technology. The general data protection regulation (GDPR), which entered into force in 2018, is the bluntest example.

In April 2021, the European Commission proposed harmonised rules on artificial intelligence, commonly referred to as the 'AI Act' proposal (European Commission, 2021a). The main goals of the proposed AI Act are to create the conditions for ethical AI and the concrete enforcement of rules that mitigate AI risk, especially as experienced by the most vulnerable. For the workplace, the proposed AI Act specifically lists as high-risk:

- *“AI systems intended to be used for recruitment or selection of natural persons, notably for advertising vacancies, screening or filtering applications, evaluating candidates in the course of interviews or tests;*
- *“AI intended to be used for making decisions on promotion and termination of work-related contractual relationships, for task allocation and for monitoring and evaluating performance and behaviour of persons in such relationships”* (European Commission, 2021a).

The proposed AI Act, however, does not provide details about the identified sources of risk when artificial intelligence is used in the workplace. Nor does it explain through which mechanisms risk can arguably translate into harm for workers.

However, such explanations are needed to disentangle potentially harmful from potentially beneficial use of technology. Furthermore, the proposed AI Act would impose a number of requirements for providers and users of high-risk AI applications. These include risk management and assessment of potential current and future risks.

However, no specific guidelines are given on how that assessment should be done (for example, what should be considered a 'foreseeable risk' associated with the use of biometric technology in the workplace?).

We aim to fill the gap in the proposed AI Act by classifying technologies and explaining how technology in the workplace can harm workers. To our knowledge, this is the first attempt to propose a taxonomy of biometric technologies used in the workplace³.

Our analysis furthermore suggests improvements that could be made to the AI Act draft text. In particular, the text should include a bigger emphasis on the role played by users of AI applications. As drafted by the European Commission, the proposed AI Act does not entail sourcing data on high-risk applications directly from, for example, companies that adopt them.

However, lack of granular use data can significantly hamper regulators' ability to understand how harm to workers can unfold at plant level. Moreover, the AI Act is geared to compelling providers of high-risk AI applications to improve their products.

However, AI applications may have significant redistributive effects when they are adopted, depending on the environment in which they are used. Such risks may not be entirely foreseeable by AI providers. It would thus be desirable that users should also engage in strategies that mitigate potential risks.

In particular, bigger companies could be required to assess the effects of high-risk AI applications on their workforces, with workers actively participating in such assessments.

2 Biometric technologies at work: a proposed use-based taxonomy

Biometric technologies can be categorised into three groups:

- Physical;
- Physiological;
- Behavioural.

Physical biometrics refers to data on static and unique bodily characteristics. Examples include DNA, fingerprints, iris and retina patterns and physiognomy, but thanks to technological progress, options now extend to include ear, palm and vein patterns and many more.

Raw biometric data is collected through a live scan or a digital image, which is then processed and translated into unique code. In facial recognition, for instance, this code reflects the size of the mouth, position and shape of the nose, the distance between the eyes, and so on (Sabhanayagam *et al* 2018).

Physiological biometrics is data on a person's physiological functioning, such as their heart rate, blood pressure, oxygen level and muscle use. While monitoring of this data is common in healthcare, physiological biometrics are increasingly moving into workplaces, especially for workplace health assessment (Mettler and Wulf, 2019).

Behavioural biometrics use patterns of human behaviour as the basis for analysis and are driven by deep-learning techniques. The underlying concept of the technology is to exploit distinct patterns of human behaviour as a means for authentication and identification, either in real-time or retrospectively (Liang *et al* 2020).

Behavioural biometrics extract information not from the outcome of an action, but from the way it is executed. For example, identity is verified by a worker's gait, while mood is evaluated from the pitch of their voice. A benefit is that data is collected without interrupting individuals in their ongoing activity in a way that an ID check or employee survey would. The ubiquity of smart devices, cameras and sensors contributes to the technology's growing importance in workplaces.

Regardless of the type of biometric technology, data analysis follows a similar, automated process. Raw biometric data is collected via sensors, cameras, microphones or other devices and pre-processed to remove noise and clean the data.

This is followed by feature extraction. Features are specific biometric data points or patterns considered to be indicative or predictive of the outcome of interest. For example, for identification, one of the features could be the distance between the eyes, or the pressure applied on certain keys while typing.

It could be the percentage of speaking time to assess personality, and the breathing rhythm to judge stress levels (Han *et al* 2017; Liang *et al* 2020; Sabhanayagam *et al* 2018; Vinciarelli and Mohammadi, 2014).

Depending on the type and amount of raw data, this step requires more or less computing power. Depending on the use case, the extracted features are fed into diverse AI models that determine the outcome of interest (such as classification, authentication or identification).

Biometric AI systems can serve a wide range of functions in the workplace. Providing security by verifying and identifying workers is one, but as we will illustrate in the next sections, there are many other purposes, including

those relying on physiological and behavioural biometric data. An important emerging field in this regard is affective computing (Yanushkevich *et al* 2020).

This refers to the computational analysis of data on human behaviour, such as facial expressions, gestures and language, or physiology, for its emotional information to derive conclusions about a person's affective state, including emotions (Balan *et al* 2020; Richardson, 2020), mood (Zenonos *et al* 2016), personality (Mehta *et al* 2020; Vinciarelli and Mohammadi, 2014) or stress levels (Khowaja *et al* 2021).

The analysis builds on several biometric technologies including facial expression recognition, tone analysis and natural language processing, and is typically based on the assumption that there are common and universal forms of emotional expression regardless of culture, gender, age or race (Barrett *et al* 2019; Richardson, 2020).

We propose to classify biometric technologies according to their use by employers. We identify the following four groups of use (Table 1)⁴:

- **Security:** security represents the classic use case for biometric technologies in workplaces. Allowing access to company resources to only authorised personnel is traditionally done using passwords, pin codes or key(card)s, but biometric authentication, such as face or fingerprint recognition, offers benefits in terms of accuracy, security and efficiency.
- **Recruitment:** the purpose of AI systems in recruitment, including biometrics, is to create objective, data-driven candidate evaluations, for example through automated interviews or psychometric assessments.

Table 1. A taxonomy for biometric AI systems in the workplace

Purpose	Technologies used	Use case	Real life example/brand
Security	Facial, fingerprint, gait, keystroke recognition	Access control, continuous authentication	BehavioSec, Innovatrics, FaceKey
Recruitment	Affective computing based on computer vision, voice and speech recognition and natural language processing (NLP)	AI-powered job interviews and personality assessments to evaluate candidates	Pymetrics, HireVue, Retorio
Monitoring	Affective computing based on voice recognition and NLP; wearable movement trackers; eye movement trackers; smart mouse	Worktime control, productivity and activity tracking, performance measurement	Cogito, WorkSmart, Geodis, Humanyze
Safety and wellbeing	Smart wearables; Computer vision	Accident prevention; physical and psychosocial health risk management	StrongArm Technologies, Fitbit, (many technologies in development)

Source: Bruegel.

- **Monitoring:** the digitalisation of work in many sectors has created new possibilities for uninterrupted and comprehensive worker surveillance. With biometric AI, employers can keep track of productivity, for example through keyboard logging or movement sensors, or measure performance using affective computing, concentration tracking or social metrics.
- **Safety and wellbeing:** one of the arguably most promising use cases for AI in workplaces is to improve worker health and safety. AI can help address a wide range of causes of morbidity by reducing the risk of accidents, burnout and musculoskeletal disorders. Most of the biometric systems we review rely on physiological data gathered through smart sensors and wearable devices that track muscle use, movement, fatigue or stress levels.

2.1 Security

Table 2. Biometric AI for security

Employees		Employers	
Risks	Benefits	Risks	Benefits
Privacy issues, surveillance, function creep	Contactless identification, simplification, no risk of losing keycards/forgetting passwords	Data protection liability	Higher security, reduced risks of insider fraud

Source: Bruegel.

Security represents the classic use case for biometric technology in workplaces. Companies have an interest in restricting access to their facilities, data and resources to authorised personnel only, which necessitates a process of identity verification.

Figure 2 shows the rate of use of biometric authentication methods in EU countries and in the United Kingdom, in 2019. One in ten of all EU companies rely on biometric authentication and verification in the workplace, with use rates ranging from as high as 24 percent in Malta to only 4 percent in Slovenia and Bulgaria.

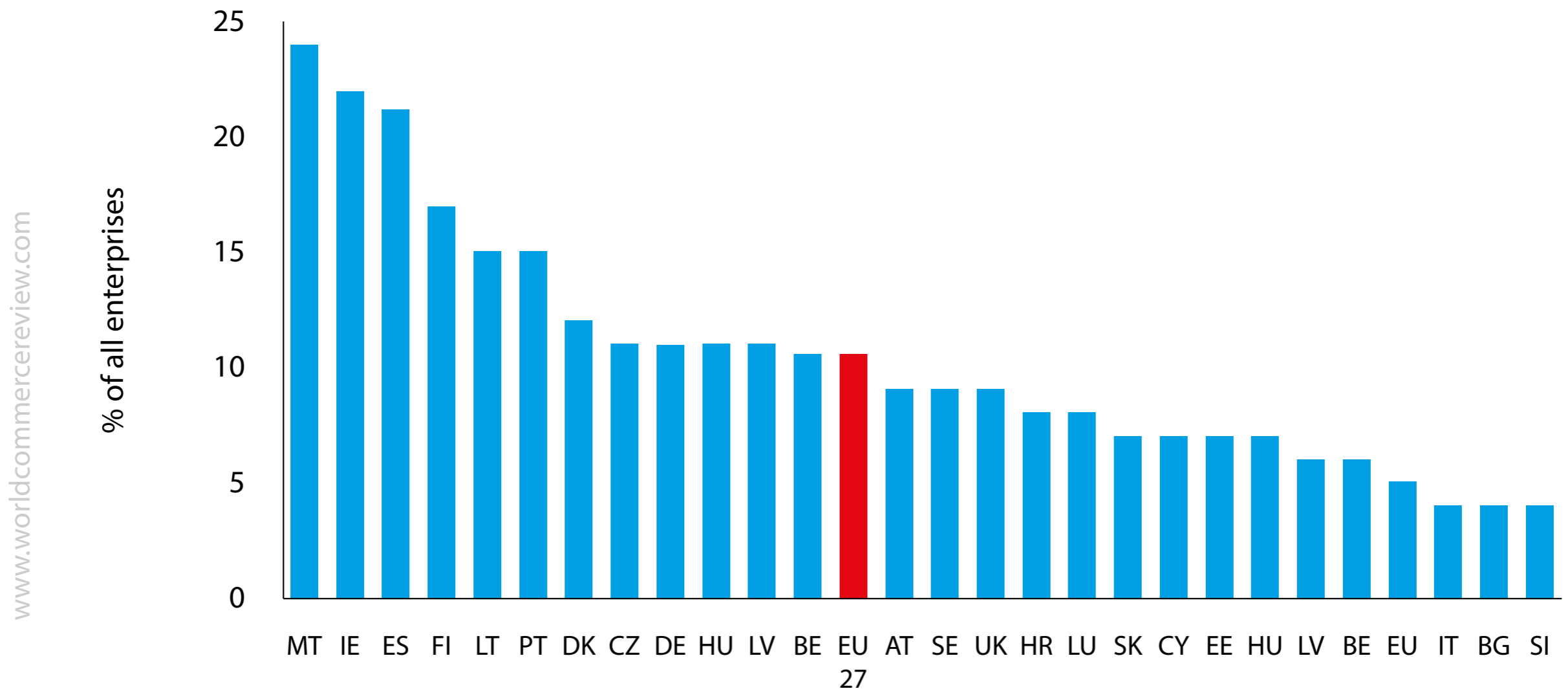
Fingerprint recognition is by far the most popular type of biometric authentication, followed by facial recognition, according to a survey of IT professionals⁵.

There are several benefits to biometric authentication compared to conventional security systems. In contrast to knowledge-based (passwords, pin codes) or token-based (key cards) security systems, biometric authentication systems rely on characteristics inherent to someone's person. While passwords and key cards can be lost or stolen, biometric recognition guarantees that the individual in question is physically present.

Biometric authentication is also more time- and cost-efficient, since the automated process only takes seconds, if that, and no human identity check is needed. Moreover, biometric features cannot be forgotten and therefore time-consuming recovery or reset processes needed for forgotten passwords or key cards are avoided.

The passive nature of behavioural biometrics such as gait or keystroke recognition allows continuous authentication to ensure that the person accessing company data, accounts or other resources is indeed the one authorised to do so.

Figure 2. Use of biometric authentication in enterprises, 2019



Note: Data for the Netherlands is not available.

Source: Eurostat.

For these reasons, behavioural biometrics are increasingly used for fraud detection and insider threat management (Hu *et al* 2019; Liang *et al* 2020). Therefore, enhancing conventional security systems with biometric identity recognition is to date the most secure, effective and efficient way to secure access to company property (Sabhanayagam *et al* 2018)⁶.

Reliance on employees' personal biometric characteristics for security has significant implications for workplaces and workers. Privacy is at the core of concerns about the collection, storage and processing of biometric data (Carpenter *et al* 2018; Holland and Tham, 2020).

Beyond being a unique feature of a person, biometric data can contain a wide range of additional, personal information, which can potentially be extracted. For example, the continuous recording of keystrokes for authentication will also capture the content that is typed, including potentially sensitive personal information.

Physical biometrics, such as fingerprints or hand geometry, may reveal private medical information. For example, Holland and Tham (2020) explained that fingerprints can be used to detect genetic disorders, and Carpenter *et al* (2018) argued that biometric samples allow the extraction of genetic markers that reveal potential health issues, such as hand swelling associated with sickle cell disease.

The mere possibility of extraction of this information from biometric data opens up new questions about privacy, and could lead to discrimination between workers.

The use of workers' biometric data for undisclosed purposes without their knowledge and consent is a central concern (Carpenter *et al* 2018; Holland and Tham, 2020). Beyond assessing medical risks, organisations could use

the data to conduct background checks or, as is being done in the US, cross-reference biometrics with immigration records to identify undocumented immigrants (Goldstein and Alonso-Bejarano, 2017).

Organisations could use the data to expand monitoring and surveillance, for instance by retracing employees' activities using historical authentication data. The GDPR prohibits function creep via the principles of data minimisation and purpose limitation.

Employers that want to expand the use of biometric data beyond previously agreed functions would need to obtain renewed employee consent. Critics point to the challenges of enabling meaningful and informed consent for data collection in an employer-employee relationship⁷.

Finally, there are concerns about potential data breaches and third-party access to personal (biometric) data. One of the key benefits of biometric systems, the fact that they rely on inherent characteristics rather than on knowledge or tokens, also implies that biometric features are irreplaceable: in case of a compromise, biometric ID cannot be changed like a password.

2.2 Recruitment

Recruitment is an obvious application field for AI-driven analytics because hiring decisions are known to be riddled with human bias and discrimination (Bertrand and Mullainathan, 2004; Carlsson and Eriksson, 2019; Drydakis, 2009; Rooth, 2009; Tilcsik, 2011).

Hence, many AI-powered recruitment tools are developed and adopted specifically with the aim of eliminating this problem from the selection process by offering an objective, data-driven and comparable assessment of candidates (Sánchez-Monedero *et al* 2019).

Table 3. Biometric AI for recruitment

Employees		Employers	
Risks	Benefits	Risks	Benefits
Discrimination, spurious correlations, bias, lack of feedback	Potentially more objective interview	Liability, loss of talent due to spurious correlations	Cost reduction, potentially more equality in the hiring process

Source: Bruegel.

Virtually every Fortune 500 company is currently using some form of applicant-tracking system in their hiring processes⁸. However, to the best of our knowledge, representative, reliable data on the use of AI in recruitment, in particular interview systems or other biometrics, currently does not exist.

There is certainly potential for AI systems to enhance recruitment processes. Cowgill (2018) showed that AI can be better than a human counterfactual if certain conditions are met. He found that using a machine-learning algorithm to screen curriculum vitae can do better than humans if the training data is sufficiently noisy.

The algorithm was built on text mining and natural language processing assessing factors including education and work experience, as well as soft skills. The algorithm led to selection of candidates who were more likely to pass the interview process, accept job offers and be more productive once hired⁹. The algorithm was more likely to select

candidates who graduated from non-elite colleges without job referrals or prior experience, but who had strong non-cognitive soft skills.

Biometric data is primarily collected during the interview process or through personality assessments, in which candidates' behaviour – including their facial expressions, pitch and choice of words – feed into an AI-driven assessment of competences and personality¹⁰.

In order to assess a candidate's suitability for a vacancy, interview systems are trained using data on the company's existing staff. Their test scores are combined with corporate performance benchmarks to identify correlations between the AI's analysis and job success. The AI then compares candidates' scores with those of the existing staff and groups applicants according to their probability of job success.

Unilever, which relies on such an AI-enhanced recruitment tool for entry-level positions, claims the software has contributed to raising ethnic and socioeconomic diversity among new employees, in addition to saving 100,000 hours of interview time and \$1 million in recruitment costs each year¹¹.

Drawing conclusions about emotional states or personality from video or tone recordings without human intervention is however challenging and potentially problematic, in particular when the automated evaluation is the basis for hiring decisions.

A key question that needs answering even before considering its potential usefulness in the workplace is whether or not AI is capable of doing what it claims. A review of the literature by Barrett *et al* (2019) emphasised that technology companies overestimate the scientific validity of their base assumption that there is universal emotional expression.

Instead, the authors found that emotional facial expression is highly context-specific, and that this variation is still understudied. They concluded that not only it is premature to use technology to draw conclusions about people's internal states, such analyses may completely lack validity if they fail to include the context of the individual (Barrett *et al* 2019).

Furthermore, there is a major transparency issue (Raghavan *et al*, 2019; Sánchez-Monedero *et al* 2019). It is currently not possible for researchers to evaluate the validity of the assessments. Developers of AI-powered hiring tools are reluctant to make their code or data available for independent audits, given their proprietary and sensitive natures.

They furthermore rely on their own definitions of unbiased or fair algorithmic assessment, as currently there are no regulations in force that provide a legal standard for these terms. Given that the tool is trained on the set of current staff for each vacancy, characteristics of performance vary from job to job.

Sánchez-Monedero *et al* (2019) concluded that even the most transparent providers fail to disclose how jobseekers can learn how their performance affected the system's evaluation. AI-backed systems are not geared to provide information on which factors (ie. facial expression, voice, pitch) and parameters influence their assessments.

In the case of the recruitment tools, this implies that neither candidates nor human resources managers can follow and retrace AI-based decision-making. The key risk, as a result, is spurious correlations. It is, for example, known that factors including lighting feature obstruction (such as covering part of the face with the hand), and expression intensity influence significantly the outcome and accuracy of computer-vision affective computing models (Patel *et al* 2020).

Finally, one of the most important discussions around AI is the prevalence of bias. Rhue (2018) found that a vision-based sentiment-analysis AI assigned more negative feelings to black faces. Similarly, racial bias has been found in algorithms for natural language processing because of lack of knowledge and understanding of the cultural determinants of linguistic emotional expression (Sap *et al* 2019).

Furthermore, affective computing and recruitment AI tools are 'ableist' by default, by assigning certain features of speech, body language and facial expression paramount importance for job performance, though they have little to do with actual suitability and are unattainable for people with disabilities (Whittaker *et al* 2019).

While some technology companies claim to undertake efforts to counter such bias by continuously auditing their algorithms, decision-making processes continue to lack transparency and traceability.

AI systems are known to frequently encode and perpetuate existing patterns of bias, and the rapid rollout of such tools without meaningful requirements or regulations imposed on them leads to the suspicion that they will exacerbate discrimination through their in-group and out-group classification systems (Crawford *et al* 2019).

2.3 Monitoring

Monitoring employees is not a new concept. Yet, in contrast to direct supervision by a physically present superior, the digitalisation of work and the internet of things (IoT) enables continuous and comprehensive tracking of all of workers' activities (Edwards *et al* 2018).

Interest in using technology to monitor and control what workers do is booming. The COVID-19 pandemic and the shift to remote work has exacerbated a trend already present before the crisis.

Table 4. Biometric AI for workplace monitoring

Employees		Employers	
Risks	Benefits	Risks	Benefits
Surveillance; loss of autonomy and control; mistrust between employee and employer, reduced job quality	Objective accounting of work efforts	Lower job quality could lead to higher employee turnover	Reduce time theft ('buddy-punching'); enhance productivity; improve performance

Source: Bruegel.

In 2018, Gartner found that more than half of large corporations had adopted non-traditional monitoring techniques, up from 30 percent in 2015 (Kropp, 2019)¹². During the pandemic, demand for biometric-monitoring AI soared, and one out of four companies introduced technologies to track their employees' behaviour passively (Kropp, 2021; Mascellino, 2020).

Workplace applications centre on tracking attendance, activity or performance. The most frequent technological methods of workplace surveillance tend to be monitoring of work emails, browser histories and files, CCTV and

the recording and logging of phone calls (however, no granular data on use of monitoring technologies by EU companies is available).

Monitoring via wearable devices is more common in workplaces that require a lot of physical activity, such as warehouses or construction sites.

Many workplaces re-apply biometric security devices for the purpose of worker monitoring. For example, fingerprint-based attendance tracking systems are widely commercially available. Advocates of the technology claim that such systems make attendance tracking more efficient while preventing some workers from clocking-in for others, improving productivity for both management and workers.

However, these systems were ruled illegal in Germany in 2020, barring exceptional circumstances (Burt, 2020). Because the systems collect highly personal data, they run afoul of European GDPR laws.

When biometric data is combined with productivity-centred algorithms, the technology can be used to push efficiency and accuracy, potentially at the cost of surveillance and lower job quality (Gutelius and Theodore, 2019). Headlines about the deeply automated tracking processes in an Amazon warehouse offer an exemplary description of the risks of algorithmic monitoring and management.

According to one report¹³, workers wear a type of tracker that monitors their location and movements as well as their work activity. Based on historic data, an algorithm establishes standardised productivity rates and benchmarks to be attained by each employee. The tracking device also measures time-off-task and sends automatic alerts to workers if the period between measured work activities becomes too long.

Reportedly, the AI system included an automated termination process: it would autonomously fire workers when quality or productivity benchmarks weren't maintained. Since thresholds were set to near-unattainable standards, workers were put under such significant time pressure that they would skip bathroom breaks in order to fulfil their artificially set benchmarks.

Discouraging and timing toilet breaks represents a questionable control over basic human needs and also raises issues around equality, illustrated by a number of reported instances in Europe where female employees (not of Amazon) were asked to wear specific clothing to signal when they were menstruating to receive permission to use the restrooms more often¹⁴.

In office settings, a similarly comprehensive picture is painted by AI-driven sociometric devices: small, wearable badges capable of tracking individual and collective behaviours at work based on audio, movement, proximity and location data.

In combination with corporate metrics on output and performance, AI can link specific behaviours, such as talkativeness, or whether a worker dominates conversations, to productivity, identify (un-) productive processes and make suggestions to improve organisational efficiency (Eveleth, 2019; Ito-Masui *et al* 2021).

Although linking a badge to the wearer's identity requires consent according to the developers, critics argue that surveillance opportunities remain within reach, in particular in small or medium-sized entities (Moore, 2020).

Affective computing can also play a role in monitoring work performance. A US start-up called Cogito developed an AI system for call centres which assesses the mood of customers during phone calls and cues agents to adapt their way of speaking accordingly.

Using voice analysis and natural language processing, the technology detects over 200 indicators of emotional state of both the customer and the agent in real-time. When it identifies a certain emotional state in a customer – for example frustration – it alerts the agent to speak more slowly, or display more empathy.

Importantly, the AI serves not only as a tool to improve customer satisfaction, but also to monitor workers, as supervisors have *“the ability to proactively listen to live calls with no extra setup required [and] are automatically alerted to calls in which a customer is having a poor experience”*¹⁵.

Automated monitoring may ensure that well-performing workers are identified and rewarded in a more consistent and objective manner. However, this comes at a cost of constant surveillance. The psychosocial risks associated with constant algorithmic monitoring are real and must be taken into account (Nurski, 2021).

2.4 Safety and wellbeing

Table 5. Biometric AI for health, safety and wellbeing

Employees		Employers	
Risks	Benefits	Risks	Benefits
Surveillance; collection of intimate health data; function creep; privacy	Prevention of accidents and adverse health outcomes	Liability for data protection	Reduction in incident costs

Source: Bruegel.

Workplaces can be dangerous. In 2018, 3,332 workers in the EU died in an accident at work¹⁶. In addition, there were over three million serious non-fatal accidents in European workplaces¹⁷.

In the EU, most workplace accidents occur in a handful of sectors. Agriculture, manufacturing, construction and transport account for over 65 percent of all fatal accidents. The most prevalent causes of workplace accidents in industrial settings are, in decreasing order of frequency, falls from heights, strikes by moving or falling objects, machine contact, ie. when a worker is caught between parts of a machine, and being hit by moving vehicles (Svertoka *et al* 2021).

Non-fatal illnesses also burden workers. Musculoskeletal disorders, together with cancer and circulatory illnesses, are the leading causes of work-related morbidity in the EU (Elsler *et al* 2017). Workplace accidents, deaths and health problems generate massive costs that burden not only employers and employees but also public budgets and society as a whole.

The European Agency for Safety and Health at Work (EU-OSHA) estimated that the costs of work-related accidents and illnesses in the EU amount to at least €476 billion per year, equal to about 3.3 percent of EU GDP (Elsler *et al* 2017).

Technology may offer a solution to improve workplace safety. More and more smart technological solutions are available to address a wide range of work-related health issues. Instead of a reactive approach to accidents and health problems, these systems enable preventive action by detecting hazards and risks before they manifest themselves in accidents or illnesses (Pavón *et al* 2018).

Through sensors, these systems gather data from the workers and their surroundings aimed at environmental sensing, proximity detection and location tracking (Awolusi *et al* 2018; Svertoka *et al* 2021). Biometric AI systems typically combine data collected on workers from physiolytic equipment, with environmental data gathered from other sensors or cameras (Svertoka *et al* 2021).

Physiolytics are wearable devices that use measurements of body functions, such as heart rate, muscle use or blood oxygen level, in machine-learning models and data analytics, from which AI draws conclusions about the physical and sometimes psychosocial state of the wearer (Mettler and Wulf, 2019).

Wearables include fitness trackers, smart watches, patches and sensors attached to the body, smart clothing and personal protective equipment (PPE) (Svertoka *et al* 2021).

Biometrics can help through five broad channels: (1) increasing compliance with PPE requirements and preventing falls; (2) addressing hazard caused by fatigue; (3) reducing sedentary behaviour and physical inactivity; (4) limiting psychosocial stress; (5) reducing physical stress and musculoskeletal disorders¹⁸.

1. *Increasing compliance with PPE and preventing falls.* Records from the US Bureau of Labor show that in most incidents resulting in severe injury, workers were not correctly wearing PPE, suggesting that the severity of the incident could have been reduced with full PPE compliance (Kritzler *et al* 2015). AI-driven solutions to PPE compliance are typically based on either computer vision or smart wearable technology.

For example, a smart helmet can detect whether it is worn or not and determine the instant it is taken off using humidity sensors (Tan *et al* 2021). In other instances (eg. see Kritzler *et al* 2015), workers may wear a smartwatch that signals which PPE is required for the task and recognises whether it is worn at that point in time. When a

worker approaches a workstation, the machinery and industrial equipment will only activate if she wears the right gear, as determined by the watch.

Similarly, AI systems can help reduce the number of falls by identifying hazardous areas in workplaces using recordings of stumbling or loss of balance from smart sensors. Supervisors can use the data to detect hazardous locations on their worksites before an incident occurs, and address specific risks with targeted measures, without disrupting workers in their tasks.

2. *Addressing hazard caused by fatigue.* According to neuroscientific research, constant and long-term exposure to high-risk environments, such as construction sites, and the resulting familiarity with hazardous surroundings, lowers people's risk sensitivity and risk-judgement capabilities (Niv *et al* 2012).

A range of wireless, wearable sensing devices has been developed to measure and assess the level of attention or situational awareness of workers in real-time using physiological biometrics such as eye-movement or brain signals. Amazon, for example, deploys AI-powered cameras in its delivery vehicles to improve safety following a number of serious car accidents¹⁹.

The vision system observes and records all drivers at all times and issues alerts for unsafe driving behaviour, such as speeding, fatigue or distracted driving. However, reports suggest that the technology sometimes unduly penalises drivers, negatively impacting their ability to earn income²⁰.

3. *Reducing sedentary behaviour and physical inactivity.* A number of health risks, including obesity, cardiovascular diseases and back pain, are associated with a lack of physical activity and extensive sedentary behaviour, typical of office environments. Workplace interventions to promote wellbeing and physical activity among employees

often involve providing workers with wearable fitness trackers, such as FitBits, to monitor and track their daily physical activities (Glance *et al* 2016; Nikayin *et al* 2014).

Large-scale collection and analysis of workers' data can provide the basis for specific health interventions to address emerging risks early on. However, whether this justifies constant monitoring of physical activity, in particular outside of working hours, should be judged by each individual worker.

4. *Limiting psychosocial stress.* A study by the World Health Organisation and International Labour Organisation identified a direct relationship between overwork and premature death (Pega *et al* 2021)²¹. Lasting psychosocial stress at work increases the risk of illness and death from heart disease and stroke.

Moreover, chronic stress can lead to negative mental health outcomes. It is, for instance, a crucial cause of burnout (Salvagioni *et al* 2017). More than half of the European labour force reports commonly experiencing work-related stressors in their jobs (EU-OSHA, 2013).

Recent technological advances in biometric technology have enabled the direct measurement of stress in the workplace. The benefits are straight-forward: early identification of chronic stress and its underlying causes can enable targeted, effective and timely preventive action by employers to mitigate the risk of adverse health outcomes in their organisations.

5. *Reducing physical stress and musculoskeletal disorders.* Physical stress can lead to musculoskeletal disorders (MSDs), one of the leading causes of occupational morbidity. Processes and environments in certain workplaces, like construction sites, assembly lines and warehouses, pose several risk factors for MSDs, including repetitive motions, force and awkward postures (Nath *et al* 2017).

However, ergonomic risks also emerge from tasks and occupations that do not require heavy labour but entail very repetitive motions, for example typing on a keyboard (Valero *et al* 2016) or scanning products at a supermarket check-out (Peppoloni *et al* 2016).

Biometric or biomechanical measurement tools, usually consisting of sensors worn on the worker's body, directly and accurately measure individual body movements over time and allow the identification of unsafe movements and detection of hazardous kinetic patterns (Nath *et al* 2017; Valero *et al* 2016).

Biometric technology used for safety purposes appears to have the greatest potential to benefit workers and employers alike. Nonetheless, its use is not risk-free. Workers may be concerned about their behaviour being constantly monitored. Workers' safety data may be accessed by their employers to assess their performance, undermining the primary goal of the adopted technology.

Physical and mental health information should not be used as a workforce management tool. Mood-recognition AI trained to associate biophysical states with stress levels and mood can allow employers to *"use this information to understand the general feeling of the work environment at any given time without explicitly asking any employees"* (Zenonos *et al* 2016), which would to many appear to be a strong encroachment on privacy, in particular since changes in mood are not necessarily related to work.

In addition to implications for data security, access by third-parties and function creep, the potential use of stress and mood-detection AI in workplaces raises the question of whether employers should come to know these things when their staff choose not to communicate them.

Box 1. Computers are everywhere except in workplace safety statistics

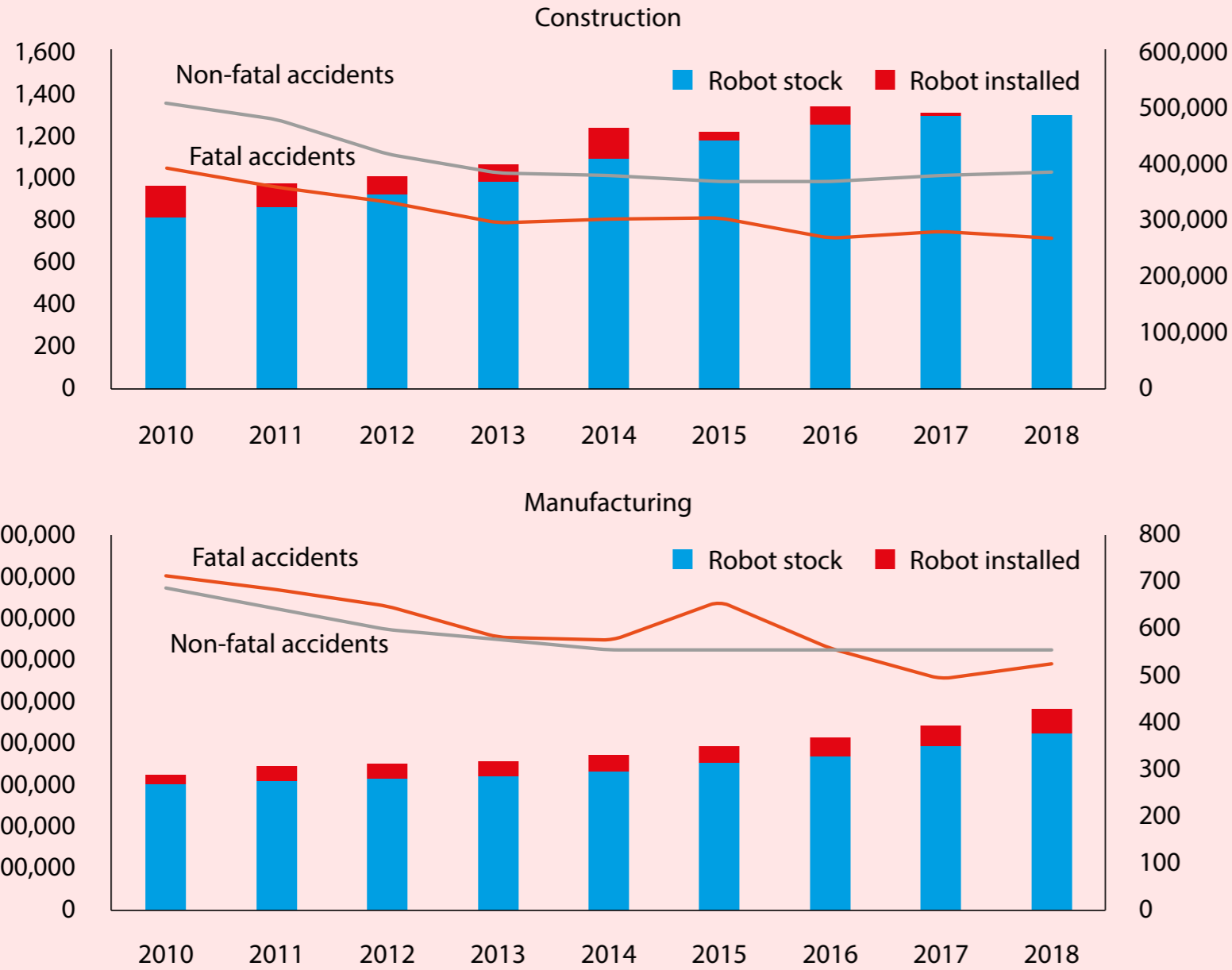
Biometric technologies have a great potential to increase safety at work. However, in sectors in which adoption of digital technologies has constantly increased in the past years, there has been no corresponding drop in injury rates.

Statistical information on the use of AI-powered biometric equipment in the EU is not yet available, but we can use proxies: it is reasonable to assume that sectors in which digitisation and robotisation are higher also tend to have a higher rate of adoption of biometric technologies.

Figure 3 compares the trend of robot adoption with workplace accidents in Europe. It might be expected that, as production processes become more automated, injuries would also become less frequent. However, that is not observed in the data: most of the growth in adoption of robotics took place after 2013/2014, but injury rates declined mostly before that.

While the insights from this analysis cannot be conclusive because of the lack of detailed data on the type of technology adopted by companies, they nevertheless suggest that worker safety does not seem yet a significant driver of companies' technological investment.

Figure 3. Workplace accidents and robotics adoption in industry, EU28



Note: number of fatal accidents in manufacturing and number of non-fatal accidents in construction expressed on the right axis.
Source: Eurostat and World Robotics.

3 From theory to practice to policy

The taxonomy of biometric technologies used in the workplace that we have described above has one primary purpose: to help make more concrete what the European Commission has only sketched in broad terms in its AI Act proposal.

The Commission is right to emphasise that using AI in the workplace can be very risky. But grasping the dynamics through which technology and actual harm are linked is an essential condition for effective regulation.

We note that there is a significant scarcity of data at granular level. This scarcity prevents observers from monitoring the implications of the adoption by employers of new technologies. While progress is being made in terms of data collection on technological adoption by European companies (for example, Eurostat has now indicators that monitor uptake of AI technology), statistics still lack detail on the type of biometric technology used.

The AI Act may help partially to address that issue, in that it imposes notification obligations to providers of high-risk applications. The European Commission plans to establish a system for registering standalone high-risk AI applications in a public EU-wide database, and this is a welcome development.

Yet, the database will be mostly driven by the information supplied by the AI application providers, which may not be able to accurately foresee all potential risks that can emerge at user level. It would be preferable to design coherent statistical systems for capturing information directly from EU employers about AI use.

The AI Act should also broaden the scope of what it considers 'biometric data': it currently relies on the definition adopted in the GDPR, which hinges on the application of the information collected to identify individuals.

However, as we have discussed, biometric technologies may have detrimental effects on workers even if not strictly used for personal identification (for example, data can be lawfully collected at personal level, but raw aggregate biometric data can be stored and used to control the workforce collectively).

For individual workers, biometric technologies in the workplace pose a variety of risks. There are privacy concerns: devices collect a myriad of detailed, sensitive data, with the risk that these may be accessed by (unauthorised) third parties or used by the employer without the employee's consent for purposes other than initially foreseen.

These risks are pervasive and represent a significant barrier. There is a potential loss of personal freedom or control over how employees organise their work. Knowing their employer has constant access to real-time metrics on their effort level can induce workers to change their behaviour and eventually leave them with less motivation and engagement.

There is a risk of over-reliance on the technology. This is particularly problematic when a technology's accuracy is overestimated. Not only can this leave workers unorganised in the case of a technology outage, it can also cause them to trust the device's recommendations more than their own feeling of wellbeing at the time.

From the perspective of workers, this also raises the question of whether it can be assumed that employers are capable of interpreting the output from AI correctly, or if they take the results as truth, though results are potentially biased.

Nevertheless, some technologies have huge potential to address long-standing issues. This in particular refers to safety and security in the workplace, which is a major, often underrated, problem in European labour markets.

It is thus important to ensure that any new regulatory requirement does not dissuade employers from adopting technologies that have a high potential to protect workers from injury or other health hazards.

Based on our taxonomy, it should be possible to design systems of incentives for providers to deploy innovative solution that maximise benefits while complying with the risk-mitigation rules, having in mind the final effect on workers.

Likewise, users could be steered to invest more in technologies that can help address workers' issues, rather than exacerbate them. For example, any discussion related to taxation of digital technologies (Christie, 2021) should be informed by that trade-off: 'robot taxes' do not necessarily need to focus on the quantity of jobs potentially destroyed by technology.

Rather they could be informed by the balance of risks and benefits which we have described in this paper. For example, it would be desirable to craft a taxation system that would reward employers that adopt technologies with high potential to increase safety at work while, if anything, penalising use of technology that can harm workers through intensive monitoring or automated emotional scrutiny.

The European Commission in June 2021 issued the *Strategic Framework on Health and Safety at Work 2021-2027*, which outlines actions to improve workers' health and safety in a changing world of work (European Commission, 2021b).

In this strategy, the Commission also recognises the potential of new technologies, including artificial intelligence, to improve occupational health, safety and wellbeing.

On a broader level, our analysis clearly indicates that no biometric technology can be considered intrinsically bad or good for workers. In other words, working hard to ensure that technology delivers accurate results, and that artificial intelligence systems are not conditioned by bias at any level of the value chain (development, data sourcing, distribution and use), do not guarantee no harm. Addressing bias is a necessary but not sufficient step to protect humans from harm.

Unbiased biometric monitoring of workers may deliver fairer assessments of worker performance, but it can still entail a worsening of their wellbeing, increasing their stress levels, for example.

That conclusion emphasises the role of risk management at local level by users of high-risk AI applications. Employers should not mindlessly adopt biometric technologies in their facilities or offices. Nor can they rely on providers' reassurances about the potential risks of the applications they develop (as it is currently suggested by the proposed AI Act).

Employers of significant size should rather be required to evaluate the impact of the implementation of high-risk technologies before adoption, possibly through the active involvement of their workforce. After adoption, employers should survey their workers' feelings and assess the effects on their wellbeing. ■

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Endnotes

1. *European Commission (2020) is a survey of firms that provides useful general insights but does not enable conclusions to be drawn about specific use cases.*
2. *European Commission (2020), while aiming for representativeness, suffers from a low response rate of only 5 percent on average, which likely biases the adoption rate upwards. Therefore, the accuracy of the exact adoption rates may be limited. We believe, nonetheless, that in the absence of more reliable estimates the relative scarcity of biometric technologies compared to other technologies considered, is a realistic assessment.*
3. *An extended version of the taxonomy with more detail is available in Hoffmann and Mariniello (2022).*
4. *It should be noted that this classification is, to a certain extent, artificial: the boundaries between different uses of technologies are often blurred. So for example a technology used for security may also be used for monitoring. Nevertheless, we propose a classification which, in our view, best captures the differences between the applications that have been so far developed.*
5. *Peter Tsai, 'Data Snapshot: Biometrics in the Workplace Commonplace, but Are They Secure?', Spiceworks, 12 March 2018, available at <https://community.spiceworks.com/security/articles/2952-data-snapshot-biometrics-in-the-workplace-commonplace-but-are-they-secure>*
6. *An additional potential benefit is the potential of touchless biometric security to limit infectious disease transmission: US-based IT firm Hewlett Packard Enterprise adopted a facial recognition access system to reduce COVID-19 infection risk compared to, for example, machines requiring PIN code entry. See: <https://www.hpe.com/us/en/newsroom/press-release/2020/06/hpe-to-deliver-five-new-return-to-work-solutions-to-help-organizations-accelerate-recovery-in-wake-of-covid-19.html>, accessed 6 August 2021.*
7. *For a discussion of the complexity of meaningful consent to data collection within the employer-employee relationship, see Moore (2020).*
8. *Linda Qu, '99% of Fortune 500 Companies Use Applicant Tracking Systems', Jobscan, 7 November 2019, available at <https://www.jobscan.co/blog/99-percent-fortune-500-ats/>*

9. The experiment was designed so that the algorithm's recommendation randomly overrode the choices of human recruiters about who to invite for interview. The effects measured were derived from candidates selected by the algorithm but not by the human recruiter.
10. Drew Harwell, 'A face-scanning algorithm increasingly decides whether you deserve the job', *Washington Post*, 6 November 2019, available at <https://www.washingtonpost.com/technology/2019/10/22/ai-hiring-face-scanning-algorithm-increasingly-decides-whether-you-deserve-job>
11. Minda Zetlin, 'AI Is Now Analyzing Candidates' Facial Expressions During Video Job Interviews', *Inc.*, 28 February 2018, available at <https://www.inc.com/minda-zetlin/ai-is-now-analyzing-candidates-facial-expressions-during-video-job-interviews.html>
12. Gartner defines monitoring as "analysing the text of emails and social-media messages, scrutinising who's meeting with whom, gathering biometric data and understanding how employees are utilising their workspace."
13. Information in this paragraph is taken from Colin Lecher, 'How Amazon Automatically Tracks and Fires Warehouse Workers for "Productivity"', *The Verge*, 25 April 2019, available at <https://www.theverge.com/2019/4/25/18516004/amazon-warehouse-fulfillment-centers-productivity-firing-terminations>
14. See for example Kate Connolly, 'German supermarket chain Lidl accused of snooping on staff', *The Guardian*, 27 March 2008, available at <https://www.theguardian.com/world/2008/mar/27/germany.supermarkets>, and Ian Sparks, 'Boss orders female staff to wear red bracelets when they are on their periods', *MailOnline*, 30 November 2010, available at <https://www.dailymail.co.uk/news/article-1334400/Female-staff-Norway-ordered-wear-red-bracelets-period.html>
15. See <https://cogitocorp.com/product/>
16. Eurostat hsw_n2_02.
17. Eurostat hsw_n2_01. Serious is defined as causing at least four days absence from work.
18. A detailed analysis of each of the five channels is reported in Hoffmann and Mariniello (2022).
19. See Tyler Sonnemaker, 'Amazon Is Deploying AI Cameras to Surveil Delivery Drivers "100% of the Time"', *Business*

Insider, 3 February 2021, available at <https://www.businessinsider.com/amazon-plans-ai-cameras-surveil-delivery-drivers-netradyne-2021-2>

20. See Sarah Jackson, 'Amazon's AI-powered cameras punish its delivery drivers when they look at side mirrors or when other cars cut them off, report says', *Business Insider*, 20 September 2021, available at <https://www.businessinsider.com/amazon-delivery-drivers-netradyne-ai-cameras-punished-when-cut-off-2021-9>

21. Measured effect of 55+ working hours per week compared to regular (35-40) working hours.

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2021 proves to be an exciting year for IPOs

Maxim Manturov takes a look back at the top IPOs of 2021, exploring the reasons behind their success and how they are currently performing

With [955 organisations](#) going public since January 2021, this year has been witness to some of the most exciting and fastest-growing initial public offerings (IPO) of the century. During this time there has been a mixture of successes and failures among these organisations – some IPOs that were expected to skyrocket ended up crashing in share price, while others vastly exceeded expectations.

Nonetheless, while the financial market did seem to mirror the growing uncertainty that the world has faced over the last year, there have been six organisations that have stood out above the rest, making them some of the most successful IPOs of 2021. These companies offer unique and distinctive products that are in high demand in their respective markets, allowing them to move beyond their competitors and thrive throughout times of uncertainty.

Doximity

Doximity is an online platform that enables medical professionals to collaborate with colleagues, securely coordinate patient care, conduct virtual patient appointments, and stay up to date with the latest medical news and research. Its clients include medical organisations, particularly pharmaceutical manufacturers, health systems, and medical recruiting companies.

With such a large user base on the platform, it should be no surprise that all 20 of the top pharmaceutical manufacturers advertise on Doximity, with the company making over £150m in revenue in 2020. Since its IPO in June, its stock price has increased by 195% and its revenue is estimated to be between £64.3 million and £65.1 million for the end of Q3 2021.

Looking to next year, instead of striving for a 100% market share of doctors and medical students in the US, the company could potentially [expand internationally](#) or into new professions like law or law enforcement – both areas where enhanced communication could help to improve the wider industry.

DigitalOcean

DigitalOcean is a cloud computing service provider, providing infrastructure and tools for developers, start-ups, and SMBs. Since its IPO in March, shares have increased by 143% and the company's Q3 revenue in 2021 increased by 37% to £83 million. This is rather impressive given its three main competitors are Amazon, Google, and Microsoft.

Looking towards the new year, the company is well positioned to maintain its momentum in increasing its share price. It is predicted that by 2024, global spending on infrastructure and platform services will total £87 billion. DigitalOcean believes that there are currently 100 million SMBs and 19 million developers worldwide that would benefit from their service, meaning it has the capability to expand its customer base exponentially.

Applying a long-term lens will mean the difference between success and failure for many investors throughout 2022

Affirm Holdings

Affirm Holdings is a financial technology start-up that enables consumers to purchase products and make payments in instalments. Traders interest in the company piqued in August when it entered into a partnership with Amazon.

In October of this year, Affirm Holdings also partnered with American Airlines, the perfect time given [74% of Americans](#) said they would spend 'more on travel this holiday season than ever before'.

However, the stock dipped in early November after its largest client, Peloton Interactive, predicted underwhelming figures for the rest of the fiscal year, which deteriorated Peloton shares and agitated Affirm's investors. Nonetheless, Affirm's share prices have increased by 210% since its IPO in January.

TaskUs

TaskUs provides digital business outsourcing services to fast-growing technology companies to represent, protect, and grow their brands. The company provides technology to the likes of Facebook, Uber, Netflix and Zoom. Its success has been a result of a multitude of factors, but its increased presence within the food and ride-sharing industry has been intrinsic as the world opens back up.

TaskUs's Q3 revenue for 2021 is £150 million, representing 64.2% of year-over-year growth, which was entirely organic. Since its IPO in June, its shares have increased by 178% and as a result of this success, it has managed to create offices in six locations including the US, India, and Colombia, with plans to further expand operations across the globe.

GitLab

GitLab is an open-source code repository and collaborative software development platform for large DevOps and DevSecOps projects. On its first day of trading, shares of GitLab jumped 35% from its £57.70 share price to £78, and since then it has jumped further to 58%.

This increase is largely down to its customer growth and retention. Overall customer count grew by 32% since the start of the year to 3,632, with customers spending over £75,000 growing by 35% to 383.

In the first six months of 2021, the company made almost £81 million in revenue, with almost £70.8 million of that becoming gross profit.

Rivian

Rivian was one of the largest IPOs of 2021, raising £8.9 billion. The company went public amidst growing market interest in electric vehicles (EV). Popularity among EV vehicles has meant Rivian stocks have jumped 58% since its IPO in November and is expected to grow even further over the coming years.

Currently only **1% of all UK vehicles** are made up by EV cars, yet by 2032 this is projected to jump to 55%, so it is safe to say that EV vehicles are the future of transport.

What does the future have in store for these organisations?

It is difficult to clearly predict what will happen to these companies in 2022 and beyond. However, one thing that is clear is that they all provide services that are in high demand in their respective markets, and offer unique products that rival even the largest companies or industry leaders.

All six organisations have grown significantly since their IPOs and will continue to be ones to watch as we enter the new year. With this in mind, below see my top tips for investors looking to capitalise on some of the most exciting IPOs of 2022:

1. Do some in-depth research

Take time to research the market or an individual stock. If you make a concentrated effort to learn the fundamental side, you can dive back into trading with a new perspective and gain confidence in your actions.

Do not rely on gut feelings alone, nor should you rely on what one person is saying. This means finding out what the company does, how it is doing financially, why there is a lot of media attention surrounding it, and why its stock might fluctuate in price.

2. Don't let your ego cloud your judgement

Many investors are overconfident and think they know better than the experts or even the market. Just being well educated or smart does not mean you won't benefit from good independent advice.

It also doesn't mean that you can outsmart the professionals and the complex systems of markets. Many investors have lost fortunes believing that they are better than everyone else. Do not let your ego, hype, or euphoria cloud your judgement.

3. Always keep a plan in mind

Putting a plan into play and including losses as part of this plan, as long as they do not exceed the norms of the trading system, is critical to success. Don't let the results of a few trades change your overall strategy and approach.

Stick to what you have learned and planned, use a trading journal, track trades and do your homework, and work on mistakes to develop your next steps. Applying a long-term lens will mean the difference between success and failure for many investors throughout 2022. ■

Maxim Manturov is Head of Investment Research at Freedom Finance Europe

A scenic view of a rocky coastline with turquoise water and greenery. The foreground shows dark, jagged rocks leading down to a small, sandy beach. The water is a vibrant turquoise color, and the sky is a clear, pale blue. In the background, there are green trees and a grassy area. The overall scene is bright and sunny.

Bermuda is another world
and it is the place to be

COVID-19 has completely changed how we live, work and play. The Economic Development Department show how Bermuda's proactive approach has shown the world how to fight the pandemic

"Bermuda is another world" is one of the Island's favourite folk songs. It speaks to the way of life and the history of the picturesque Atlantic island. It is also aptly describes how Bermuda has responded to the COVID-19 pandemic and used it to drive economic growth.

It is now common knowledge that COVID-19 has completely changed how we live, work and play. It has caused companies to rethink their business models and, often, to pivot. Due to nationwide restrictions and various quarantines, staff everywhere have taken to working remotely where possible.

Many have reordered their priorities, changed their goals, spent more time with their loved ones and looked at their habits and health with renewed focus. But the pandemic has not changed the need for countries to continue to function, generate revenue and provide services.

Bermuda has been a leader in the fight against COVID-19, providing an example to the world of what is possible when a government is proactive and strikes a balance between being firm and fair. Thanks to its robust testing policy, Bermuda has maintained a low R rate¹ and controlled the spread of the virus.

Bermuda has therefore become an ideal place for digital nomads, many of whom have seized the opportunity to work from the near-idyllic location, moving to Bermuda in significant numbers.

Teamwork makes the dream work

As a leading offshore centre for insurance, reinsurance, corporate and financial services, Bermuda is a reputable, blue-chip jurisdiction with a progressive regulatory framework that works with industry to stay ahead of the curve. Bermuda is a world leader in transparency standards and strives to be the centre of legitimate global commerce.

Building on the success of its forays into fintech, the Bermuda government has expanded its strategy, actively targeting economic development in various sectors.

In 2020, it created the Economic Development Department (EDD) and gave it the ambitious directive to lead the jurisdiction's post-pandemic economic recovery. The EDD has the mandate of growing the local economy, attracting more business to Bermuda, generating incremental revenue, boosting foreign direct investment, increasing the size of the workforce, creating jobs, and building an economy that would compel not just digital nomads of all nationalities, but also Bermudians living and working overseas, to come home.

... services that are key to foreign investors - such as applications for work permits, company incorporations and tax accounts - are often expedited

In addition to its legislative and business development divisions, the EDD's concierge arm has enhanced the time-efficiency of government processes. As a result, services that are key to foreign investors - such as applications for work permits, company incorporations and tax accounts - are often expedited.

Bermuda has also adopted a team approach to marketing itself as a business and visitor-friendly jurisdiction. If you're looking for an innovative, well-respected, transparent jurisdiction with a cooperative government and regulators who 'get it' and can react quickly to your needs and to changes in the global landscape, Bermuda is the destination for you and your business.

Several entities cooperate to attract companies and leisure travellers to the Island. In addition to the EDD, the Bermuda Tourism Authority (BTA), the Bermuda Business Development Agency (BDA), the Bermuda Monetary Authority (BMA) and the Bermuda Economic Development Corporation (BEDC) all play key roles in the effort.

The BTA promotes the country to the world while the BDA attracts businesses that are looking for a sophisticated, progressive, safe and well-regulated country in which to base their operations.

The BMA is one of the most highly regarded regulators in the world but also one of the most progressive, as it often meets with clients to provide feedback during the license application process.

The BEDC supports local entrepreneurs, teaching homegrown innovators how to successfully build and launch their businesses and creating conditions for them to be sustainable in the long run. Recognising that small businesses, new businesses and entrepreneurs are significant job creators, the BEDC has the full support of the government in creating opportunities for them. ■

Government of Bermuda | Economic Development Department

Endnote

1. R, the reproduction number, equals the average number of people each person with a disease goes on to infect.



CAYMAN ISLANDS AIRCRAFT REGISTRY

**RESPONSIVE
EFFICIENT
INNOVATIVE**

**TOTAL AIRCRAFT
REGISTRATION SOLUTION**

A business jet is shown from a front-on perspective, flying over a body of water. The sun is setting in the background, creating a warm, orange glow that reflects on the water's surface. The sky is a mix of orange and dark blue. The text is overlaid on the upper half of the image.

Year-end offers chance to consider opportunities on the horizon

As we look toward 2022, Ed Bolen is confident that business aviation will continue to innovate, respond and adapt quickly to the challenges ahead

The COVID-19 pandemic has certainly been a time of self-examination for all of us. As we contemplate what the future may hold at the end of 2021, we have many reasons for optimism.

For example, flight activity by companies has continued to rise throughout the year; at the same time, we continue to see unprecedented growth in aircraft charter, as new users seek out the benefits of on-demand air travel.

We've also seen continuing innovation across our industry. Throughout 2021, aircraft manufacturers introduced new aircraft designs offering increased performance, endurance and interior volume, while also promising even greater efficiency and lower emissions than ever before. New products, avionics and support options have further evolved to meet the needs of this rapidly-advancing industry.

Innovation on display at NBAA-BACE

Many of these new offerings took centre stage as the stars of the show at the 2021 NBAA Business Aviation Convention & Exhibition (NBAA-BACE) in Las Vegas, NV in mid-October.

This year's edition of NBAA-BACE was unquestionably among the most exciting and impactful ever, as our industry once again met in-person during an era of robust growth, fast-paced innovation and a shared desire to shape the future.

Being together at NBAA-BACE again was truly exhilarating, from the packed exhibit floor to the stunning aircraft display, to the epic keynote speakers. Indeed, the entire week was filled with new products and major announcements - underlining our sharp focus on technology and the future - and the enthusiasm of bringing people face-to-face was electric, and inspiring.

Perhaps most importantly, NBAA-BACE was also an opportunity to consider big-picture issues, like sustainability business aviation sustainability. Aircraft are unquestionably cleaner and quieter than ever before, but there's more to be done.

On the eve of NBAA-BACE, executives with several business aviation organisations stood unified in renewing the sector's Business Aviation Commitment on Climate Change, with the aim of reaching net-zero carbon emissions by 2050. Of course, sustainability relates to commitments in the air and on the ground: a new carbon-offset program also made NBAA-BACE one of the world's largest carbon-neutral aviation events, and nearly 100 exhibitors signed a Green Pledge to reduce their carbon footprint at the show.

Throughout 2021, aircraft manufacturers introduced new aircraft designs offering increased performance, endurance and interior volume, while also promising even greater efficiency and lower emissions than ever before

As *World Commerce Review* readers know, NBAA is also promoting ways to increase production, availability and use of sustainable aviation fuels (SAF), including championing the creation of a blender's tax credit to incentivize SAF production across the US.

NBAA's second annual Business Aviation Sustainability Summit - held during NBAA-BACE and including fuellers and operators - further spotlighted SAF's benefits and other pathways toward sustainability.

Additionally, every outbound aircraft from the NBAA-BACE outdoor aircraft display at Henderson Executive Airport (HND) flew with SAF in the tank, and the renewable fuel was also available at McCarran International Airport (LAS) for the first time. Also launching this year was a program by which operators flying to NBAA-BACE could use book-and-claim to choose SAF, growing the market for the low-carbon fuels and generating emissions benefits.

Looking to the future, we know that sustainability will incorporate all manner of innovation - that's why NBAA-BACE was also an impressive showcase for technologies advanced aerial mobility (AAM) vehicles, which hold the promise of electric-powered, on-demand air transport. NBAA recognizes the importance of AAM in providing sustainable transportation to a diverse set of communities and has worked to nurture development of this emerging industry.

Challenges ahead

Even as our industry evolves toward a promising future, we must also consider what we can all do in surmounting the hurdles ahead of us. At the forefront of such concerns is the need to attract the next generation of business aviation professionals at a time when multiple sectors across aviation, and most other industries, face similar challenges.

NBAA welcomes the recent signing into US law of the bipartisan Infrastructure Investment and Jobs Act, which contains important measures championed by NBAA, including support of the aviation community's efforts to attract and retain a diverse and inclusive workforce.

The Infrastructure Investment and Jobs Act also includes significant funding for the Airport Improvement Program, including \$500 million for general aviation airports, and to spur development of next-generation transit programs like AAM.

Of course, we also face continued challenges from the lingering COVID-19 pandemic. Surging trends in the number of COVID cases across some areas - nationally and internationally - demonstrate the need to remain vigilant in combating the spread of the coronavirus.

Our industry also faces challenges, wrought by the pandemic, to the critical supply chain that supports our industry. Slowdowns at manufacturing and production facilities, with shortages of critical items - such as rubber, for tires - compounded by logistical bottlenecks that further constrain the timely delivery of critically-needed components, leading to difficulties in supporting business aviation flight operations during this time of rapid growth.

Despite some uncertainty as this year comes to a close and we look toward 2022, I'm confident that our industry will continue to innovate, respond and adapt quickly to these and other challenges, as we have countless times before, and celebrate the many promising developments that indicate a tremendously bright future ahead for business aviation. ■

Ed Bolen is President and CEO the National Business Aviation Association (NBAA)



Responsive... Efficient...
Innovative!

The Cayman Islands Aircraft Registry: Responsive...Efficient...
Innovative! Offering total aircraft registration solutions

The Cayman Islands Aircraft Registry (CIAR) is the registry of choice for many owners, financiers, management companies, attorneys and other key decision makers. Stringent standards and a mandate for absolute safety guide our oversight of Cayman registered aircraft. The CIAR has been operating as a reputable offshore aircraft registry since the early 1970s and has an outstanding safety record.

As custodian of the CIAR, the Civil Aviation Authority of the Cayman Islands' (CAACI) dedicated technical teamwork with aircraft operators on annual plans to ensure regulatory safety standards and timelines are met and where appropriate, flexibility and customised solutions afforded.

The CAACI works closely with Cayman Islands' industry experts in the legal/financial and company registration sectors to ensure sound and secure transactions for the initial aircraft registration or changes thereafter.

The CAACI staff is highly qualified and experienced in regulatory safety oversight and in working with aircraft management and maintenance organisations to ensure compliance with internationally mandated standards.

The CAACI regulates in accordance with the Air Navigation (Overseas Territories) Order, 2013 (AN(OT)O), as amended, a statutory instrument predicated on UK legislation that contains regulations governing the operational and airworthiness requirements for Cayman registered aircraft. Also relative is the guidance contained in the Overseas Territories Aviation Requirements (OTARS,) as published for all UK Overseas Territories.

The criteria for registering an aircraft begins with the first phase of the submission of registration documents through VP-C Online, the CAACI's bespoke secured data management portal. All of the registering owner's due diligence documents are required to be submitted when the Registration Application is submitted.

Appropriate due diligence is conducted in compliance with the Anti-Money Laundering Regulations of the Cayman Islands. With stricter Anti-Money Laundering regulations coming into effect in the Cayman Islands and the world over, the CIAR is required to be knowledgeable and comfortable with qualifying registrants that are accepted to the registry.

During the initial application process, the applicant can choose from a list of available registration marks which start with VP-C plus two variable letters. All information pertaining to registration of aircraft on the CIAR can be obtained from the CAACI website at <https://www.caacayman.com/aircraft-registry/>

*Stringent standards and a mandate for absolute safety
guide our oversight of Cayman registered aircraft*

The Cayman Islands provides a credible, politically stable jurisdiction of choice for aircraft registrations. As a leading tax neutral international financial centre, the English legal system provides owners and financiers of aircraft certainty and confidence.

Traditionally a private/corporate Aircraft Registry, the CAACI in conjunction with the CI Government and the Cayman Islands' Special Economic Zone – Cayman Enterprise City (CEC) has introduced an alternative means for compliance with the 'Principal Place of Business' criterion to allow offshore Air Operator's Certificates (AOC) to be granted for certain commercial operations.

The CIAR also works in close partnerships to ensure that aircraft registrants have expert guidance on applicable law and procedures. One such example is participation in a CI Government working group in partnership with local aviation finance attorneys to enable legislation compliant with The Convention on International Interests in Mobile Equipment (Cape Town Convention). The International Interests in Mobile Equipment (Cape Town Convention) Law (Cayman Islands), 2015, was enacted and came into effect on 1 November 2015.

Accordingly, the Cayman Islands received international recognition under the Cape Town Convention. This provided further comfort to global financial institutions that participate in aircraft finance transactions who wish to transact with parties in jurisdictions that are recognised under the Cape Town Convention.

An example of exceptional service provided by the CIAR is the creation of VP-C Online, a bespoke electronic data management system that provides a secure way to manage all aircraft documents including applications (starting with the registration application), certificates and approvals. VP-C Online is a convenient and secured way for registrants to apply for authorisations and certificates that are required for both initial aircraft registration and for continuing airworthiness and operations.

The ability for clients to file applications 24/7 from any time zone around the world is yet another positive client service benefit associated with the CIAR. The secured portal also acts as a repository for all technical and supporting documentation for the registration and continuing airworthiness processes for the tenure of the aircraft on the Registry.

Registrants will also enjoy the ability to check the status of applications and to re-print certificates or authorisations should the need arise. Testimonials received indicate that this convenient system makes The Registry a preferred choice in registration of aircraft.

The CIAR has always recognised the importance of aircraft financiers and lessors, as many of our clients in aircraft ownership and operation depend on these financial intermediaries. This is a valuable relationship we wish to foster through an insightful and collaborative understanding to the interdependencies of the industry.

We have introduced material processes, bespoke products and refined online portals, all specifically designed to support the interests of lessors. The CIAR is working to establish long term relationships with lessors to provide ready solutions where aircraft registration support is required with emphasis beyond the registration process.

The CIAR is currently focused on offering a 'Transition Register' that is supported by highly experienced employees and full-time personnel of the CAACI. Our team have extensive regulatory backgrounds and experience in several regulatory jurisdictions; this along with our regulatory Code (Overseas Territories Aviation Requirements [OTARs]) enables our ability to place aircraft in multiple jurisdictions in an expeditious manner following our normal attention to stringent safety protocols.

A new objective of the CAACI, within the Transition Register offering, is to delegate responsibilities to qualified Continuing Airworthiness Management Organisations (CAMO) under the Air Navigation (Overseas Territories) Order (AN(OT) O). This is a significant task for the CAACI where specific oversight arrangements in keeping within the delegation have to be established to ICAO performance-based regulation standards.

This delegation to selected CAMOs (approved for Aircraft Transition activities) provides for significant efficiencies in the relationship between the CAACI acting in regulatory oversight and the CAMO making submissions for gaining Approvals and Certificates.

Scenarios such as aircraft repossessions where timely and proactive solutions are necessary, these pre-established compliant resources in CAMO and Ferry Flight Operators are vital to achieving reliable and safe outcomes.

The CAACI has established a project management system for Transition Aircraft. This generates the need for close coordination between all involved, regular liaison meetings are arranged to ensure the Transition project remains active during the aircraft's registry in the Cayman Islands and commensurate with the status of the Lessors operational objective. The key is to mitigate last minute exercises often the case where aircraft sit in storage without any oversight.

Our online portal VP-C online is being innovated to include a Lessor Module whereby a lessor can apply for a VP-C Online account for visibility to the aircraft that a lessor may manage.

The CAACI offers Lessors a Service Level Agreement (SLA) that is specifically designed for Aircraft Transitions, offering a clear list of the services provided and a fixed fee structure. This provides the Lessor with confidences and pre-defined budgetary information often required by financiers and investors associated with aircraft assets.

With a focus on the quality of service and flexibility the CIAR continues to set themselves apart from other jurisdictions offering aircraft registration. The CIAR remains committed to offering a personal, responsive and high-quality service to clients and partners and to finding innovative and efficient solutions to the needs of those they serve.

The Cayman Islands Aircraft Registry: Responsive...Efficient...Innovative! Offering total aircraft registration solutions. ■