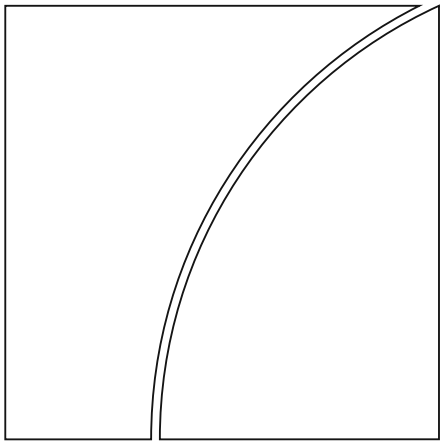
BANK FOR INTERNATIONAL SETTLEMENTS



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Foreword

The 18th BIS Annual Conference took place in Zurich, Switzerland, on 28 June 2019. The event brought together a distinguished group of central bank Governors, leading academics and former public officials to exchange views on the topic "The digital economy and financial innovation". The papers presented at the conference are released as *BIS Working Papers No 841 and 842*.

BIS Papers No 109 contains Panel remarks by Claudia Buch (Vice President, Deutsche Bundesbank), Norman Chan (former Chief Executive, Hong Kong Monetary Authority) and Jon Cunliffe (Deputy Governor, Bank of England) and a resulting Panel discussion between Agustín Carstens and them.

Programme

Thursday 27 June 2019

18:00	Welcome cocktail and informal barbecue	

Friday 28 June 2019

09:00–09:10	**Welcome**	**Hyun Song Shin**, Bank for International Settlements
09:10–10:30	**Session 1:**	**Technological advances and the financial system**
	Chair:	**Veerathai Santiprabhob**, Bank of Thailand
	Author:	**Susan Athey**, Stanford Graduate School of Business
	Discussants:	**Franklin Allen**, Imperial College Business School
		Cecilia Skingsley, Sveriges Riksbank
10:30–11:00	**Coffee break**	
11:00–12:20	**Session 2:**	**Machine learning and central banking**
	Chair:	**Mario Marcel**, Central Bank of Chile
	Author:	**Hélène Rey**, London Business School
	Discussants:	**Francis X Diebold**, University of Pennsylvania
		Luiz Awazu Pereira da Silva, Bank for International Settlements
12:20–14:00	**Buffet lunch**	
14:00–15:20	**Session 3:**	**Financial innovation and changes in financial intermediation**
	Chair:	**Pablo Hernández de Cos**, Bank of Spain
	Author:	**Thomas Philippon**, New York University, Stern School of Business
	Discussants:	**Manju Puri**, Duke University, Fuqua School of Business
		David Dorn, University of Zurich
15:20–15:50	**Coffee break**	

15:50–17:10	**Session 4:**	**The real effects of financial innovation**
	Chair:	**Olli Rehn**, Bank of Finland
	Author:	**Antoinette Schoar**, MIT Sloan School of Management
	Discussants:	**Thorsten Beck**, Cass Business School
		Janice Eberly, Northwestern University, Kellogg School of Management
17:10–18:20	**Wrap-up panel:**	**Financial innovation in the digital age: implications for central banks**
	Chair:	**Agustín Carstens**, Bank for International Settlements
	Panellists:	**Claudia Buch**, Deutsche Bundesbank
		Norman Chan, Hong Kong Monetary Authority
		Jon Cunliffe, Bank of England
18:45–21:30	**Conference dinner**	

Saturday 29 June 2019

07:30–10:00	Buses depart for Basel

Contents

Panel remarks – Claudia Buch

Claudia Buch[1]

After the global financial crisis, central banks were assigned a crucial role in contributing to a stable financial system. In this regard, monitoring and assessing risks to financial stability is a core responsibility. Assessing the financial stability implications of digital innovations requires an understanding of how vulnerabilities emerge and how they change over time. This includes assessing the risks of individual institutions, connections with other institutions, and exposure to common shocks. To the extent that new providers of digital financial services such as fintechs and big techs change the value chains of financial activities and cooperate with financial institutions, disruptions of value chains might become systemic.

Digital innovations affect vulnerabilities and the resilience of the financial system

Obtaining reliable information on the activities of fintechs and big techs from traditional statistics and reporting systems is difficult. Hence, mapping interconnectedness in the financial system – so far – focuses mainly on "traditional" financial institutions (see graph). Given the patchy knowledge base, it is crucial to monitor the resilience of institutions to assess whether emerging vulnerabilities will ultimately endanger financial stability. In this regard, it is interesting to note that some new providers of digital financial services, such as big techs, are not funded through deposits and are well capitalised. This may – a priori – mitigate financial stability concerns. However, these companies might venture into the realm of "traditional" financial services such as deposit-taking and lending or innovatively bundle existing services and products to create a new product. In this case, fintechs and big techs may assume the same risks or even greater risks than regulated financial institutions do. Hence, assessments of resilience and of the related risks may change, which requires first and foremost adequate coverage of these institutions in official statistics.

[1] Vice-President of the Deutsche Bundesbank.

Interlinkages in the German financial system for selected sectors

Quarter-end data of claims/liabilities as a percentage of GDP, as at 2018 Q4

Source: Financial accounts of the Bundesbank, Federal Statistical Office, and Bundesbank calculations. * Data on the following claims were taken into account: deposits, debt securities, loans, listed shares, investment fund shares, insurance technical reserve entitlements and trade credits. **1** Including non-profit institutions serving households. **2** Excluding money market funds.

Deutsche Bundesbank 25 Jun 2019, F3PR0153.Chart

Digital innovations could be a catalyst for structural change in the financial system

Historically, structural changes in the financial system have been a consequence of the process of financial innovation in terms of new products or services, new production processes or new organisational forms.[2] Financial innovation has often had its roots in advances in the processing power of IT systems and lower costs for data storage.[3] In a similar vein, digitalisation has the potential to change the competitive advantages of providers of financial services. New market entrants may have superior technologies for the screening of borrowers and thus lower information asymmetries.[4] For example, big tech firms have access to a wide range of customer data, which may be used to improve risk assessments and the screening of borrowers.[5] Additionally, big tech firms might be able to achieve economies of scale through network effects. As a result, the business models of financial institutions that are based on the cross-subsidisation of different types of service may come under pressure.

Financial innovations and new digital financial services may help to raise productivity in the financial sector. While the global financial sector has grown

[2] S Frame, L Wall and L White, "Technological change and financial innovation in banking: some implications for fintech", Federal Reserve Bank of Atlanta, working paper, no 2018-11, 2018. S Frame and L White, "Technological change, financial innovation, and diffusion in banking", in *The Oxford Handbook of Banking*, second edition, Oxford, 2014.

[3] T Beck, T Chen, C Lin and F Song, "Financial innovation: The bright and the dark sides", *Journal of Banking & Finance*, vol 72, 2016, pp 28–51.

[4] G Dell'Ariccia, "Asymmetric information and the market structure of the banking industry", *IMF Working Papers*, no 98/92, 1998. G Dell'Ariccia, E Friedman and R Marquez, "Adverse selection as a barrier to entry in the banking industry", *RAND Journal of Economics*, vol 30, no 3, 1999, pp 515–34.

[5] J Frost, L Gambacorta, Y Huang, H S Shin and P Zbinden, "BigTech and the changing structure of financial intermediation", *BIS Working Papers*, no 779, 2019.

significantly, it has not been one of the most innovative sectors. Relative to GDP, the assets of German banks, for example, have increased from around 50% to more than 200% since the 1950s. Trends are similar for other banking systems. However, data for the past 150 years show that financial services in the United States have been produced under constant returns to scale, with an annual average cost between 1.5% and 2% of outstanding assets.[6] Similar trends are documented for European banks, albeit based on shorter time series.[7] More recently, roughly since the global financial crisis, the costs of financial intermediation seem to have declined as a result of improved technology and increased competition.[8] How digital innovations affect productivity in banking crucially depends on changes in the competitive structure of markets. As in other industries, the entry of new, more productive firms and the exit of incumbent, less productive firms, can be a channel for improvements in productivity.

This process of "creative destruction" is, however, constrained by the fact that financial institutions which are being restructured or are eventually resolved may pose threats to financial stability. A core objective of post-crisis financial sector reforms has been to restore normal market functioning. Among other things, restructuring and resolution regimes for systemically important banks were introduced. The ongoing ex post evaluation of the too-big-to-fail reforms by the Financial Stability Board can be expected to provide useful insights in this regard as it assesses – inter alia – the effects of new resolution regimes.[9] The evaluation focuses on the implementation of reforms, and their credibility and effectiveness in terms of coping with the failure of systemic banks.

Additionally, changing patterns of competition in the banking industry can have implications for financial stability that go beyond those for individual banks. Insufficient exits can lead to overcapacity and excessive risk-taking by weakly capitalised banks, weaken aggregate profitability, and limit banks' ability to rebuild buffers following negative shocks. Generally, the link between competition and financial stability depends on the nature of the shock, risk-taking incentives at the level of the individual firm, and the overall structure of the banking system. In a highly concentrated banking system, dominated by a few banks, an idiosyncratic shock hitting a large financial institution can have repercussions for the entire system (granularity effects or "too big to fail"). But a decentralised and weakly competitive banking system populated by many small banks might also have destabilising features. If many smaller banks are exposed to the same (macroeconomic) risks, this too may create systemic instability ("too many to fail").

How the entry of new firms and the use of new technologies in the provision of financial services affect financial stability is thus hard to predict. It depends on changes in the riskiness of individual institutions and on structural features of the financial system such as the degree of concentration, interconnectedness and commonality in exposure to shocks. Assessing the costs and benefits of new financial

[6] T Philippon, "Has the US finance industry become less efficient? On the theory and measurement of financial intermediation", *American Economic Review*, vol 105, no 4, 2015, pp 1408–38.

[7] G Bazot, "Financial consumption and the cost of finance: measuring financial efficiency in Europe (1950–2007)", *Journal of the European Economic Association*, vol 16, no 1, 2017, pp 123–60.

[8] T Philippon, "On fintech and financial inclusion", *BIS Working Papers No 841*.

[9] Information on the evaluation, including consultative and final reports, will be available at www.fsb.org/work-of-the-fsb/implementation-monitoring/effects-of-reforms/.

technologies is, therefore, conceptually difficult, and a lack of data on new entrants and suppliers of financial services adds an additional layer of complexity.

This moves to centre stage the question of resilience against both shocks and mismeasurement of vulnerabilities. Risk assessments must take into account the structure of asset portfolios, maturity structures, exposures to common shocks, or funding structures. Key to a surveillance of the emerging market for financial services and changing vulnerabilities is thus sufficiently detailed and granular information on all relevant actors.

Better statistics are needed to improve surveillance

Answering these questions requires, first and foremost, an assessment of the business models of new market entrants. If the characteristics of these firms resemble those of regulated financial institutions in terms of risk characteristics that justify regulation, regulation should adequately address those risks.

Reliable statistics are the first ingredient in any discussion on regulatory responses to financial innovation from a macroprudential perspective. This presents a "chicken-and-egg" problem: decisions on (macroprudential) regulation – including the decision *whether or not* to regulate – require good and reliable data as an input for surveillance work. At the same time, data on financial institutions are traditionally collected within the context of (micro)prudential regulation and for monetary policy purposes. Hence, data would be collected *after* taking the decision to regulate.

One key policy response to digital innovations and new providers of financial services is thus to address what one may call the "big data paradox". On the one hand, new technologies promise a better, faster and safer provision of financial services and a more efficient use of data. On the other hand, financial regulators are struggling to understand the implications of digital innovations because there is hardly any consistent statistical information on how those innovations change market structures.

Currently, many statistics on the financial sector do not capture fintechs as most of these firms are recorded as providers of non-financial services. Therefore, the activities of these firms are not collected systematically, and information on the riskiness of big techs and fintechs is patchy. It is even difficult to obtain accurate figures on the total number of firms in the market or their market shares. Therefore, globally coordinated initiatives are needed to improve the statistical reporting on new financial activities, including information on activities, risks and capitalisation.

To close these gaps, a working group on fintech data issues was set up by the Irving Fisher Committee (IFC) to take stock of existing data sources, identify data gaps, provide guidance on fintech classification issues and develop a way forward.[10] The preliminary results of an IFC membership survey show that central banks are closing data gaps and gathering data from fintech infrastructure and service providers.[11] However, more work still needs to be done, especially with regard to the statistical business classification of fintech firms.

[10] The IFC is a forum of central bank economists and statisticians that operates under the auspices of the Bank for International Settlements.

[11] The results of the IFC survey on fintech data will be summarised in a report and published on the BIS website, www.bis.org/ifc/publications.htm?m=3%7C46%7C94.

Panel remarks – Norman Chan

Norman Chan[12]

Today I would like to make four sets of comments. The first comment is more generic in nature. The second comment relates to distributed ledger technology (DLT) and its implications for central banks. The third comment relates to a topic that was mentioned in earlier sessions today, which is about personal data protection, storage and use. The final comment is quite timely with Facebook's recent launch announcement for Libra. It is about the entry of big techs into finance.

Financial innovation: much more than technology

There is a lot of fuss being made about the potential for technology to change the financial landscape. But in my view, financial innovation is not just about technology; it is much more than that. For a long time, conventional financial institutions (FIs) and banks have focused a lot on their product offerings. They design products, think that these are what customers need and ensure that the products comply with rules and regulations. However, quite often they are doing so without really understanding how to provide an easier customer journey. So in my view, in addition to new technology applications, we also need to re-think about the processes.

I like the following analogy. Most of us have an audiovisual entertainment system at home. I have a very nice system, perhaps one of the best available in the market. But there are 85 buttons in the remote control that comes with the system. In the older model, there were more than 20 buttons. My wife could not manage it and she gave up. But there are now 85 buttons, so I also gave up. In contrast, for some other products such as Apple TV and Android TV, there are just five or six buttons in the remote controls. They are much easier to navigate and give you a better customer experience for the functions you need. Apparently, these companies devote huge amount of resources trying to reduce number of buttons and clicks to enhance the customer experience. This analogy shows us what a customer-centric/client-centric mindset would require. In fact, a lot of problems and unpleasant customer experiences with banks are basically about the processes, bureaucracy and legacy systems, which have nothing to do with technology.

The second point I want to make is about the tradeoff of convenience and speed. If you ask customers, they almost always prefer speed and convenience at no cost until something goes wrong. Only when something goes wrong do they become very careful and cautious. Indeed, convenience does not provide a safeguard. Speed does not guarantee safety. For example, in some jurisdictions, peer-to-peer lending platforms are based on mobile networks. They offer some advantages such as a fast and convenient online application process, but they do not necessarily provide safety.

My last point for this slide is about the blurring of FIs and fintech companies. When you talk with banks, they said they have invested millions and millions of dollars

[12] Former Chief Executive of the Hong Kong Monetary Authority

in technology. So fintech is not the monopoly of tech firms. There is, however, a big difference when big techs enter into the market. I will come to that later.

Implications of distributed ledger technology (DLT) for central banks

It seems clear to me that crypto-tokens without backing are unlikely to be qualified as money. As a means of payment, crypto-tokens are not scalable and you have to think about something else.

Then, the concept of central bank digital currencies (CBDC) has also attracted attention. For retail usage, I do not see a lot of merit because, in many jurisdictions, there are already very efficient, fast and safe retail payment systems that make use of commercial bank balances, not central bank balances. CBDC also poses the risk of an unclear and complicated impact on the monetary transmission mechanism and financial stability. In the case of a financial crisis, public demand for CBDC would replace that for commercial bank deposits, and that would pose a threat to financial stability.

Stablecoins require more attention as they present new benefits and risks. The banking system and the credit card system have been very inefficient in meeting the need for cross-border payments and making small payments at point of sale. Libra intends to tackle that, particularly in the cross-border context.

Finally, supervisors have been relying on entity-based regime to conduct supervision. But DLT, which is decentralised, can pose challenges to this entity-based regime, and authorities need to craft an effective supervisory strategy.

Challenges on personal data protection, storage and use

Some speakers have already touched on the topic of personal data protection. A key issue is whether customers own their personal data or not. Also, nowadays, a lot of financial firms are processing customers' data. Do customers own this processed data? Or do banks or FIs also own part of it? But fundamentally, what really matters is how the economic value derived from use of personal data, or the "digital dividend", is shared. At the moment, it is not shared by the customers whose data are being used. This is something we should think about.

The next concern is about the concentration risk of data storage and processing service providers (eg in the Cloud and AI). Now, only a few firms can provide such services, and you can immediately think about the concentration risk and operational risk if any one of these service providers fails.

The last point is tricky. As more and more banks and FIs use Cloud services, the location and domicile of the Cloud become an important issue. First of all, when the Cloud is located overseas, to what extent would foreign host authorities have access to the information with or without the home authorities knowing that? Secondly, in the case of disputes, and if banks were to be denied access to the Cloud, it would be similar to a death sentence for the affected banks. This is not something that an individual jurisdiction can overcome. We need dialogue and collaboration between international authorities.

Challenges of the big techs' entry into finance

On this one, I would recommend that you read the excellent chapter on the big techs' entry into finance, just published in the 2019 *BIS Annual Economic Report*. I want to add one point. We know in China, WeChat Pay of Tencent and Alipay of Ant Financial have hundreds of millions of customers and trillions of dollars in transactions. These e-wallets are mainly used domestically in China, even though they are clearly systemically important in nature. But in terms of cross-border transactions, it is mainly Chinese people using WeChat Pay or Alipay to make payment and shopping overseas, and therefore it is not truly global. What Facebook is trying to do with Libra, however, will be, in my view, truly global. Given WhatsApp's gigantic penetration, if it can be turned into a payment network, hundreds of millions of people will be covered globally. Then the problems identified in the *BIS Annual Economic Report*, regarding the trade-offs between financial stability, competition and data protection, will become imminent. This will require a more comprehensive approach in public policy that draws on financial regulation, competition policy and data privacy regulation, and these three levels of authorities will have to really come together and talk. As big techs expand beyond geographical borders, apart from domestic authorities that need to talk with each other, international cooperation is also urgently needed.

Panel remarks – Jon Cunliffe

Jon Cunliffe[13]

We have been doing some work on the future of finance at the Bank of England, and I want to talk not just about the detail but where, as a central bank, you position yourself in this debate.

Some of this speaks to political economy questions at a time when central banks are under challenge from a number of directions – so we asked Huw van Steenis to do a report on the future of finance. The report goes far beyond the responsibilities of a central bank, so why did we do this? Well, first, the way economies and people interact and transact is changing – and if we don't get ahead of these issues, we'll find we are behind on a number of them. So we thought that it would be useful to have a framing of these issues.

Why a central bank? First, we sit at the centre of the financial system, and we thought we have the ability to produce that overview – the central bank can put these issues on the table so that they can be addressed before you find yourself playing catch-up. Second, our starting point was not the risks or how to manage them, but the opportunities and the benefits – because you need to start with the recognition that the current system is not fully meeting societal needs. So we wanted to ask how society is changing, what are the drivers, and how finance might meet those needs.

Third, we wanted to ask what we as a central bank could do: I'll run through these items very quickly – the payment system, platforms for SME finance, a huge problem in the United Kingdom – we have a £22 billion SME financing gap – the transition to a low-carbon economy – regtech, data strategy, the cloud, and more generally, how technology can be used.

I'm going to focus now just on payments and regtech. On payments, we have already opened the central payment system, the RTGS, to non-banks, so we already have six payment providers in the system, and another 20 plus trying to come in – these have intra-day settlement only; we will open up a consultation on whether they could gain greater access, including overnight access, to the central bank balance sheet. A lot will depend on the regulatory framework and the business model of the applicant.

We helped the government to launch a payments strategy – the reason is that we have piecemeal regulation in the UK, with areas of overlap and underlap and, more importantly, because there is "oversight" rather than "supervision" of the payments system. This is because, historically, these facilities were owned by a small number of big deposit-taking banks, so that if you had supervision of these banks, you also had oversight of the payments system. But we're now in a situation where parts of the payments system are being conducted by others, being split up, and we need to have an end-to-end view of risk – which means taking a view of risk across a payment system that includes a number of different providers. We need to move to a more activities-based approach to payments regulation.

[13] Deputy Governor of the Bank of England

Moving to the data and regtech side, this is really about the use and hosting of regulatory data – our supervisors get 1 billion lines of data per month coming in from the insurance and banking industry, and our rule book is longer than *War and Peace*. There are estimates that it costs the industry between £2 billion and £4.5 billion a year just to produce the regulatory data that we need. So the question is whether we can move to a model where we pull the data in when and where we need it, applying AI and ML techniques. Can there be an interface that the industry can use? Can we bring the industry and the tech sector to achieve that? And at the same time we aim to make the rule book machine-readable.

I'll finish with a few words on Libra – we'd just announced this when Libra came out, which changed the reception – suddenly, when Facebook got behind it, this was seen as something that could happen quickly. In Mark Carney's words, we said we would approach Libra with an open mind but not an open door – but this underlined the need to get ahead of Libra, not to stop it, but to set out the perimeter within which it would have to evolve, so that it evolves for the good. A number of areas are involved, including AML, data protection, investor protection and securities regulation, but we see it as important to approach Libra holistically – because, if it succeeds as its proponents hope, it'll be a systemic cross-border network – potentially very quickly – so we have to think about the envelope for the whole ecosystem, not just about individual regulatory permissions.

The last point I'd make is we're not always very good at collective regulation and assurance on cross-border infrastructure – a common approach on which we can all depend – and this sort of development is going to ask very testing questions of us, which we'll need to solve.

Panel discussion

Agustín Carstens: I would like to ask some short but I hope meaningful questions. Claudia: what would be the key elements of a public policy on data?

Claudia Buch: Regarding potential new entrants and market participants, the first thing is that they should also have to fulfil the same reporting requirements as incumbent firms so we can properly assess the risks. Secondly, we have to review our reporting systems and see if they're fit for purpose. It might be the case that an increasing amount of activity is taking place outside the reporting system so that not all relevant developments are captured. Thirdly, we should cooperate with all authorities involved – cyber security, competition authorities, consumer protection, and so on. As these authorities also have data needs, data-sharing to the extent possible across institutions should be beneficial for all parties involved.

Agustín Carstens: Norman, in your presentation, you mentioned, I think rightly so, that the line between fintech, big tech and financial institutions is blurring. Can you tell us a little about your approach with open banking?

Norman Chan: Many conventional banks find it hard to move into a more customer-centric mode – mindset and legacy problems make the shift very difficult, although they all claim to be investing huge amounts in making processes more customer-friendly. So what we've decided to do is to make use of virtual banking as a new pilot scheme. We have just granted eight virtual bank licences. Two licences went to conventional banks – Bank of China (Hong Kong) and Standard Chartered – but the big tech companies, Tencent and Alipay, also got licences, together with Ping An, another big tech.

The aim of this exercise is to demonstrate how financial services could be delivered in ways different from conventional banking. One thing we've achieved, even before virtual banks have come into operation, is that conventional banks have done away with account fees that deter customers with low balances. Conventional banks have announced that they'll abolish such fees – because no virtual banks can charge a low-balance fee, this being a condition for getting these licences. So competition is already driving behavioural change.

The line between fintech, big tech and financial institutions is blurring because they are all competing in this regulated space. In the payments field, regulation varies a lot from place to place, but banking is heavily regulated, and there we as regulator need to come in. Turning to Hong Kong SAR, we have a lot of developments with the launch of the Faster Payment System. In a few years' time, we'll be able to tell you more about the outcome of this pilot, and whether it will create innovation, a better customer experience and financial inclusion – but I believe this is a positive development that we should all welcome.

Agustín Carstens: Jon: the Bank of England's choice of words was interesting – you said you wanted to "champion a platform" for SME financing. So how exactly do you champion a platform?

Jon Cunliffe: We have a big problem with small and medium-sized enterprise (SME) financing in the United Kingdom We don't have the kind of credit register that exists in other countries, although technology gives us the chance to actually change that.

We can't do that at the Bank of England, but the key is to enable SMEs to develop a portable credit file – to put together something that shows their credit history and enables them to have access to finance.

The government was working on creating a platform for small corporate data – and we said we'd try to help develop the model and an API interface that people could use to access that. We could do some of this because of the work we're doing anyway on the payment system. The Bank has a secondary objective of supporting the government's economic objectives, and this is an economic objective. In the United Kingdom, this would help solve the problem of the banking system not being much involved in lending to SMEs, and most SMEs are financing themselves on their credit cards and personal loans.

Agustín Carstens: Very interesting – now the floor is open for questions.

Norman Chan (in response to a question about the Faster Payment System): In Hong Kong, we're pursuing two initiatives with the Faster Payment System. The first is to introduce a very comprehensive system for retail and P2P payments. It serves the purpose of levelling the playing field for banks to compete with the very competitive big tech providers; and allowing individuals to transfer funds among themselves within seconds, at no cost.

The second initiative is to introduce a customer-to-merchant payment system, which will have a very profound impact. The credit card duopoly charges merchants high fees – as much as 5% for small operators. So we're developing a customer-to-merchant payment system to create a level playing field and give people an additional choice.

On third-party service providers, the most difficult issue is having trust in them, because once you allow these providers to have access to personal data, then the banks can legitimately ask how we know this transaction is authentic, and if something goes wrong – fraud, theft – who is responsible.

Banks are very careful about liability but it's not easy for a third-party service provider to be vetted. In the UK, you have the FCA licensing regime, but in Hong Kong we don't yet know the best way forward.

Jon Cunliffe: Norman just covered some of the points I would have made. PSD2 is now implemented in the United Kingdom – we're ahead of many other EU countries – but it went together in the United Kingdom with Open Banking, which came from our competition authorities. This was about creating a common interface across the banks, so that app designers could create apps that would work across all the banks.

I would say three things: the take-up has not been high; we're not yet seeing much developing in that space – that could be because people just take time to think about this. Or it might be that people are worried about their data. The second point is about liability; the Van Steenis report suggested we should look again at this issue because, if something goes wrong, people will sue the banks, which have deep pockets, not the software provider. So there's the question whether we've got the playing field right, which we'll look at again. The last point is that the United Kingdom is the only country I know that has an economic regulator for payments, in addition to the Financial Conduct Authority and the Bank of England.

Jon Cunliffe (responding to a question on the slow speed of implementing the reforms): It's 10 years since the crisis, and my feeling is that we've lost some of the energy behind the reform programme. It's nothing unusual to have national or

jurisdictional objectives, and it's only when you see what happens after failing to coordinate that you get results. So we're now in a period which is much more challenging than immediately after the crisis. But I think we now have more infrastructure for international coordination, and we have more mechanisms for connecting the regulators and standard setters with political authority. The task now is to work with the political authorities to get ahead of some of these issues before their citizens start to complain.

On the question about the limits of central banking – central banks have in some cases evolved over 300 years – we've picked up new responsibilities and lost some old ones. Our remit will be set by the political system, not ourselves: the key is that we remain the custodians of money and the safety of money, which also means the way people transact and the systems through which they transact. But these mandates may change: in the end, we report to a political authority.

Norman Chan: As to how we can speed up international collaboration, we need another financial crisis (laughter). Agreements on financial sector reforms were reached in the first year or two after the global financial crisis. After that, implementation became more difficult. Too-big-to-fail was a big deal, and at least we got a framework in place. But momentum has faded.

Where are the limits to central banks? For me, it's in the payments area. The most painful area is cross-border payments, especially for smaller participants. Therefore, central banks have to think carefully – or work collaboratively – to decide whether this should be left entirely to the private sector. Is this best left to private firms such as Facebook with Libra, or should the international official sector think about doing this? I don't think we should delay this discussion; we should start thinking about it.

To respond to the question about China's fintech ecosystem, it won't be long before Tencent and Alipay want to become truly global. When Libra comes into play, these two giants will think about what they should do. So the question for central banks is: are we content to leave it all to the private sector?

Claudia Buch: I agree that central banks are very special animals, with monopoly powers in some areas, and a key role in providing infrastructure within the financial system. Especially with regard to payments infrastructure, central banks shouldn't diminish their role – we're doing a lot and investing a lot. It will be interesting to see if and how new competitors will enter into this field. As central banks have a powerful position in many areas, we have to make sure that we don't cause any distortions. Let me also add some remarks on the topic of speeding up international cooperation: the Financial Stability Board and other international forums are still actively pursuing their mandates, and it's up to us to take on these new challenges. Our key focus should be to ensure that everything we've agreed upon so far is maintained and not diluted.

Agustín Carstens: I would like to propose a round of applause for our panellists and thank you all for your participation in this very successful conference.

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No	Title	Issue date
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