

Oesterreichische Nationalbank (Ed.)

## Proceedings

# The financial system of the future: 44th Economics Conference 2017 of the OeNB in cooperation with SUERF

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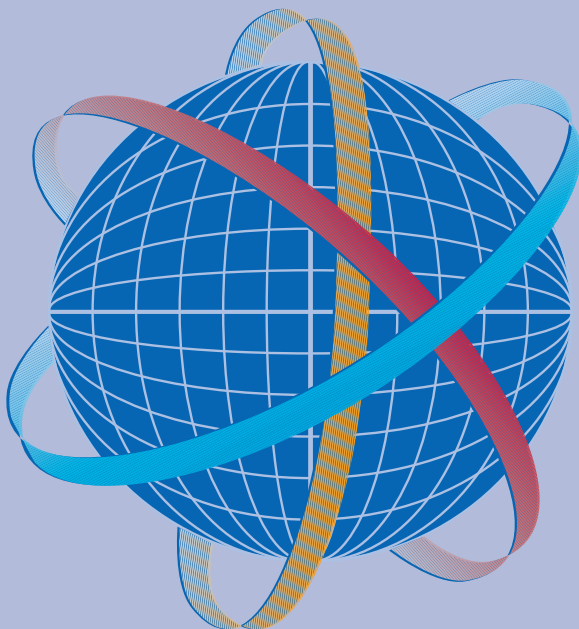
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44<sup>th</sup> ECONOMICS CONFERENCE 2017  
of the OeNB in cooperation with SUERF

The Financial System of the Future



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Ewald Nowotny

Governor  
Oesterreichische Nationalbank



## Opening Remarks

Ladies and gentlemen,  
I am very pleased to welcome you to the 44<sup>th</sup> Economics Conference of the Oesterreichische Nationalbank here in Vienna.

Today, I want to invite you to take a break from our routine engagement in the daily workings of the financial system. Let us take a look at the future instead: what kind of institutions and markets will manage our financial wealth, our liabilities and our payments in 10 or 20 years?

To explore this issue, we have assembled a noteworthy list of distinguished speakers from different backgrounds in academia, policy making and the financial sector. I am sure they will provide us with intriguing food for thought during our two-day conference. I would like to thank all of them for coming to Vienna and for contributing to our endeavor. I would also like to take the opportunity to thank the staff members of the OeNB, and our friends at SUERF, for their effort in organizing this event.

We are very pleased to organize this year's Economics Conference jointly with SUERF – The European Money and Finance Forum. SUERF has been in existence since 1963 and has made countless contributions to research on money and finance matters over the past half century.

SUERF's central aim is to facilitate and promote dialogue between policy makers, financial firms and practitioners as well as academia on money and finance topics. Such a dialogue is definitely also key to shaping the *Financial System of the Future*.

The OeNB has had a very special and good relationship with SUERF for over a decade. The OeNB hosts SUERF's Secretariat, and a senior OeNB staff member acts as SUERF's Secretary General. We are very glad about this

cooperation and would also like to encourage those among you who are not yet SUERF members to join this network.

My particular welcome goes to Federal Minister for Arts and Culture, Constitution and Media *Thomas Drozda*, who will tell us what role the financial system plays in his vision for the future of the Austrian economy.

I am also very honored to welcome my colleague *Erkki Liikanen*, Governor of Suomen Pankki – the Bank of Finland, who will give a lecture here tomorrow. Erkki Liikanen is not only a dear colleague of mine on the Governing Council of the European Central Bank, but he also heads the central bank of a country that is very advanced with respect to digitalization, which seems to be a major route for the future financial system to take all over Europe. He is therefore in a vanguard position to shed light on some of the challenges we are most likely to face on the road ahead.

Thank you very much for joining us today.



Ladies and gentlemen,

One of the key tasks central banks have is to ensure stability. Regardless of how stability is defined, it is inextricably linked with a longer-term orientation. Looking back at the 200-year history of our bank last year, we were re-

mindful of the many unforeseen events that had unfolded during the past two centuries. And this will become manifest in an even broader perspective when we celebrate the centenary of the establishment of the Republic of Austria next year.



Times change, and time and again we realize how flawed our efforts are at predicting the future. Public institutions that are committed to maintaining stability are invaluable because, in a long-term perspective, uncertainty about the future seems to be one of the few constants in life.

Today, technological innovation is an ever-present factor, but we should be wary of drawing deterministic conclusions from it. Structural changes in our economic system have exhibited a remarkable tendency to prove unpredictable. It seems that the only thing we can be certain about is uncertainty. This applies both to the future path of innovation and the future sources of financial crises. The former U.S. Secretary of Defense Donald Rumsfeld is well

remembered for his referral to “known knowns” as distinct from “known unknowns” and “unknown unknowns”.<sup>1</sup> In economics, these distinctions are well known, although under different names – certainty, risk and uncertainty.

For a central bank, committed to representing an anchor of stability, the main orientation points which guide its behavior in an uncertain world are of a macroeconomic nature: economic growth prospects, population trends and the distribution of the fruits of growth.

With respect to growth, the recovery in the wake of the financial crisis has been modest by historical standards. Strong savings, modest investment activity and a continuing debt overhang have led some observers to expect a period of secular stagnation. I do not share this gloomy perspective, but I agree that we cannot expect a return of growth rates comparable to those seen in Europe during the two decades of reconstruction after the Second World War.

Let me turn to population trends to illustrate that unforeseen events do not always imply a need for a downward revision of expectations, but can instead require an upward adjustment. A decade ago, Austria’s demographic projections pointed toward stability, even decline.<sup>2</sup> Yet, recent unforeseen developments have transformed perspectives. Largely due to migration, Austria’s population is expected to grow by as much as 12% until 2040 according to the latest forecasts.<sup>3</sup>

The impact of migration serves as a reminder that we live in an age of globalization. One reason for gloomy

expectations in Europe is a widespread perception that we are about to be overtaken by strongly growing emerging economies. And indeed, the EU’s share in global economic activity has been declining, namely from 26% in 2004 to 22% in 2015, and it is expected to fall below 20% by 2030. Similarly, the EU’s share in world population, currently at 6%, will shrink to a mere 4% by 2060.<sup>4</sup> But let us not lose sight of the fact that neither one of these shares in isolation is relevant for measuring our prosperity. What really counts is per capita income. Here, the EU – while still slightly lagging behind the U.S.A. – is still far ahead of any other economic region. And within the EU, Austria is among the top performers with respect to per capita income.

Perceiving the world economy as an endeavor where the expansion of one country results in a loss for the rest is a misperception that can become outright dangerous if it forms the basis of international policy making. Economic growth in emerging markets in recent decades went hand in hand with a growing world economy. In such an environment, a declining share in the world economy does not imply a welfare loss. After all, the global economy is not a zero-sum game.

Focusing on per capita income might undoubtedly mask huge asymmetries in the distribution of the gains from globalization within countries. But also in this respect, the European Union comprises the most equal societies in the world. Admittedly, it has not managed to escape the general trend of declining labor income shares that had started in the 1980s. As to household

wealth, information collected in the Eurosystem’s Household Finance and Consumption Survey points to disparities that are even more pronounced than inequalities in income. Income and wealth inequality may fuel social tension and harm economic growth, as pointed out by the IMF’s recent World Economic Outlook. To tackle inequality, the IMF reminds us that we will have to envisage policies which strengthen the position of those at the bottom of the income and wealth distribution in the labor market, and more substantial redistributive measures.<sup>5</sup> Otherwise, we risk losing public support for policies which contribute to our prosperity. We should not forget that international cooperation and exchange remain the key to prosperity in an interconnected world economy.

Finally, I would like to come back to the role of technology.

Let me touch on a few implications for the banking sector. Whatever impact digitalization will have on the future shape of the financial sector, it is reasonable to expect a reduction of the current labor force in the banking sector. To some degree, such downsizing is already an ongoing process in the post-crisis landscape. In Austria, we see employment in the banking sector decline. And we must be prepared to see a continuation of this trend in the years to come.

The other important change that is likely to occur is the rising importance of market-based forms of finance, also in countries like Austria, i.e. countries which are traditionally characterized by a dominance of bank-based finance. The capital markets union pursued by

<sup>1</sup> Graham D. A. 2014. *Rumsfeld’s Knowns and Unknowns: The Intellectual History of a Quip*. <https://www.theatlantic.com/politics/archive/2014/03/rumsfelds-knowns-and-unknowns-the-intellectual-history-of-a-quip/359719/>.

<sup>2</sup> Scherbov et al. 2008. *Probabilistic Population Projections for the 27 EU Member States Based on Eurostat Assumptions*. [http://www.oeaw.ac.at/fileadmin/subsites/Institute/VID/PDF/Publications/EDRP/edrp\\_2008\\_02.pdf](http://www.oeaw.ac.at/fileadmin/subsites/Institute/VID/PDF/Publications/EDRP/edrp_2008_02.pdf).

<sup>3</sup> Statistics Austria. 2017. *Population Forecasts*. [https://www.statistik.at/web\\_en/statistics/PeopleSociety/population/demographic\\_forecasts/population\\_forecasts/index.html](https://www.statistik.at/web_en/statistics/PeopleSociety/population/demographic_forecasts/population_forecasts/index.html).

<sup>4</sup> Source: European Commission. 2017. *White Paper on the Future of Europe. Reflections and scenarios for the EU27 by 2025*. *World Bank Database*. [https://ec.europa.eu/commission/sites/beta-political/files/white\\_paper\\_on\\_the\\_future\\_of\\_europe\\_en.pdf](https://ec.europa.eu/commission/sites/beta-political/files/white_paper_on_the_future_of_europe_en.pdf).

<sup>5</sup> IMF. 2017. *World Economic Outlook. April. Chapter 3. Understanding the downward trend in labor income shares*. p. 140. <http://www.imf.org/en/Publications/WEO/Issues/2017/04/04/world-economic-outlook-april-2017>.

the European Union will foster activity and cross-border integration in this domain, promoting the development of new forms to finance economic activity.

But the extent of economic activity to be undertaken and its financing needs will be shaped less by technology than by the macroeconomic parameters and policies I have already referred to above.

Having said that, framing technological evolution in a way that best adapts to macroeconomic circumstances

and contributes to their favorable development is certainly an important endeavor in an era of rapid change. I hope our conference will help foster our understanding of emerging trends and their possible impact – with all due modesty, given our experience in attempting to forecast the future.

I wish all of us two days of lively and productive discussion, and I hope we will succeed in strengthening confidence in the future ahead of us.



Thomas Drozda

Federal Minister for Arts and Culture,  
Constitution and Media



## Opening address: The Financial System of the Future

Dear Governor,  
Ladies and gentlemen,

It is my pleasure to welcome you today, also on behalf of Chancellor Kern, who sends his greetings. I have started my personal career in the central bank, so this is kind of a homecoming for me. Today, I would like to talk about the financial system and its role in the allocation of capital. I will also briefly mention what the government and the regulators can do to make the financial system of the future more stable.

But first, let me thank the central bank for hosting this conference for the 44<sup>th</sup> time because when you bring together policy makers and economists, bankers and academics, you provide us with a good opportunity to exchange our views and learn from each other. Today, the production of knowledge very often is organized in strictly separated fields, sometimes even called “silos”, and even within one field, theory and practice often are not much in contact. I would like to thank my former colleagues for organizing this event where we can mingle and chat and see what views we have on the financial system of the future.

When I worked as an economist in the Oesterreichische Nationalbank (OeNB) – some 25 years ago – our present financial system of today was still very much the financial system of the future. I am quite sure that back then no one would have imagined the financial system of the future in the way it has developed since. In the words of Paul Krugman: “The old world of banking, in which institutions housed in big marble buildings accepted deposits and lent the money out to long-term clients, has largely vanished.”

Then like today, we were concerned about the efficient allocation of capital. This has always been one of the most important functions of the financial system. Our economics textbook offered a rather sketchy idea how this allocation would work: banks take deposits and lend to enterprises that use these credits to fund their investments; the investments in new machinery, or more general: in new technologies, would then enhance the productive capacity of the economy and thereby drive growth. If each credit expansion was used to finance productive investment, financial deepening indeed would always contribute to growth and employment.

But it wasn't, so it didn't.



More and more often we see that people take credits to buy already existing assets, for example houses. While building a new house creates value added and therefore contributes to growth and employment as it generates profits for the construction firm and wages for the masons and plumbers, buying an already existing home is merely a financial transaction. Sure, there might be some value added from the real estate agent, but in comparison, it is negligible.

Adair Turner analyzed this phenomenon very well and called it “too much of the wrong sort of debt”. He shows that 2/3 of bank lending in the UK went into residential mortgages and another 14% into commercial real estate. By using a large share of credit for real estate transactions, you can inflate house prices, thereby making the house owners richer. But this is not the most productive use of capital one can imagine. And it also raises the question of sustainability: credit-fueled asset inflation drives up house prices and higher house prices justify larger loans because the loan-to-value-ratio stays within reasonable limits. As long as credit supply is unconstrained the expectation of increasing future prices itself leads to higher house prices and eventually to a bubble that will burst.

This is exactly what we have seen in the U.S.A., in Ireland or Spain. To prevent these self-reinforcing boom-bust-cycles from happening, we have to equip our regulators and supervisors with macroprudential instruments. But as useful as these instruments may be in strengthening the resilience of the financial sector and the economy as a whole, they do not address the root cause of the unsustainable credit demand: the rising inequality in our societies.

Thomas Piketty, Tony Atkinson and others have well documented the increasing inequality in western societies over the past decades. Raghuram Rajan was one of the first to explain the rising financial instability of the 2000s by the simultaneously rising inequality of income and wealth. His reasoning is straight forward: when a rising share of income goes to the people at the very top of the distribution, the middle class and everyone else must take credits to keep their standard of living. This leads to growing indebtedness of more and

more private households and once an asset price bubble bursts, these households end up being over-indebted. This over-indebtedness makes the recession following the crisis especially painful and long, because households have to deleverage before they can spend a larger share of their income on consumption again.

Now for what we know, in Austria income inequality has not risen as strongly as in other countries, but we cannot be quite sure as we have no reliable data. We know that wage inequality has not risen strongly, but information on capital income is lacking. Besides, wealth inequality is rather high in Austria as we know from the studies conducted by the OeNB in cooperation with the Household Finance and Consumption Network, for example.

So what is our policy response? If we want to avoid financial turmoil and strengthen the resilience of our economies, we have to strengthen the middle class. As it happens, this is exactly what our chancellor aims to do. Already last year Chancellor Kern has presented his vision for more growth and broadly shared prosperity by strengthening investment and labor demand. His aim is to implement practical measures that improve the lives of the men and women in our country directly.

As we are here on invitation by the central bank, let me quote Mario Draghi:

*“In a society where [...] the welfare state generously supplies education, health and housing benefits, covers against the risk of unemployment and protects old-age income levels, [...] holdings of wealth are less important. When these conditions cease to hold, [...] wealth takes on a new significance for household prosperity.”*

The plan of the chancellor, the so called “Plan A”, also aims at the sustainability of the welfare state. It includes

many initiatives that can be implemented at the national level and we have already started to do so.

But I would like to come back to the allocation of capital, this time at the international level. We know from our textbooks that national savings minus national investment equals the current account balance. This is not a theoretical conjecture but a mere accounting identity, so we know it must hold. Countries that exhibit a current account surplus save more than they invest and lend their excess savings to other countries. This might be a perfectly sensible thing to do as many countries face demographic challenges in the form of ageing populations. The financial system should also facilitate the allocation of capital over time and enable people to manage their personal finances across their lifetimes, between generations and across borders. In theory, well-integrated financial markets allow for international risk sharing and should stabilize the economy.

There are several problems with this assumption. First, there is no empirical evidence that risk sharing has happened in Europe to a degree that would have had any stabilizing impact on final demand, even before the crisis, despite a significant amount of financial integration (e. g. Moser et al., 2004). And second, investing abroad does not really yield high returns, if any. When German and French savers invested in U.S. mortgage backed securities or Spanish residential property, they suffered quite painful losses.

At the same time, investment at home is lacking. This is in particular true for the public sector: public investments have been at low levels for many years but the ministers of finance are obsessed with the “black zero”. This is worrisome because if domestic infrastructure is deteriorating, incentives

for private investments are waning, too. And in the current low interest rate environment, public investment would be cheaper than ever. Martin Hellwig, one of the most eminent German economists of our time, published an opinion piece in the FAZ last week, in which he was asking his government exactly to do that: invest more in public infrastructure to improve German roads and rails and to reduce the exorbitant German current account surplus.



I would also like to comment briefly on the stability of the financial system of the future. That financial stability is dear to central bankers goes without saying. But also we in government have a very strong inherent interest in the stability of the financial system, mainly for two reasons:

1. The economic, social and political consequences of financial crises can be dreadful. The Great Depression that followed the financial crisis of 1929 brought poverty and despair, radicalization and war.
2. Even if a financial crisis does not lead to depression, the cost of fighting a financial crisis or of avoiding a meltdown of the financial system usually ends up on the government's balance sheet.

Unfortunately, according to the work of Hyman Minsky we seem to be trapped





in a cycle: financial stability bears complacency, complacency bears crisis, crisis bears better regulation, better regulated markets bear financial stability, and so on.

How can we break this cycle? If I may say so, there are some dialectic lessons from the past:

First, we were told to avoid a financial meltdown at all cost, which meant to save banks, sometimes even bankrupt banks in order to prevent panic. This was the big lesson from the 1930s.

Then we learned that banks that were almost bankrupt could delay or even impede the recovery when kept alive artificially; the warning example has been Japan since the 1990s. So, the conclusion was to avoid “zombie banks”, and let bankrupt banks go belly up. (e. g. Caballero et al., 2008)

So how do we square this circle? The synthesis seems to be to save the part of financial sector that serves a useful economic purpose, and unwind the rest. To do so, we had to create a workable and credible resolution framework. An appropriate EU framework has been enacted, now we have to live by the rules that we have agreed upon in order to establish the credibility that we need.

In this context, I would like to echo a warning by the IMF. In its recent Global Financial Stability Report, the

IMF states that in response to the financial crisis, major regulatory reforms have been started. However, while the financial system is still vulnerable in some respects, there are pressures to stall or even roll back the reform process. Clearly, we have to evaluate our reforms constantly and adjust shortcomings or overshooting when needed. But, for the very reasons I have just presented, we want the financial system of the future to be strong and stable and therefore we cannot allow ourselves to be complacent or our regulations to be weak.

Also the policy makers must be strong and sincere on this point. It is not sincere to agree on regulations in Brussels and then to complain at home about the onerous EU regulations. They did not appear from nowhere, member states’ ministers have a fair share of ownership for these regulations and they have to live up to that.

Before I end let me just briefly mention two more issues about the future of payment systems that you might discuss during the conference. With respect to Bitcoin and other alternative forms of money: personally, I am rather open to these approaches, but also skeptical about their chances. We know that Hayek had this idea about competing private currencies and good money driving out bad money. However, that was in the 1970s. Now, in the days of Google and Facebook, we are constantly reminded of the existence of network externalities that might also work in favor of our legal tender issued by the central bank.

And with respect to the future of coins and banknotes, let me paraphrase Mark Twain: reports on the death of cash are greatly exaggerated. We will use cash in everyday transactions for the foreseeable future and we in government have no intention to take away

cash from our citizens. Unfortunately, some politicians like to evoke a phantom menace that is threatening the public because they hope to gain some additional votes by fighting these made-up conspiracies. Unfortunately, some sensationalist media like to propagate these made-up threats. But I can assure you that there are enough serious politicians who are focused on the financial system of the future and the real problems and the real solutions.

Finally, as Governor Nowotny quoted Rumsfeld’s distinction of “known knowns”, “known unknowns” and “unknown unknowns” I would like to bring to your attention a response by the philosopher Slavoj Žižek who reminded Rumsfeld that next to these “knowns” and “unknowns” there is also the “unknown known”: things that we don’t know that

we know them. Žižek was referring to the Freudian unconscious. When it comes to the financial system and the question: how to avoid a financial crisis? I find it quite interesting how many things that we have known were unknown when we needed them. The insights and findings of Keynes, Minsky, Tobin or Galbraith – just to name a few – have been suppressed to establish a new orthodoxy in the spirit of the ever so efficient market. Generations of economists had to unlearn the things they had known from their university training and when the crisis hit us, many policy makers and their staffs were unprepared. I hope that this conference also gives us the chance to uncover some of these insights and help us to establish a more stable financial system of the future.

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Session 1

Digital money and digital banking



## Introductory remarks: Digital money and digital banking

Central banks and the banking system have been the institutional backbone of the monetary system for roughly three centuries. Today digitalization is making inroads into both of these domains. While it is still unclear how transformative these changes will turn out to be for money and banking as we know it, the discussion, both among academics as well as among practitioners, has gained momentum in the past few years.

We want to take up the major themes and issues of this debate right at the beginning of our conference on the future of the financial system, which will obviously be a future profoundly shaped by digitalization.

In the debate, some have embraced a rather utopian interpretation of the recent technological advances in money and banking. For them, digitalization promises a future of higher financial inclusion, and unprecedented user-friendliness by broadening the availability of financial services and by slashing the costs of providing these services. At the same time, it is argued, we can expect improvements in financial stability because thanks to their decentralized nature, the new technologies of digital money and banking, in particular the blockchain technology, will increase the resilience of the financial system.

Others are more concerned with potential downsides, fearing, in particular, the retreat of the state from money and banking, monetary chaos, financial instability and financial exclusion rather than inclusion as well as negative labor market implications for those in the financial industry who will be made redundant.

How is it possible that the participants' views in the debate differ so widely, with even contradictory interpretations of the implications of recent develop-

ments for the near or mid-term future? One obvious reason is that we tend to have a poor understanding of many aspects of the issues at stake. While we discuss at length particular aspects, say, cryptocurrencies and blockchain technology, FinTech and banks, peer-to-peer lending and payment innovations, very rarely due consideration is given to the bigger picture, taking into account how the different parts interact and influence each other. For instance, we still know very little about how the digital revolution in money will interact with the digital revolution in banking. How will monetary policy work in a digital world? Should central banks actively adopt new technologies or pursue a more passive strategy? Is it necessary to develop regulatory tools now, or is it better to pursue a “hands-off” approach and not to impede financial innovation?



In the end, the discussion of the implications of digital change in money and banking forces us to rethink the foundations of our monetary and financial system and the key economic functions it has to and should fulfill.

In this session, we will have two papers that can help us with this task. Our first speaker, *Michael Kumhof*, senior research advisor at the research

hub of the Bank of England, will present a paper about the macroeconomics of central bank-issued digital currency. Michael and his co-author, John Barrdear, see great potential in an activist approach, where central banks embrace and actively use the new technology of digital currencies for monetary policy and macroeconomic stabilization. Our second speaker, *Thomas Puschmann*, will shed light on the digital revolution in banking. He can draw on rich experience as

the head of the Swiss FinTech Innovation Lab at the University of Zürich and Executive Director of Swiss FinTech Innovations, an independent association of Swiss financial institutions committed to driving collaboration and digital innovation in the financial service industry. Based on this experience he will discuss the question whether technological change in banking will lead to an effective end of banks as we know them and lead us into a future of “banking without banks.”





## The macroeconomics of central-bank-issued digital currencies

The emergence of the distributed ledger technology (DLT) and of Bitcoin was a watershed moment in the history of electronic monies. It may now, for the first time, be technically feasible for central banks to offer universal electronic access to their balance sheet, to a central bank digital currency (CBDC). The only existing form of electronic access, centralized real-time gross settlement (RTGS) systems, has only been designed for a small number of participants, and would not be sufficiently robust to accommodate universal access.

We define CBDC as a monetary instrument issued by the central bank, available on a 24/7 basis, electronic and probably based on DLT, universal (meaning accessible to banks, firms and households), national-currency denominated, issued either through public spending or against eligible assets (government debt), coexisting with the existing banking system (with banks remaining the creator of the marginal unit of domestic currency), and interest-bearing, with the interest rate managed so as to equate demand and supply for CBDC at a 1:1 exchange rate with other forms of national money.

We use a state-of-the-art DSGE model to study the benefits and costs of introducing CBDC into an economy that is calibrated using U.S. macroeconomic data. The key ingredients of this model are a banking sector that creates private deposit money through the extension of loans, a government that creates CBDC, and a private sector that requires liquidity to purchase consumption goods, investment goods, and inputs into production. Liquidity in turn is produced through an imperfectly substitutable combination of bank deposits and CBDC. Government policy rules cover fiscal policy (including the use of revenue from CBDC creation), traditional mone-

tary policy that determines the risk-free nominal policy interest rate, and CBDC policy that determines either the quantity of or the interest rate on CBDC. Countercyclical CBDC policy either withdraws CBDC from circulation in a boom, or makes CBDC less attractive to hold by paying a lower interest rate in a boom.

In this model, if liquidity becomes scarce, increases in tax-like monetary frictions increase the cost of doing business, leading to lower output. Liquidity scarcity originating in the banking sector can be partly offset through the creation of additional CBDC by the government.



Our first quantitative experiment studies the introduction of CBDC into an economy without CBDC. The magnitude equals 30% of GDP, which is introduced through buying back government debt equal to that amount. The result, which of course is calibration-dependent (but where that dependence can easily be studied), is a 3% increase in GDP, and this is shown to be due in roughly equal measure to three factors.

The first factor is lower real interest rates, due to a 30% of GDP reduction in the outstanding stock of high-interest defaultable government debt, and its replacement by 30% of GDP of low-interest non-defaultable CBDC. The

low interest rate on CBDC is explained by its non-pecuniary convenience yield due to its use in economic transactions, while its non-defaultable nature is due to the fact that holders cannot ask for repayment of sovereign money in something other than sovereign money.

The second factor is lower distortionary tax rates on labor, capital and consumption. The assumption is that the government uses the interest savings from CBDC issuance, and the revenue from its creation, to lower these taxes while leaving the deficit target unchanged.

The third factor is an increase in liquidity that lowers the cost of doing business. CBDC can be produced by the central bank without the cost of the spread and of other frictions that accompany the creation of bank deposits, leading to an overall increase in liquidity. The increase in CBDC is accompanied by a small further increase in bank deposits due to an increase in demand for liquidity in an improving economy. CBDC therefore need not crowd out but to the contrary may crowd in bank deposits.

Our remaining quantitative experiments study the use of CBDC as a monetary policy tool in a post-transition economy that is operating, on average, with CBDC balances equal to 30% of GDP.



One question concerns the comparative advantages of using a quantity rule or an interest rate rule to manage CBDC issuance over the business cycle. This choice turns out to be especially important following shocks to the supply of or demand for liquidity. Consider a sudden increase in the demand for liquidity, either in the form of bank deposits or of CBDC. We interpret this as a flight to safety, with agents preferring to hold on to their liquid and safe balances rather than spending them. This is represented in the model as an increase in the cost of doing business, and it has a contractionary effect on GDP. Going back to an argument of Poole (1970), under such money demand shocks a quantity rule is far inferior to a price rule, because holding liquidity fixed in the face of an increased demand for liquidity forces a much larger real adjustment. However, in Poole's world the central bank controlled the entire broad money supply, which is true neither in the current environment nor in a world with CBDC. Central banks only ever control narrow money, with very imperfect control over broad money due to the autonomous role of banks. The presence of CBDC does not alter this significantly, because CBDC only represents a fraction of the money supply, because its substitutability with bank deposits is unlikely to be extremely low, and because banks remain the creators of the marginal unit of currency. Our simulation finds that there is a trace of the Poole (1970) argument, in that a CBDC interest rate rule performs better than a quantity rule in buffering the effects of the shock, but it also finds that the difference is quantitatively small. The choice between a quantity rule and an interest rate rule does therefore not make a great difference.

Another question concerns the effects of using the CBDC interest rate countercyclically, in combination with the conventional policy rate for the interest rate on central bank reserves. To illustrate this, we choose a CBDC interest rate rule that, similar to the policy rate, responds to deviations of inflation from a target, and that otherwise maintains the CBDC interest rate at a fixed spread below the policy rate. Our simulations show that, in a credit boom-bust cycle, a negative response to inflation stabilizes output. In other words, during the boom/bust the spread between the policy rate and the CBDC rate widens/narrows, thereby making it less/more attractive to hold CBDC. The endogenous withdrawal and injection of CBDC liquidity during the boom and bust periods helps to stabilize GDP, over and above the effects of the policy rate. This result holds considerable promise for CBDC, but of course the subject requires further study.

There are also some arguments that advise caution with regard to CBDC. The most important of these is that the transition to such a system could be quite difficult, and getting the "plumbing" right requires very careful homework, including attention to legal and regulatory issues and to questions of computer hardware, software and protocols. But the good news is that many central banks are right now doing such homework.

Another objection to CBDC, the danger of a bank run due to the greater (electronic) ease of trading bank deposits against CBDC, seems to this author to be mostly based on a partial equilibrium fallacy. The point is that while it may become possible for an individual to quickly find a counterparty to dispossess of his bank deposit in exchange for

CBDC, there is no way for the economy as a whole to do so. The exchange of bank deposits between individuals does not change the aggregate stock of bank deposits, while a run from bank deposits against CBDC at the aggregate level would require that the central bank accept bank deposits in exchange for CBDC issuance. This however is ruled out as part of the assumed monetary policy operating environment. First, under a quantity rule the central bank allows the interest rate on CBDC to adjust to remove any demand in excess of the quantity target. And second, even under a CBDC interest rate rule CBDC is only issued against eligible assets such as government bills, not against bank deposits. A run scenario therefore requires extreme assumptions, such as CBDC interest rates that become too negative to be politically acceptable, together with a market that runs out of eligible assets to obtain more CBDC. It is hard to envisage such a scenario, particularly in a world where the presence of CBDC is likely to make resolution of troubled banks much easier and quicker, thereby removing part of the ex-ante incentive to run.

There are therefore many reasons to look at the possibility of CBDC issuance as a positive development, so long as the above-mentioned technical issues can be addressed. Central banks' stated reasons for considering CBDC issuance furthermore go beyond what is mentioned above, including improved wholesale securities settlement (Canada, Singapore), replacement of vanishing cash (Sweden), and greater financial inclusion (several developing countries). The future therefore promises to be very interesting, and research will have an important role to play.



## Banking without banks: Will technology transform financial intermediation?

### 1 What we know from the past: digitization as an enabler of financial (dis-)intermediation

Digitization changes the mechanisms of the established financial system from a hierarchical, centralized structure towards a more decentralized, networked one. But digitization is not a new phenomenon for the financial services industry. Some major milestones of early developments of digitization in the last century are the introduction of the automated teller machine (ATM) in 1959 in Arlington/Ohio (the first ATM in Europe was launched in 1967 by Barclays Bank in London), the transition from physical to electronic trading of NASDAQ in 1971, the introduction of home banking through Citibank and Chase Manhattan in 1981, the launch of the first internet banking in 1994 by Stanford Credit Union as well as the first mobile banking from the Norwegian Fokus Bank (Arner et al. 2015, pp. 9 ff.). The digital development of banking can generally be split up into three phases, each of them focusing on a different areas of digitization (Puschmann and Weber, 2017):

1. *Internal digitization (phase 1)*: The first phase of digitization concentrated on internal processes, such as advisory, payment transactions or portfolio management. Here, banks focused on the automation of financial services processes like for example cash transactions with ATMs.
2. *Provider-oriented digitization (phase 2)*: In the second phase financial service providers focused on the integration of core banking systems. For this, they had to standardize processes and application functions which were

delivered from standard core banking solution providers such as SAP or Temenos.

3. *Customer-oriented digitization (phase 3)*: This third phase of digitization is centered around customers and their processes redefining today's inside-out, product-centered to an outside-in logic. This phase is characterized by the application of new IT-developments like social media, smartphones, cloud computing etc.

The first two phases have already changed the banking value chain and financial intermediation, defined as banks' role as an intermediary of taking in funds from a depositor and then lending them out to a borrower (<http://www.businessdictionary.com/definition/financial-intermediation.html>). A well known example are the electronic stock exchanges that emerged as additional intermediaries between buyers and seller of securities. But with the third phase of digitization, financial intermediation might even increase in customer-related areas like robo-advisors and thus lead to new forms of financial intermediation between customer and banks.



## 2 What we know today: potential changes of the financial services value chain towards digital ecosystems

The market for so-called digital banking solutions or financial technology (short “FinTech”) solutions just recently developed as part of the third, customer-oriented phase of digitization in banking. These FinTech solutions differ regarding the provider type (bank/non-bank), interaction type (business-to-customer (B2C), customer-to-customer (C2C), business-to-business (B2B)) and the banking processes they support (advisory, payments, investments, financing, cross-process). Table 1 gives an overview on existing FinTech solutions and is characterized by the following developments (Puschmann, 2017):

1. **Banks:** Although many FinTech solutions from the third phase were developed from start-up companies from the non-banking sector, many banks currently start to adopt them. Among the B2C examples are video confer-

encing (advisory), robo-advisory (investments) and online credit application (financing). In contrast to B2C services where banks are the primary provider, C2C-solutions focus on peer-to-peer-services and platforms. Examples are peer-to-peer-payment or online customer communities.

2. **Non-banks:** The market sector of non-banks covers both start-up companies and large IT companies like for example Apple, Google or Alibaba. In contrast to banks, these FinTech solutions often focus on disintermediation and concentrate on single activities. In addition to the B2C and C2C interaction models, non-banks also provide B2B services which focus on cooperation among banks and non-banks. Prominent examples are digital client advisory (advisory), personal finance management (payments), digital identity or stock analysis and prediction (investments).

The maturity level of the different FinTech solutions differ regarding the pro-

Table 1

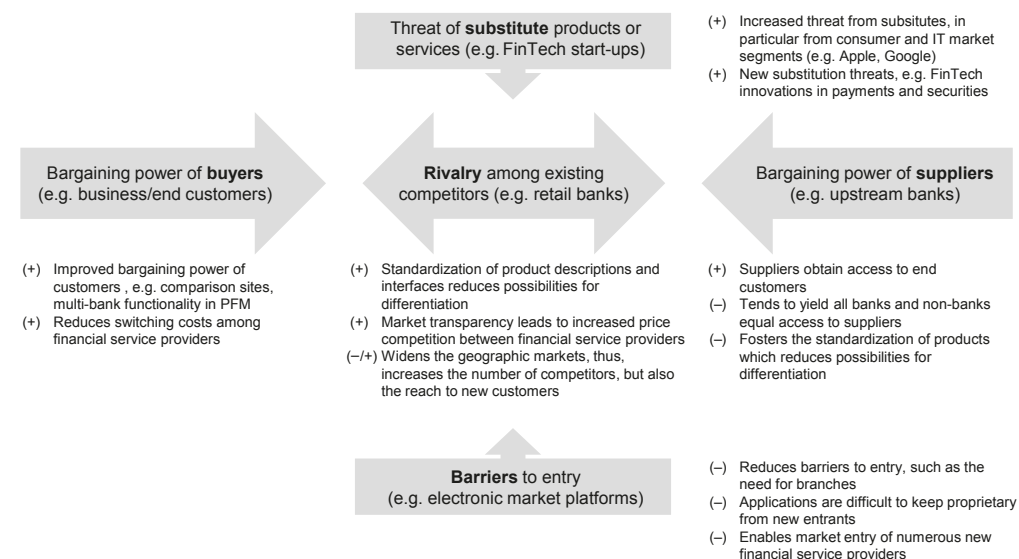
### Overview on FinTech Solutions

Provider type	Interaction type	Advisory	Payments	Investments	Financing	Cross-Process
Bank	B2C	Video conferencing (HVB, DE)	Social Media Payment (Commonwealth Bank of Australia, AU)	Robo-advisory (UBS, CH)	Online credit application (Targobank, DE)	Online bank account opening (Fidor Bank, DE)
	C2C	Online customer community (Bank of America, U.S.)	Peer-to-peer payment (Paymit, CH)	Community-based interest rate (Fidor Bank, DE)	Crowdlending (Hypothekarbank Lenzburg, CH)	Social network (Fidor Bank, DE)
Non-bank	B2C	Personal finance management (Mint, U.S.)	Cryptocurrency (Bitcoin)	Multi-asset trading (360t.com, DE)	Corporate credits (Finpoint, DE)	Electronic data safe (Secure-Safe, CH)
	C2C	Community-based advisory (Wikifolio, AT)	Mobile Payment (Square, U.S.)	Covesting (Covestor, U.S.)	Crowdlending (Lendico, DE)	Loyalty points marketplace (PointsPay, CH)
	B2B	Digital client advisory (Folio-Dynamix, U.S.)	Personal finance management (Meniga, SE)	Stock analysis and prediction (Stockpulse, DE)	Crowdlending (PostFinance & Lendico, CH)	Digital identity (WebID Solutions, DE)

Source: Puschmann (2017).

Chart 1

### Impact of FinTech on the banking value chain and financial intermediation



Source: Porter (2001), Alt und Puschmann (2012, p. 212).

cess areas covered. A recent study for example identified, that the most important sector of the emerging FinTech market is financing, followed by payments, cross-processes and investments (Haddad and Hornuf 2016, p. 21).

FinTech solutions enable both, more efficient business processes among the involved parties and the change of the existing value chain in banking towards new digital ecosystems<sup>1</sup>. A more in-depth analysis of the drivers behind this transformation can be structured along five forces (according to Porter, 2001; Alt and Puschmann, 2012, see chart 1):

- The new digital ecosystems strengthen the *bargaining power of buyers* because of reduced switching costs and the elimination of existing bilateral channel structures.

- FinTech leads to *increased rivalry among existing competitors* due to the entry of numerous non-banks and the adoption of FinTech solutions by banks.
- The increasing standardization reduces the *barriers to entry* in the market. Examples are the Payment Services Directive 2 (PSD2) or the Open Application Interface Programming (Open API) approaches of the British Financial Conduct Authority (FCA).
- The growing number of FinTech startups and the increasing service offering of technology companies lead to a growing *threat of substitute products or services*. An example is Financial Innovation Now, a cooperation of Amazon, Apple, Google, Paypal und Intuit for the development of new global financial services.

<sup>1</sup> A business ecosystem is defined as an “economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world. The economic community produces goods and services of value to customers, who are themselves members of the ecosystem. The member organisms also include suppliers, lead producers, competitors, and other stakeholders. Over time, they co-evolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of the ecosystem leader is valued by the community as it enables members to move toward shared visions of aligning their investments, and finding mutually supportive roles.” (Moore, 1993).



- The easier comparability of banking and products and services leads to an increased *bargaining power of suppliers*. An example is DNAppstore, an electronic toolbox for banks to bundle services from different service providers.

### 3 What we know today about the future: The internet of values and the peer-to-peer-economy

The five driving forces introduced before already seem to change the mechanism of the existing banking value chain. But does this mean that we are at the forefront of a new global financial order with new actors, new currencies and the possibility to conduct financial transactions across borders without any limitations? Four drivers might spur this development in the future:

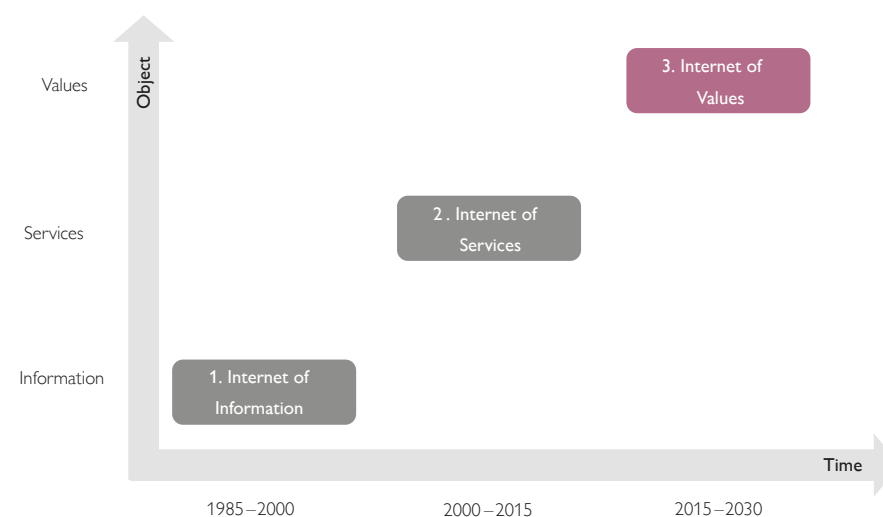
- *First*, the emerging peer-to-peer economy leads to a fundamental change of how economies work in the future (Sundararajan, 2016). Examples are Airbnb for renting flats or Getaround's mobility platform for lending and borrowing cars among private individuals. This peer-to-peer economy is not only characterized by transactions among peers, but also has an increasing impact on the existing digital infrastructures. First examples are AKASHA's peer-to-peer social networking platform or Sharetribe's peer-to-peer service marketplace. They all have in common that they are not built on centralized digital platforms like Google or Facebook (Parker et al., 2016).
- *Second*, from a technical point of view, the internet developed from the "internet of information" to the "internet of services" and currently takes another step towards the "internet of values" (chart 2). The first phase covered the standardization and exchange of information with the Hypertext Transfer Protocol (HTTP)

and the Hypertext Markup Language (HTML). The second phase focused on digital platforms like Facebook and Google and included standards like the Simple Object Access Protocol (SOAP). The third phase focuses on standards around blockchain, standards for digital payments, smart contracts and other areas for the exchange of values. The W3C consortium for example initiated a standardization group for online payments.

- *Third*, the development of cryptocurrencies has led to a new possibility to exchange "money" among individuals (peer-to-peer) that do not necessarily know and trust each other. Among the examples are Bitcoin or Ether. These cryptocurrencies all have the advantage that they provide a standard for exchanging "money" across country borders in almost real-time without the limitations of the existing financial infrastructures that require currency exchange platforms and banks. This trend is spurred by the big technology companies like Apple that just recently started to offer a peer-to-peer payment service via its iMessaging service or the different approaches for digital wallets. Both, the digital wallet and the possibility to exchange "standard" money globally is attractive from a consumer point of view, yet the national hurdles still limit these approaches.
- *Fourth*, many national regulators started to decrease hurdles for FinTech startups and their solutions which might lead to a de-regulation of this market. Examples are London, Hong Kong, Singapore, and Switzerland. All these countries for example introduced so-called regulatory sandboxes where startups can test innovative solutions in a protected area. An example is Switzerland where public funds of up to CHF

Chart 2

#### Evolution phases of the Internet



Source: Author's compilation.

1 million are exempted from authorization. In addition, some countries even launched new FinTech licenses. For example, Switzerland just recently introduced a banking license "light" to accept public funds of up to CHF 100 million.

#### 4 What we don't know yet about the future: Technology limitations, regulation and legal preconditions

All four drivers may have an impact on the future of the financial system. With the development towards a peer-to-peer, self-organizing financial system, the existing functions of the financial system to provide liquidity, to govern and coordinate financial markets and to reduce information asymmetry may change to some extent. If for example a firm can self-issue security papers fully digital on a blockchain, it can initiate and coordinate all processes in a decentralized manner without the need for a central party like a bank (e.g., for an IPO) or a stock exchange (e.g., for trading). In addition, cross-country stock trading could be improved by payments based on crypto-

currencies and thus, stock trading could be settled in real-time. These scenarios fundamentally change financial intermediation and the financial system as they decentralize more services than ever before. But although the potentials seem to be huge, there are still some limitations. A first one is the still low technical maturity of standards including areas like security, etc. Sure, they might evolve over the forthcoming years, but as we learned from the development of HTTP and HTML, it took many years and the same will probably apply for blockchain-related standards, too. A second limitation are the the political and regulatory preconditions that are not yet given to foster the internet of values. Still, most national regulations are too different as if a global standard might emerge in the next few years. In addition, many legal questions like ownership rights etc. have to be addressed.

Just as the first examples of the early internet pioneers have shown, many ideas emerged very early (e.g., to watch TV online), but finally took many years to develop. The same can now be observed with the internet of values, where many

new services can already be seen on the horizon (Ito et al., 2017). But it may take some more years until we can finally use them. In addition, not all things might become reality, a lesson that we could also learn from the first phases of the internet. So the future of the internet of values remains exciting over the next years.

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Session 2  
Keynote address

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## Introductory remarks: Preparing banking regulation for the future

### Introduction

Major reforms in banking regulation have been implemented as consequences of financial crises, where each crisis revealed further weaknesses and blind spots of the existing regulatory framework. The history of banking regulation provides vivid examples for this intuition: The Glass-Steagall Act of 1933 was introduced in the aftermath of the Great Depression in order to protect depositors and the real economy from turmoil on securities markets. The G20 and the Financial Stability Forum – today’s Financial Stability Board (FSB) – were established in 1999 in the wake of the Asian financial crisis. Basel III, the CRD IV and the CRR were introduced after the financial crisis of 2009.

Progress in banking regulation consists of a gradual learning process. A drawback of such a learning-by-doing approach, however, is that the regulatory framework can become quite complex.

So, what can regulators do to prepare financial regulation for the future? In the remainder of this text, I briefly reflect on some principles that I think could inspire future efforts in banking regulation to contribute to the efficient allocation of financial resources and fulfilling its key macroeconomic functions even if financial imbalances and shocks occur. This means that the banking system should consistently direct funds to those activities that deliver the greatest economic benefits. Under conditions of financial stability, economic agents have confidence in the financial system and good access to financial services, such as payments, lending, deposits and hedging, which also contributes to the effective transmission of monetary policy.

### Resilience: equity is king

As an immediate response to the global financial crisis, the G20 and the Basel Committee brought on the way major reforms that made the financial sector more resilient to shocks and promoted sound risk management. The European Union implemented legislation such as the Capital Requirements Regulation (CRR) and the Capital Requirements Directive IV (CRD IV). These reforms resulted in significantly higher levels of capital and liquidity than before the crisis and made individual institutions more resistant to shocks.

In addition to minimum capital requirements, Pillar 2 requirements allow for bank-specific liquidity and capital regulations to address bank-specific risks. In the euro area, the introduction of the Single Supervisory Mechanism (SSM) effectively contributed to the harmonization of standards in the setting of Pillar 2 requirements. This does not only lead to an increased loss absorbing capacity of banks. It also contributes to a level playing field and the further integration of the euro area banking system and, by that, to gains in economic efficiency.

The assessment of the Internal Rating Based (IRB) approach for the calculation of risk-weighted assets (RWAs) is a key priority for the SSM in 2017. Both supervisors and investors have expressed concerns about “RWA tweaking”, where banks exploit blind spots of the IRB approach to reduce their RWAs in order to reduce their capital requirements.<sup>1</sup> In this respect, I welcome the ongoing Targeted Review of Internal Models (TRIM) and efforts by the Basel Committee to improve the IRB approach<sup>2</sup> so that banks have to calculate

<sup>1</sup> *Le Leslè and Avramova (2012) and EBA (2013).*

<sup>2</sup> *BCBS (2016).*



risk weights and hold capital buffers, which better reflect the risks on their balance sheet.

The global financial crisis also demonstrated that the stability of an individual financial institution is not sufficient to ensure the stability of the whole financial system. The additional dimension of systemic risk was neglected until it materialized during the financial crisis and many banks held not enough liquidity and equity to withstand this shock. Hence, macroprudential supervision was introduced as a key lesson from the financial crisis. By addressing the systemic risk arising from the interconnectivity and inherent cyclicity of the financial system, macroprudential supervision is an indispensable instrument to maintain financial stability.

Preparing banking regulation for future challenges requires to closely monitor trends in financial services and to assess whether the potentially associated risks are captured in the existing regulatory framework. For example, with the rise of FinTech companies new opportunities can arise for consumers and businesses, but new types of risk might gain in relevance as well. Therefore, the OeNB in cooperation with the FMA closely monitors developments in this area within the European supervisory architecture.

### Resolution: bank market exit at acceptable social costs

Although banks have become significantly more resilient, some of them will at times have to exit the market. This is the simple logic of a market economy. In this context, maintaining the stability of the financial system and reducing systemic risk associated with bank resolution constitutes the task of macroprudential supervisors and the bank resolution authority. The insolvency of a large and highly interconnected bank could lead to contagion and expose an otherwise healthy financial sector to severe adverse shocks with possibly severe negative repercussions on the real economy. In the past this “too-big-too-fail” problem led to large bailouts. This implied wealth transfers from the public to bank shareholders and worsened the incentive structure for large banks.

After the financial crisis regulators agreed that they never wanted to be in a position again, where banks were “too-big-too-fail”. Therefore, the FSB in 2011 published Key Attributes of Effective Resolution Regimes for Financial Institutions, which provided the foundation of legislation such as the Bank Recovery and Resolution Directive (BRRD).<sup>3</sup> The BRRD requires European Member States to implement bank resolution regimes, which ensure that shareholders and certain creditors will bear the burden of failing banks through bail-ins.<sup>4</sup> Such instruments internalize the potential social costs of bank failure by limiting its negative effects to a clearly defined group of stakeholders in the financial sector, which are compensated for bearing that risk. This helps to avoid spillovers to the real economy and lowers the incentives for moral hazard, which makes the BRRD a welcome contribution to a structurally stable financial system.

The BRRD requires European banks to hold a Minimum Requirement for Own Funds and Eligible Liabilities (MREL) eligible for bail-in. According to the Final Report on MREL by the EBA European banks are well advanced in fulfilling the MREL requirement and the additional funding needs were estimated between 1.1% and 2% of total RWAs.<sup>5</sup> I expect well-capitalized banks with sustainable business models to be able to fulfil their MREL requirements in a timely and cost efficient way. However, there are still ongoing discussions about procedural issues concerning MREL, which delay the completion of the European banking union with respect to an effective resolution mechanism in the EU. This requires regulators to think about credible tools for the remainder of the current transition phase such as, for example, higher Pillar 2 requirements or significant increases in the systemic risk buffer.

### Proportionality: one size does not fit all

Although the reforms of financial regulation in the aftermath of the financial crisis significantly improved the stability of the financial system, they also increased the complexity of regulation. This is the result (i) of the international commitment to risk-weighted capital requirements and internal models, (ii) of the complexity of bank business models, and (iii) of the tension between international harmonization and the heterogeneous nature of national financial systems.

As already indicated in the introduction, the cohesiveness of the current regulatory framework suffers from the gradual extension of existing regulation. Complex rules for the calculation of RWAs of assets and for the governance of the Internal Rating Based

approach, and the opacity of the setting of Pillar 2 requirements lead to efficiency costs, which put a burden on financial markets, the real economy, and supervisory authorities.<sup>6</sup> Hence, reducing the complexity of the regulatory rulebook must be a key objective of future regulation. One way to do this could be to rely on more blunt measures such as a substantially higher leverage ratio at the expense of the risk adequacy of minimum capital requirements. But as long as the global regulatory community remains committed to risk-weighted capital requirements and the Internal Rating Based approach, banks and supervisors will have to cope with a certain complexity of bank regulation.

One way to approach this challenge is to strengthen the principle of proportionality in banking regulation. Complex regulatory rules in the European Union put smaller banks at a competitive disadvantage. Hence, they should be subject to simplified reporting obligations in accordance with their size, degree of connectedness and riskiness. In addition, the CRR should recognize the consistent application of the proportionality principle more systematically. Regulators should identify business models, where a more proportionate treatment could reduce compliance costs without cutbacks to the effectiveness of the supervisory regime. In addition, the rules regarding internal governance should consider a more proportionate approach to ensure appropriate management regimes, remuneration and disclosure.

On an international level, coordination and harmonization of regulatory standards must remain a key objective of future regulatory efforts. This would simplify the simultaneous compliance of internationally active banks with dif-

<sup>3</sup> FSB (2011).

<sup>4</sup> Deutsche Bundesbank (2014) and Deutsche Bundesbank (2016).

<sup>5</sup> EBA (2016).

<sup>6</sup> Liedorp et al. (2013) and Véron (2014).

ferent legal frameworks in different markets, reduce their compliance costs and, by that, support both competition and stability across global financial systems.

### Concluding remarks

Overall, I regard the current framework of banking regulation to be fit for the future. In fact, much has been achieved since the global financial crisis. Banks are more resilient to shocks because of higher capital and liquidity requirements as well as better supervision of internal risk models. Macroprudential supervision reduces systemic risk substantially. Once the BRRD and the Single Resolution Mechanism (SRM) are fully operative, they will reduce the “too-big-to-fail”-problem. In combination, these reforms massively reduce the probability and potential costs of financial crisis for society. Further cooperation on international

regulatory standards will reduce complexity, support competition and contribute to global welfare gains.

The banking sector and the real economy evolve dynamically. Over the next decades technological progress and changing consumption patterns will eventually affect the kind of financial services needed by households and firms. New developments such as the mushrooming of FinTechs affect various areas of the financial system and might lead to significant changes in the structure of the banking business. Therefore, banking regulatory, supervisors, and central banks need to closely monitor these trends to assess their implications for economic efficiency, financial stability, and for the transmission of monetary policy.

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## The political economy of central banking in the digital age

It is a great pleasure to be at this conference, which has prompted me to try to pull together my thoughts on how the new technology might affect central banks: what central banking is and what central banks do. I am glad to have that opportunity because quite some years ago, in 2004, I aired the possibility of the Bank of England issuing e-money at an annual strategy meeting.<sup>1</sup>

Since leaving central banking, my preoccupations have been less with substance than with the political economy of unelected power, of which today's post-crisis central banks are, of course, the epitome.<sup>2</sup> I am therefore going to try to put the substantive issues raised for your community by the new technology into a political-economy framework. By those lights, it is vital that the purported boundaries to any central bank e-money ventures or other new services be credible.

I will start out, in section 1, by outlining a conception of central banking as it is (or could be) practiced now, just as society starts to grapple with the new technology. I shall then ask, in section 2, whether and how the new technology challenges or even undermines that broad conception. Perhaps surprisingly, the big picture answer is that it will not, unless central banks move into providing banking services for everyone, which would make them more like a latent state-credit bank. An important qualification to "things stay the same" is that central banks will need to re-engage with the integrity

of the deep plumbing of the financial system. They must, though, be vigilant in not taking on roles that give them excessive power or which don't fit with their core purpose of maintaining monetary system stability.

### 1 A conception of late-20<sup>th</sup>/early-21<sup>st</sup> century central banking

In setting out a conception of central banking, I shall ask why they exist; what their purpose is; what they do; and whether they are too powerful for comfort in our constitutional democracies.

#### Why central banks exist: the pivot of a monetary economy

Towards the end of the 18<sup>th</sup> century, Francis Baring, the founder of the English banking dynasty, described the role of the Bank of England in the following terms. It was, he said:<sup>3</sup>



*"The centre or pivot, for enabling [the monetary and credit] machine to perform its functions".*

<sup>1</sup> With thanks to Steve Cecchetti for comments on an earlier draft.

<sup>2</sup> Forthcoming in a book, contracted to Princeton University Press, with the working title *Unelected Power: Central Banking, the Regulatory State, and Democratic Legitimacy*. This paper draws heavily on some of that material.

<sup>3</sup> Baring, F. 1797. *Observations on the Establishment of the Bank of England. And on the Paper Circulation of the Country*.

Today we would make the same point by saying that central banks are issuers of the economy's final settlement asset.

### Two types of central bank money

From then until now, there have been two types of central bank money: physical notes circulating amongst households and firms, and balances held by banks in accounts (today often called *settlement accounts*) with the central banks. It is important to remember that it was not always grasped that those balances were money.

In 1844, Prime Minister Peel personally took through the Westminster Parliament legislation that split the Bank of England in two accounting identities: into an *Issue Department* that issued notes and held gold as backing for them, representing the privately owned Bank's public functions; and a *Banking Department* that acted as banker to the banks, purportedly representing its continuing private or commercial functions. This, of course, was an egregious error. Not only were those bankers' balances central bank money, but the deposits held with the banks themselves were a form of privately issued money.

This is a monetary morality tale for our times, but one which needs some unpacking.

### A tiered payments-monetary system

One vital point is that the payments system, and hence the monetary system, is tiered. Most people hold most of their money in accounts with private banks, some big, some local and small. Since we do not all BANK with the same bank, those banks need to settle

claims amongst themselves. Smaller banks might do so by holding accounts with a bigger bank (*clearing banks* in Britain, *money center banks* in America). Those bigger banks in turn settle amongst themselves across the central bank's books, and so in central bank money.

We, households and businesses, might be able to overdraw our bank accounts, and similarly the smaller banks might be able to borrow from the bigger banks. But the big banks would have to overdraw with the central bank if they did not hold enough reserves there to settle up with their peers. The central bank is, then, the lender of last resort, a sentiment first captured by Baring when referring to Threadneedle Street as the *dernier resort*.

Another vital point is that monetary liabilities of the private banking system are partly created by their lending. They do not arise simply from members of the public or small shopkeepers going to their bank and handing over bank notes. More important, in terms of scale, is banks' lending: every bank loan creates a deposit liability somewhere in the system.<sup>4</sup> When a bank's deposits are no longer accepted as money, it cannot function. When the whole of the banking system is no longer trusted, bank lending ceases.

Three things are striking about this set up. It takes for granted:

- that private banking inevitably exists,
- that, in consequence, the economy's money system and its credit system are unavoidably intertwined, and
- that that calls into the existence a central bank as a monetary institution and liquidity reinsurer.

It also implicitly assumes that only banks will have access to the central bank's facilities. That is a big deal, and we should therefore take a brief look at the two *existence* assumptions, precisely because the new technology makes each of them moot.

### Banning central banking

A generation after Baring and on the other side of the Atlantic, President Andrew Jackson's conviction that a national bank would threaten the country's welfare prompted him to veto renewal of the charter of the Second Bank of the United States, the descendent of Alexander Hamilton's First Bank. Ever since, this has provided inspiration for the *free banking* movement, which wants to abolish central banking. Deprived of their liquidity backstop and forced to compete, bankers would, it is maintained, be driven to prudence, and so the economy could operate without the social costs of boom and bust.

Over the course of the 19<sup>th</sup> and early 20<sup>th</sup> centuries, weaknesses in this line of argument were exposed. First and foremost, it assumes that the legislature and elected executive are somehow themselves deprived of the right to bailout ailing banks: by the middle of the 19<sup>th</sup> century, the U.S. Federal government was effectively guaranteeing privately issued bank notes, giving depositors an incentive to switch into notes at the first sign of trouble. Surely, in today's full-franchise democracies the *moral hazard* problem is not sourced solely in central banking. Indeed, central banking creates the possibility of separating liquidity reinsurance for fundamentally sound intermediaries from the political question of whether to rescue fundamentally insolvent firms.

Second, it assumes that banks are sufficiently homogenous and monitorable for an improvident note-issuer to

be spotted and excluded from the *clearing house* via which they would settle their obligations to each other. But, in contrast to that club-like world, today's banks are so complex and heterogeneous that the dynamic would just as likely be towards a collective slide towards over-issuance.

Third, and in a quite different register, free-banking also implicitly assumes that society could live with even more power than now being in the hands of private bankers.

So, as the world is currently organized, the existence of central banks is no surprise.



### To ban or permit fractional-reserve banking?

What about private banking itself? Between our continent's two world wars, Chicago economists launched the other line of attack on the place of banking within a monetary system. Under the *Chicago Plan*, fractional-reserve banking itself would be banned, leaving only what are today known as "narrow banks" wholly invested in government bonds or central bank reserves (with central banks in turn invested in government bonds).

Why wasn't that taken up? I think the best explanation is that we, society, value the liquidity insurance provided

<sup>4</sup> A 2014 article by my former colleague Ryland Thomas has been welcomed in parts of the U.S. scholarly community as overturning orthodoxy about the very nature of the monetary system. This is, frankly, weird (not a word often used of central banking debates). The article is very good, but what Thomas describes was orthodoxy at the Bank of England well before I joined in 1980. McLeay, Radia and Thomas, *Money creation in the modern economy*, *Bank of England Quarterly Bulletin*, 2014 Q1.



by banks, including through committed credit lines. It reduces the need for households, businesses and other financial intermediaries to self-insure against liquidity risk by holding stocks of liquid securities, releasing resources for use in the risky enterprises that can help to generate growth and prosperity.<sup>5</sup>



It is also worth recalling that, rather amazingly, some of the strongest support for the 1930s *Chicago Plan* came from advocates of government deciding how to allocate *credit* in the economy. As Senator Bronson Cutting put it at the time, “private financiers are not entitled to any profit on credit”.<sup>6</sup> A project that academics saw as immunizing money from credit was, in political eyes, a means of getting the price mechanism out of credit allocation. It is something to ponder: credit-creation in the hands of politicians, pandering to

popularity, doing favours for friends, or approximating a planned economy. I do not find that especially attractive, but it does have lessons for central banking e-money innovations, as discussed below.

Irrespective of whether those arguments are persuasive, in the wake of the 2008-09 phase of the crisis, the issues were debated, to different degrees in different countries.<sup>7</sup> Rightly or wrongly, the universal decision was not to make what would have amounted to a massive change in the constitution of money. The costs of transitioning from one set up to a radically different one were too unknowable for it to be taken seriously by elected politicians. For better or worse, the world has persevered with fractional-reserve banking, subject to redesigned regulatory constraints.

#### What central banks are for: monetary system stability

The crisis did, however, prompt reconsideration of what central banks are for: what social purpose they serve. The older amongst you here will probably recall the siren words of Paul Volcker’s valedictory lecture to his international peers:<sup>8</sup>

*“I insist that neither monetary policy nor the financial system will be well served if a central bank loses interest in, or influence over, the financial system.”*  
(Paul Volcker, 1990)

<sup>5</sup> If the likelihood of deposit withdrawals and credit-facility draw-downs are not highly correlated, the aggregate benefits increase. Kashyap, Rajan and Stein. 2002. *Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-taking*. *Journal of Finance* 57/1. 33–73.

<sup>6</sup> Phillips, Ronnie J. 1992. *The Chicago Plan and New Deal Banking Reform*. *The Jerome Levy Economics Institute of Bard College Working Paper* 76. June.

<sup>7</sup> In the UK this was given oxygen when the then Governor Mervyn King expressed interest in the ideas in John Kay’s *Narrow Banking*. This led the government to establish a review of structural reforms of banking chaired by John Vickers, which came down against narrow banking (and against Glass Steagall separation of “commercial” and “investment” banking), but recommended ring-fencing any material retail banks within wider banking groups, after which the ‘narrow banking’ debate subsided. UK Independent Commission on Banking. *Interim Report*. 97–100.

<sup>8</sup> Volcker, Paul. 1990. *The Triumph of Central Banking? The 1990 Per Jacobsson Lecture*, Per Jacobsson Foundation.

After more than a decade in the wilderness, that wisdom is re-established as orthodoxy. Banking stability is *integral to monetary stability*. The public policy objective of preserving a stable financial system, able to provide the core services of payments, credit and risk insurance in all weathers, is not completely separable from monetary stability, because it is largely the stability of the private part of an economy’s monetary system, the banks, that is at stake.

Indeed, we should think of *monetary system stability* in this broad sense as having two components:<sup>9</sup>

- stability in the value of central bank money in terms of goods and services; and also
- stability of private-banking system deposit money in terms of central bank money.

The latter does not mean that no bank can be allowed to fail but, rather, that the supply of payments services from the system as a whole must be maintained.

#### A Money-Credit Constitution

The world I have described requires not a *monetary constitution* of the kind once advocated by the late James Buchanan but, instead, a *Money-Credit Constitution (MCC)*. By that, I mean joined-up rules of the game for banking and central banking designed to ensure broad monetary system stability.

This notion would have been familiar to our 19<sup>th</sup> century and early-20<sup>th</sup> century predecessors. Their money-credit constitution comprised: the gold standard plus a reserves requirement for private banks (an indirect claim on the central bank’s gold pool) plus the lender-of-last-resort function celebrated by the mid-19<sup>th</sup> century British journal-

ist Walter Bagehot. That package was deficient in so far as it did not cater explicitly for solvency-crises as opposed to liquidity-crises. Worse, as our economies moved to embrace fiat money during the 20<sup>th</sup> century, policymakers relaxed the connection between the nominal anchor and the binding constraint on bank balance sheets so comprehensively that it became non-existent.

At a schematic level, a *MCC* for the world as we know it (i. e. today’s familiar technology and public expectations) might have five components:

- a target for inflation (or some other nominal magnitude);
- a requirement for banking intermediaries to hold reserves (or assets readily exchanged for reserves) that increases with a firm’s leverage/riskiness;
- a liquidity-reinsurance regime for fundamentally solvent banking intermediaries;
- a resolution regime for bankrupt banks and other financial firms; and
- constraints on how far the central bank is free to pursue its mandate and structure its balance sheet.

We need five rather than three because one (resolution) was missing in the 19<sup>th</sup> century set up and because, in a world of fiat money, the nominal anchor does not of itself (seriously) constrain the size and composition of central banks’ balance sheets. In other words, banking institutions should be forced to self-insure against liquidity risk; and the legal system should be able to reconstruct failed intermediaries so as to combine continuation in the supply of services with losses falling on equity investors and bondholders. We are going to be interested in whether FinTech challenges the need for or composition of the *MCC*.

<sup>9</sup> This fed into the UK’s post-crisis reforms: Tucker, Paul. 2009. *Remarks at the Turner Review Conference*. Bank of England. London. March 27.

### What central banks do: manage the state's consolidated balance sheet, and constrain banking system balance sheets

Before getting to that, we need to be clear about what a canonical central bank (with some regulatory functions) does and/or should do under the conception of the monetary system I have described. Basically, it frames and implements the various components of an implicit or explicit *MCC* in pursuit of the two pillars of monetary system stability.

#### Monetary policy and LOLR: Managing the state's consolidated balance sheet

In doing so, it is useful to think of the central bank as conducting financial operations that change the liability structure and, potentially, the asset structure of the state's consolidated balance sheet in pursuit of the goal of nominal stability.

If a central bank buys (or lends against) only government paper, the structure of the state's consolidated liabilities is altered, with monetary liabilities substituted for longer-term debt obligations. If it purchases (or lends against) private-sector paper, the state's consolidated balance sheet is enlarged, its asset portfolio changed, and its risk exposures affected. In either case, any net losses flow to the central treasury via reductions in seigniorage income, entailing either higher taxes or lower spending in the longer run (and conversely for unexpectedly large net profits). That leaves plenty of room for competing visions of central banking.

A minimalist conception would restrict the proper scope of central bank interventions to open market operations (OMOs) that exchange monetary liabil-

ities for short-term Treasury Bills (in order to steer the overnight money-market rate of interest). The lender of last resort (LOLR) function would be restricted to accommodating shocks to the aggregate demand for central bank (base) money, and so plays no role in offsetting temporary problems in the distribution of reserves amongst banks in the private money markets.<sup>10</sup> Further, at the effective lower bound for nominal interest rates, the only instrument available to the central bank would be to talk down expectations of the future path of the policy rate (what has become known as "forward guidance").

At the other, maximalist end of the spectrum, the central bank would be given free rein to manage the consolidated balance sheet, buying and lending against instruments of all kinds, and being a seller in some phases of the so-called credit cycle.

#### Stability policy: regulatory constraints on banking

In framing and pursuing the other pillar of monetary system stability, the central bank would put constraints on banking balance sheets.

Broadly, those constraints take the following broad shape:

- $x\%$  of the face value of short-term liabilities ( $S$ ) to be covered by holdings of liquid assets, discounted to the value attributed to them by the central bank ( $d$ . LA);
- Residual assets ( $(1-d)$ .LA plus assets ineligible at the central bank) to be funded in prescribed minimum proportions by common equity ( $K$ ) and debt that can be converted into equity without disruption (known as bail-inable debt,  $B$ ), plus any "uncovered" short-term liabilities ( $(1-x)$ . $S$ ).

- $K$  and  $B$  could be higher, the riskier or lumpier the asset portfolio.
- Where  $x$  is set at 100%, this delivers full liquid assets cover for short-term liabilities.<sup>11</sup>

Given that the fragilities inherent in fractional-reserve banking are not confined to *de jure* banks and, furthermore, given endemic regulatory arbitrage and legion financial-system interconnections, the focus would be on the economic substance of *banking* (maturity transformation, leverage, and credit intermediation) rather than on the legal form of *banks*. In other words, both the central bank's liquidity reinsurance facilities and the corresponding constraints would extend to banking-like organisations, structures and vehicles.

#### The problematic power of central banks

The problem, of course, is that that is a lot: a lot to do; a lot to explain and defend; and, critically, a lot of power.

The underlying problem is whether it is possible to balance the welfare advantages of the credible commitment that central banks can deliver against the loss of majoritarian control.

One question is how to keep central banks on the "right side" of a blurred line between monetary policy and fiscal policy. Another is how far central banks should be able to write the rules of the game for finance.

I will leave those questions hanging, because my purpose here is to explore whether the new technology makes them go away or exacerbates them.



## 2 Central banking under the new technology

I hope, it will be apparent how that exegesis sets up a series of questions, challenges or threats, according to your taste, posed by the new technology. They are, staying with the structure I employed:

- Will central bank money still be the final settlement asset?
- Will fractional-reserve banking continue: i. e. will the money system and the credit system be coterminous, or
  - could they become separate, and
  - should the authorities push things in that direction?
- Will only banks need to bank with the central bank or could anyone?
  - and if banking with the central bank is not compulsory, what form would the intermediaries take?
- Will central banks still shape the state's consolidated balance sheet?
  - and if so, will the regime move towards the minimalist or maximalist conception of central bank balance-sheet operations?

<sup>10</sup> Tucker, Paul. 2014. *The Lender of Last Resort and Modern Central Banking: Principles and Reconstruction*. BIS Papers 79. Bank for International Settlements.

<sup>11</sup> An idea first floated in the Bank of England as a contingency plan by David Rule when, before the Great Financial Crisis, we were thinking about how to cope with a 9/11-type disaster. A permanent facility of this kind is advocated by Mervyn King, *End of Alchemy*. Under such a 100%-cover scheme, ongoing industry lobbying (and associated political pressure) would be directed at the definition of "short term liabilities", the population of eligible instruments, and the level of haircuts.

- Will the core of the macro/micro-prudential function remain essentially the same?
  - or will it extend to a much larger population of intermediaries?
  - and will it revolve around integrity against cyber attacks as much as around constraining intermediaries' balance sheets?
- Will central banks become more or less powerful?

Needless to say, I don't know the answer to any of those questions. But I will offer a few thoughts by way of testing whether two hundred years of central banking as we know it is approaching its denouement. I will start with a vision where that's just how things turn out.



### Markets without money: clearing houses as the new pivot

If bundles of (a defined set of) financial assets were routinely accepted in settlement of payment obligations, we might dispense with money as a medium of exchange. And if everyone could meet everybody else, however distant, across a system that enabled real-time credit checks, we might dispense with banks as payment and settlement intermediaries. This is the kind of futurology opened up by things like *blockchain*.

Crucially, the bundles we exchanged with each other would have real worth, rather than being like the *fiat* counters we use at present. This is not Bitcoin; it is more fundamental.

The preconditions for such a transformation are not merely technological. The integrity of the markets in each of the assets eligible to be a component in a payments bundle (eligible instruments) would matter hugely. In particular, the market infrastructure – the plumbing – would be vitally important. Some key infrastructural standards would, of necessity, morph.

In today's world of money, the standards applying to intermediaries, reflecting work by my generation in the late-1980s and early-1990s, include real-time Payment versus Payment (PvP) in the currency markets and Delivery versus Payment (DvP) in asset markets. In the new world, there would no P in money. Wholesale intermediaries and possibly individuals would sometimes exchange an equity directly for, say, a bond. One key standard would, therefore, be real-time finality in Delivery-versus-Delivery in eligible instruments: DvD.

For each of the eligible assets, there would still be financial and other transactions for deferred or future settlement, and so there would still be counterparty credit exposures. Indeed, left in a simple state of nature, the system of financial intermediation would, as now, be rendered fragile by the complex interlinkages created by chains of counterparty credit exposures. Clearing houses, possibly backed by central counterparties, which are really devices for mutual insurance, would accordingly be crucial to the system's resilience. They would, in effect, control entry to and handle orderly exit from the markets in eligible instruments;

and they would set the terms (collateral haircuts and margins) designed to keep the system of credit in each market on an even keel.<sup>12</sup>

As such, for each key market, the clearing house would be the pivot connecting the market in the underlying assets with the system of counterparty-credit-risk control.

Continuous liquidity in the markets for the eligible instruments would be similarly vital. The system would not require a conventional Lender of Last Resort capable of creating money at will, but instead a Market Maker of Last Resort which insured against unwarranted or contagious liquidity crunches in core capital markets.<sup>13</sup> That MMLR might be government or might be delegated to the clearing houses, which would become public authorities.

Within the market community, the leaders of these clearing houses might, plausibly, enjoy the status of a 21<sup>st</sup> century Montagu Norman or Benjamin Strong, the human pivots on which all in international finance turned. As time passed, standards for inclusion in the settlement bundle would no doubt erode, until eventually this world needed its equivalent of Paul Volcker to restore a standard of stability (and they would, no doubt, in turn, find themselves succeeded by a phase of 'science' during which some core truths would be marginalised, as in our time).

### FinTech and monetary revolution

I have been describing a world with no monetary instrument; where anyone can settle with anybody else in bundles of eligible financial assets; and in which

financial intermediaries make continuous markets in those instruments. Are we on the brink of such a world?

It seems unlikely. Today, transactions in even the most liquid equities and bonds are settled only after a lag of a few days, so using bundles of securities as the medium of exchange is hardly within reach.

Nevertheless, you might think some lesser revolution is upon us given the excitement set off by FinTech. At times, the mental spaces opened up by Bitcoin and *blockchain* make almost anything seem possible. At the revolutionary end of the spectrum, there are two broad scenarios:

- The numeraire becomes separated from the medium of exchange
- Private issuance of a final-settlement instrument that acts as numeraire

### Unbundling the numeraire from the medium of exchange

The clearing-house world described above is an extreme case of a class of systems in which control of the numeraire (unit of account) is separated from supply of the medium of exchange (the final settlement asset). Such systems leave the official-sector controller of the unit of account in a strange position.

Most obviously, it would not be able to supply more money in the face of surges of demand other than by changing the measuring rod (the equivalent of adding 000s to notes today).

In a similar vein, while the supplier of the medium of exchange could attempt to impose the inflation tax (by suddenly increasing the amount of money in circulation), the numeraire-

<sup>12</sup> *Futurology aside, this matters for today. Tucker, Are Clearing Houses the New Central Banks?, Over-the-Counter Derivatives Symposium, Chicago Fed, 11 April 2014. <https://chicagofed.org/~media/others/events/2014/annual-over-the-counter-derivatives-symposium/tucker-clearinghouses-new-central-banks-tucker-2014.pdf>.*

<sup>13</sup> *A possible need for a MMLR can also arise in monetary economies (Tucker, BIS 2014, op. cit. but, I suspect, would be unavoidable in a system without a central monetary authority.*

controller could in theory take offsetting action. In practice, doing so might be reasonably straightforward when the monetary injection was massive and abrupt, but might be harder in the face of more gradual shifts in the money supply as it would be necessary to judge how far money demand had shifted *parri passu*. To the thought that we coped well enough under the classic gold standard during the 19<sup>th</sup> century, when governments could not easily control the discovery and circulation of gold, I would observe simply, first, that the gold standard was not infrequently suspended; and, second, that since the shift to full-franchise democracy, the people have become less tolerant of swings in real economic activity and jobs.

Even if the private money supplier did not actively pursue actions against the public interest, any official macro-economic stabilisation policy would require regular changes in the numeraire. That is a slightly odd way of providing a measuring rod.

#### A new final-settlement asset?

Against that rather abstract background, it becomes easier to evaluate Bitcoin, which simply represents the latest attempt to create a private monetary settlement asset, and has no intrinsic worth. I think it unlikely that governments will allow their own fiat money to be displaced. Not only because of their interest in seigniorage, but also because the identified difficulties in unbundling the numeraire from monetary exchange mean that the final settlement asset is, in effect, a public good. Constraining the power of issuing that instrument, making it ours, played no small part in our long path to liberal democracy.

That does not rule out an evolution towards the real-asset-bundle settlement-instrument described above. But, however much it was used in private transactions, I find it difficult to envisage a world in which governments do not require taxes to be paid in an instrument they issue or directly control or where delivery of that instrument did not suffice to settle a private debt (legal tender).

If that is correct, there will be residual use of central bank money for some time. But that does not, of itself, entail an unchanged monetary-system structure.

#### What central banks do (1): who has access?

The big question becomes who can hold central bank money, and on what terms.

At first sight, the answer is obvious: everyone. Today, everyone can own and use banknotes issued by the central bank. In the future, we, citizens, could acquire specific quantities of central bank money loaded into cards or into phones or whatever. That is what I was thinking of in 2004. In terms of the economics, nothing profound is involved: merely a substitution of a physical card or a digital store for paper as the manifestation of a monetary property right.

That is well short of the vision aired by Ken Rogoff: of e-money that pays interest, and which could therefore open the way to negative interest rates.<sup>14</sup> Rather than discussing here the through-the-looking-glass world of negative rates, I am interested in the structure of the monetary system. The world conjured by Rogoff is a world in which the new technology leads to much wider, even universal, access to accounts at the central bank.

#### Universal access to accounts at the central bank

If, technologically, the public could bank with the central bank, then why not allow everyone to do so in order to reap various efficiencies from de-layering the payments system and, more politically, to spread the privileges associated with access to the central bank?

In the limit, this would be a world with a central bank but *without private monetary institutions*, i.e. without commercial banks as we have known them over the past two to three hundred years. Credit intermediaries (CIs) would, no doubt, still exist, but they would fund themselves in the capital markets and, crucially, without the state guaranteeing repayment of deposit liabilities. In law, all CIs' liabilities would be risky.

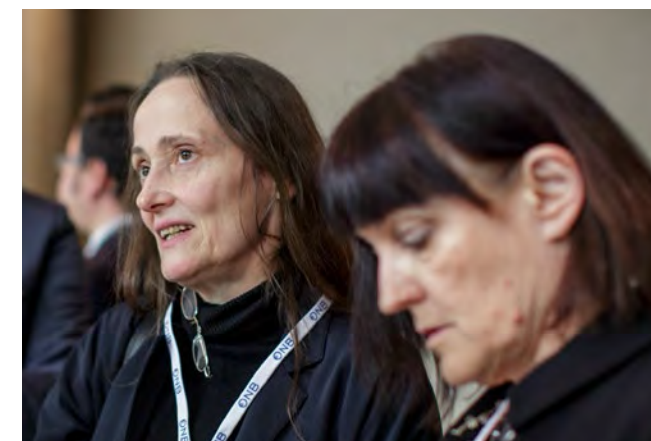
One principled objection to this course is that it might give everyone access to loans from the central bank. The case for lending to an account holder who had run out of money would not rest, as now, on the social costs to third parties of not lending to temporarily illiquid but sound banking intermediaries: the negative externalities associated with banking distress. Rather, it would be driven by the political costs of neglecting private hardship. This is a world where the central bank becomes part of the redistributive fiscal state.

It is very easy to say that central banks could commit not to lend to households and small businesses, but that is glib. Any such rule could be broken. History shows that what would matter would be the second-order rule: i. e., what counts as "exceptional" and how far it is factored into the behaviour of economic agents (otherwise known as people).

Short of introducing a deeply entrenched constitutional bar on such lending, allowing citizens access to central bank

accounts would be the end of central banks' insulation from quotidian politics. This would be (or could be driven towards) "state banking", not central banking as we know it. That is the lesson of the U.S. Senate's debate on the Chicago Plan.

Separately, exploiting the new technology to bring everyone into a direct relationship with the monetary institution would have the perverse effect of cutting off the incentives for innovation in the payments system. For all of its faults, the tiered public/private structure of today's monetary system has been a driver of change over the decades, leading to cheques, ATMs, debit cards, telephone banking, and now online payments.



#### Beyond banks as we know them?

But if there are arguments against universality, they don't make a case for the status quo.

Already central banks have been considering whether the post-crisis clearing houses should have access to central bank liquidity insurance given their super-systemic status. In a similar spirit, some monetary authorities have granted broker dealers access to the discount window. FinTech potentially transforms the options: why not grant access to payments companies, peer-to-peer lenders, and so on.

<sup>14</sup> Rogoff, Ken. 2014. *Costs and Benefits to Phasing Out Paper Currency*. NBER Working Paper 20126. May.

The stakes are high. As British economist R. G. Hawtrey observed nearly a century ago:<sup>15</sup>

“Anyone who can borrow from the central bank can thereby procure legal tender money.”

This is penetrating on account of its corollaries:

- Anyone who can procure legal tender can offer private monetary liabilities.
- Anyone who can offer monetary liabilities should be regulated as a monetary institution.

But, and this is the point, at the level of principle that has nothing to do with the new technology. Hawtrey’s insight could usefully have guided policy over the past quarter century, and should frame the so far inconclusive debate about *shadow banking*. Basically, if an intermediary is likely *ex post* to gain access to central bank credit, then it would be well to anticipate that in the regulatory framework.

#### FinTech under the Money-Credit Constitution

Thought of in that way, the significance of FinTech for central banks is that, at the least, it provides another opportunity to make clear what is within and what outside the monetary system. But unlike previous episodes, where the opportunity was fatally missed – money market funds in the 1980s, broker dealers in the 1990s, SIVs in the 2000s – it might demand such clarity. That would be a good thing.

#### What central banks do (2): beyond constraints on intermediary balance sheets

There is another element in all this, which also has its precursors.

If the purpose of central banking is to maintain monetary system stability, since the 2007–09 crisis we have come to think of this as, pre-eminently, constraining banking balance sheets. But that takes for granted the operational and legal integrity of the infrastructure that undergirds the monetary system.

Over the course of the past two centuries, amongst many other things that has meant clarifying the law for negotiable instruments (bills of exchange and cheques), anti-forgery protections for banknotes, and delimiting a banker’s duty of confidentiality. During my own career, it meant designing what we then called a dematerialised system of settlement for money-market instruments after a Messenger, as they were called, was mugged and robbed of a sack of paper instruments in the vicinity of Lombard Street.

That wave of infrastructural innovation, which led to the Depository Trust & Clearing Corporation (DTCC) in the U.S.A. and electronic transfers of title in Euroclear and Clearstream, necessitated changes in the law. Potential changes spurred by *blockchain* and similar technology would likewise require firm legal foundations. It is all very well providing for confidentiality and anonymity, but property rights cannot be enforced unless it is possible for an adjudicator (the courts) to verify ownership and transfer of title.

As the City theft incident a quarter of a century ago illustrates, legal foundations are necessary but not sufficient. For individual users, trust in the system demands a warranted conviction that assets will not be stolen or lost. For the society as a whole, there is a normative expectation that the system of exchange won’t collapse or break. Unless the financial-services industry retreats to being

a small-scale club, government regulation inevitably plays a big part in this.

Cyber-integrity is in that sense merely the latest in a long line of challenges, but on a scale rarely contemplated before. Some years ago Philip Bobbit impressed upon the guests at a dinner held by Mervyn King the prospect of warfare via cyber attack: “We have shut off your peninsula. Here are our terms.” Central bankers must today engage with the possibility of their financial infrastructure – the wholesale payments system, the clearing house, trading platforms – being switched off or fatally corrupted.

After 9/11, common wisdom was that “best practice” contingency plans included real-time, continuous back-up of data to a physically distant server site. In a world of cyber-attacks, continuous back-ups might flip to being “worst practice”, because the attacker can infect the reserve as well as the prime system.

After 9/11, policy makers focussed on disaster recovery at the expense of standard boom and bust risks. Over the past decade, the effort to contain those risks might have deflected attention from cyber crises. The most fundamental change brought by FinTech is less likely to be in the economic structure of our monetary system than in the very conditions for its survival.

Obviously, this is not a field where central banks can always lead. Alongside finance ministries, they will find themselves engaging with the security and intelligence services more than ever before. The gravity of central banking concerns and demands for the operational integrity of the monetary

system’s basic infrastructure will need to be clear. Sometimes they will be part of the solution, marking the return of the central banking plumber.

Back in the 1980s and into the 1990s, central banks led on many core-infrastructure projects, developing settlement systems and sometimes operating them. The *monetary institute* moment rejected or neglected that orientation, just as it neglected or rejected an interest in the soundness of individual banks. A decent *Money-Credit Constitution* for tomorrow will, I suspect, have to re-embrace the plumber just as it has already embraced the prudential supervisor.

#### The core of banking will remain prudent balance-sheet management

The commercial counterpart of that thought is commonplace amongst FinTech entrepreneurs and consultants today. It is not unusual to hear people say that technology and delivery systems will be more important to the future of banking than balance-sheet management. I think, I have even heard it said that balance-sheet management is an artefact of the old technology.

That thought is, let’s be clear, utter rubbish. The technology of banking has changed radically more than once over the past two hundred and fifty years. It seems likely to do so again. But so long as the underlying economic service is liquidity transformation and credit supply, the changes in technology will not alter the public interest in prudent balance sheet management and as resilient monetary system. Anyone who holds otherwise – and some do – should be a doubtful candidate for a banking licence.

<sup>15</sup> Hawtrey, R. G. 1922. *The Genoa Resolutions on Currency*. *The Economic Journal* 32/127. 290–304.

## Conclusions

Here then are my current answers to the questions posed at the beginning of section 2:

- Central bank money will survive as the final settlement asset
  - as such central banks will remain the pivot, but it is a role they could eventually share with central-counterparty clearing houses.
- Fractional-reserve banking will continue, so the money and credit systems will remain inter-twined
  - But many more types of intermediary involved in payments services, clearing or liquidity-insurance might gain access to the central bank.
  - If so, that should be recognised formally rather than stumbled into in the midst of crisis.

- As such, the regulation and oversight of private monetary institutions is likely to become broader.
- Central banks will continue to conduct financial operations that reshape the state's consolidated balance sheet
  - But they are more likely to find themselves acting as Market Makers of Last Resort, so they will not be at the minimalist end of the spectrum.
- The central banker as plumber is likely to be resurrected.

As such, in answer to my final question, far from withering away, the central banks are likely to be even more powerful. The challenge is to minimise the scope and depth of their role, and to ensure that it enjoys wide public and political support. That might end up being a greater challenge than technological change itself.



Session 3

Technological change and the  
future of financial intermediation

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## Introductory statement: Technological change and the future of financial intermediation

The future of the financial system will be shaped to a large extent by the future of financial intermediaries. If we follow media comments and the public debate, we could get the impression that technology will make financial intermediaries redundant. Is this expected demise of financial intermediaries real or an illusion? On the other hand, is the future of financial intermediation something quite to the contrary, a future with an all-encompassing power of banks, where their already existing power is levered and enhanced by digitalisation, data science and unlimited computing power? Is technological innovation in financial services – FinTech – “disruptive” as many FinTech-entrepreneurs like to suggest, or is it rather traditional banking with other means, something that changes the interface by which banks, businesses and consumers interact with each other but otherwise remains quite similar to banking as we know it? Is this technological change an issue regulators should be concerned about and if so, which are the specific issues of concern? If we would enter a time machine that catapults us 50 years into the future, would we still recognise banks and financial services, as we know it based on our experiences from today?

To discuss these and other issues related to the consequences of technological change on the future of banking and financial intermediation, I am happy to welcome two leading experts:

*John Kay* is an economist whose career has spanned the academic world, business and public affairs. Currently, he is a visiting Professor of Economics at the London School of Economics, a Fellow of St John’s College, Oxford. He is a Fellow of the British Academy and of the Royal Society of Edinburgh. He is a director of several public com-

panies and contributes a weekly column to the Financial Times. He recently chaired the Review of UK Equity Markets and Long-Term Decision-Making which reported to the Secretary of State for Business, Innovation and Skills in July 2012. He is the author of many books, including *The Truth about Markets* (2003), *The Long and the Short of It: Finance and Investment for Normally Intelligent People Who Are Not in the Industry* (2009) and *Obliquity* (2010). His latest book, *Other People’s Money – towards a financial system for the needs of the economy rather than financial market participants* – published by Profile Books and (in North America) by Public Affairs in September 2015.

*Patricia Jackson* is a member of the EY Global Regulatory Network in the Financial Services Risk Management Group. Patricia joined EY in 2004 as the Partner leading the banking risk practice and then later financial regulatory advice. She was involved in projects with the major banks globally on all the risk types as well as Basel III and stress testing. She is also increasingly involved in risk governance issues including developing an approach to setting and embedding risk appetite and risk culture. She is now a strategic adviser to EY. Prior to this she was the Head of the Financial Industry and Regulation Division in the Bank of England and represented the UK on the Basel Committee for Banking Supervision for 7 years, leading the global QIS studies and calibration of Basel II. Patricia has published a wide range of papers on market and credit risk and bank capital. She is a non-executive director on the board of the digital challenger bank Atom and is involved in setting their strategy going forward.



## Patricia Jackson

Strategic Adviser, Ernst & Young  
Council Member, SUERF  
Non-executive Director, Atom Bank



## PSD2 and open banking: the policy issues

The digital revolution raises a range of policy issues for the authorities. In Europe the move to open banking is regulatory-driven, but will authorities build a legislative framework which fully embraces the potential for future change? There are also strategic challenges facing the industry itself. Will existing players move fast enough to take advantage of the new environment, or will new players gain an edge in some areas?

Traditional banking is under pressure from low interest rates, much higher capital requirements which have reduced ROE and resulted in pressure from shareholders,<sup>1</sup> new entrants, including digital players, and shadow banks. Yet, digital also offers opportunities for banks in terms of the way they interface with clients and reengineer internal processes to cut costs. The question is whether the intense cost pressures traditional banks are facing will deter the upfront spend needed to achieve long-term digital goals. Again new challengers with a more flexible architecture may benefit much faster.

Under the developing requirements in Europe, banks will be forced to embrace at least part of the digital world. European banks will have to build a new architecture such as open Application Programming Interfaces (APIs) to meet the new regulatory requirements, and they need to consider carefully the strategy which they need to follow to maximise the benefits.

### Digital opportunities

Banks are facing considerable pressure on business models, and need to reduce costs and improve efficiency: cost-to-

income ratios of the largest banks in Europe vary between around 55% to over 90%.<sup>2</sup> However, costs cannot be brought down significantly without fully streamlining operations using digital. For example, banks are experimenting with blockchain, have already moved to robotics for various repetitive processes, and are developing cognitive systems using artificial intelligence as well as smart analytics.



Open banking, which is about the external environment is also an opportunity. It changes the way that banks can interface with their customers and the range of products offered. It is also a threat. It will provide a framework for a wider variety of players outside banking to engage in a revolution around personal and small business finance. The thinking behind open banking is that it will enable banks' customers to use the banking services to which they have access, in the context of other FinTech services – literally integrating banking and wider cutting-edge services.

A core part of open banking centres on the standardisation of how banks

<sup>1</sup> *A Set of Blueprints for Success: Seventh annual global EY/IIF Bank risk management survey 2016. Available from [www.ey.com/bankingrisk](http://www.ey.com/bankingrisk).*

<sup>2</sup> *LeDonne, G. and F. Garrido. 2016. Global cost-to-income ratios show regional diversions for banks. SNL Data Dispatch. 31 May.*

share customer data with third parties at the customer's request, for use in new third party services, in a secure way. Banks develop products and distribute them. In the future, with open banking, they could partner with FinTechs over the creation of new products; or FinTech firms could create new products that would be distributed by either the bank or the FinTech. Authorities envision that it will lead to more customer choice and enhance competition, driving lower cost and a wider scope of services.

With bank customers increasingly using digital channels such as internet or mobile banking, this is an extension of the current journey and takes the industry towards integration of a range of bank and non-bank players into a wider network of services. However, it is a path that requires rules and standardisation. Without standards there would not be interoperability, making cross-company integration cumbersome and substantially reducing the potential for substantial change.

## PSD2

In Europe, regulators are driving open banking. The revised Payments Services Directive (PSD2) requires banks to enable customers to authorise licensed third parties to access their transactions history. It also requires banks to enable third parties authorised by the customer to initiate payments from the customer's bank account to another party through the use of dedicated interfaces such as APIs – direct channels into the bank. Open APIs enable banks to connect with their customers in a different way, and to connect with new styles of player to offer different ser-

vices. APIs are the interfaces between software applications within an organisation, and between one organisation and another using a standard sets of requirements which make the interface easy to use and protect quality.<sup>3</sup>

PSD2 provides the way forward for a variety of players to aggregate a customer's information across all their different bank accounts – analysing spending, total savings and so on. PSD2 will come into force early next year, but with much still to be agreed, full implementation it is likely to be delayed. The final impact is dependent on the full regulatory environment including customer authentication to be in place which currently seems likely to be early 2019.

PSD2 will create scope for new services, such as money managers offering a highly tailored service for customers. By using the data on the customer that will now be available from a customer's bank accounts /credit card transactions, the money manager could use artificial intelligence to predict what products the customer needs and then find the exact array of products which offer the best features and terms, given the customers' needs and circumstances.

The extent to which customers will be willing to give third parties access to all their financial data to support these services is unclear. Nonetheless there is quite a lot of evidence that customers are willing to share information if they can save money. This seems to be the case even with the current aggregators, which are using scraping techniques where they use the current passwords/credentials of the customer to in effect “impersonate” them to acquire the data. In the U.S.A., aggregators such as Mint

have been very successful at disintermediating banks.<sup>4</sup> Mint started in 2010 and now claims it is acting as an aggregator for 10 million users – providing a free service collecting customer information across different accounts and aggregating it. Mint customers can create budgets, know what payments are coming in, receive customised advice on actions to save money and receive a free credit score. Mint makes money from banner advertising on its website and from referral payments from financial services, products or credit cards that a customer takes up after advice from Mint. In Asia too, banks and FinTechs are looking at open banking to drive innovation.

The second major innovation of PSD2 is to allow third parties, for example merchants, to initiate a payment direct from the bank account of the customer through APIs – bypassing the need for a credit card transaction.

The move to open banking is likely to spread globally. For example, the authorities in Singapore and Australia have expressed intent to adopt open banking with use of APIs.

## Legislative framework

Unlike the private sector solutions in the U.S.A. and currently in Europe, PSD2 will provide a legislative framework requiring open banking. This is what gives rise to the policy choices. PSD2 is accompanied by the General Data Protection Regulation (GDPR). This reforms the data protection requirements for companies operating in the EU which handle their customers' personal data. PSD2 will also have its own regulatory technical standards set by



the European Banking Authority (EBA). These standards were expected by January 2018 but two core standards are likely to lag by even as much as eighteen months. These are the standards around strong customer authentication, and common and secure communication. Both are critical parts of the design, and fundamental to the strategy of the different players and it is important that these are completed as soon as is practical. It is also essential that they are really effective while not hampering ease of use.

An important policy question currently on the table is whether PSD2 should require APIs to be used as the sole channel through which data could be accessed as originally envisioned, or whether current scraping techniques should also be allowed. Players currently using scraping are lobbying the EU Commission intensely to allow it in the future: a coalition of 62 FinTech firms and lobbying organisations is fighting plans by the EBA to ban screen scraping from online banking interfaces on the grounds it would damage their business models.<sup>5</sup> The EBA had

<sup>3</sup> For a more detailed description see the European Banking Association information paper *Understanding the business relevance of Open APIs and Open Banking for banks*. 2016. Working Group on Electronic Alternative Payments. May.

<sup>4</sup> MuleSoft. *Open Banking and the Future of Financial Services: Are you a survivor or a thriver?* <https://www.mulesoft.com/lp/whitepaper/api/psd2-open-banking-financial-services>.

<sup>5</sup> Ainger, N. 2016. *FinTechs fight plan to bar screen scraping and protect European banks*. CNBC news, retrieved from [www.cnn.com/2017/05/08/FinTechs-fight-plan-to-bar-screen-scraping-and-protect-european-banks.html](http://www.cnn.com/2017/05/08/FinTechs-fight-plan-to-bar-screen-scraping-and-protect-european-banks.html) on 14 June 2016.

been proposing to use the technical standards surrounding PSD2 to ban screen scraping.

Allowing screen scraping would change the end point of open banking. It also raises important cyber security questions which need to be addressed. Unlike using open API technology, scraping requires the “impersonation” of the customer. The scraper acquires the passwords and account details from the customer, accesses the bank as if it were the customer, calls up the data required on the screen and collects and



translates it so that it can be used by another application. Currently, the wave of activity from the “scrapers” can appear to a bank as a hacker. Given the small number of current players and the set times of day when they seek information, this has been more or less manageable – although in the U.S.A., such problems have been substantial, causing some banks to produce APIs for scrapers to use. Once access to information by aggregators becomes a core part of financial services, the effects of scraping on cyber security could become unmanageable. It is also hard to see how a route that does not require mandatory use of an open API framework can meet the second PSD2

objective which is enabling the initiation of payments from a customer’s account, given the complexity of authentication in the payments area.

The importance of an API architecture to ensure that the full benefits of open banking are achieved is underlined by the thinking of leading players across a wider selection of the industry. For example, Goldman Sachs has made clear that they are packaging everything they do around APIs.<sup>6</sup> Goldman has built a data lake pulling in information from across the firm – transactions, markets, investment research, materials from emails, phone calls etc. Using artificial intelligence, their sales forces can decide who to call and what to offer them. The importance of the APIs is that they enable clients to access directly the data available in the lake. Goldman Sachs say they will have more than a thousand unique data sets available for clients. The APIs make access quick, usage can be measured and the impact on clients assessed. APIs are the standard way for computer programmes to interact with each other and this is what makes the API based solution much more robust and straightforward.

The same will be true of retail operations involved in open banking. APIs offer a sound mechanism to underpin the new architecture – enabling information to be pulled from different accounts of a client and payments to be triggered. The benefits for customers of a fully API based model rather than a mix of API and scraping are substantial. The risk of the latter is that rather than one universal approach providing ease of use, some interactions based on scraping will fail or trigger cyber reactions in a bank where data is being extracted. Standard processes for customers will not be possible because firms

using scraping will still need customer passwords to access customer data, rather than computers talking direct to each other through APIs.

Of course in this open banking world there needs to be protection for customers covering their data and their payments. GDPR provides some of the framework and further EBA rules will provide more. However, policy questions remain to be answered in this areas too. Participants in the open banking architecture – those triggering payments through a customer’s bank or requesting information from a customer’s bank – will have to be licensed, but the details of this licensing regime have not yet been agreed.

With regard to payments triggered by a third party, there are concerns about liability if the payment was fraudulent. The bank which made the payment initiated by the third party has to make good the customer and then sue the third party. This raises issues about the stringency of regulation of the third party – who should be able to initiate a payment?

This raises an important policy issue about the size and structure of the open banking ecosystem. Will the regulators favour an ecosystem of hundreds of firms licensed to request data on customers from banks and initiate payments through banks or will they favour a small number of interface players who stand between the FinTech companies and the banks. The FinTech company with approval of the client would send an information request or a payment request to one of the 10 or so interface companies who would then access the information from the bank and transmit it back to the FinTech or initiate the payment through the bank. The choices need to weigh up whether an approach might create barriers impeding the development of a flexible competitive

market and whether it would provide the right incentives.

The whole process of certification of the third party and authentication by the customer of information and payment requests to a bank also needs to be worked out. This needs to be secure but not cumbersome. A mechanism which ensured authorisation and certification at the same time would be much more streamlined.

The policy decisions taken are critical and will affect the extent to which PSD2 heralds a new style industry.

### Winners and losers

The changes brought by PSD2 will alter the value chain in banking for retail and SME products. The credit card value chain is likely to be undermined over time by the ability of licensed third parties to trigger a direct payment from a customer’s bank account.

Organisations that are quick to embrace the scope to aggregate information from customers’ accounts and use artificial intelligence will be able to offer customers savings in search time and cost when selecting a wide range of products, assessing the appropriateness of products in a much more granular way reflecting the richness of customer data to which they have access. An example here is Yolt, an ING tool being tested in the UK, offering the customer a comparison of bank account fees, interest rates, cost of energy contracts, and insurance. The new landscape will offer customers the benefits of money management and price comparison. Using artificial intelligence a customer’s needs can be predicted.

The net effect is likely to be a move to a much more fluid banking and financial services model, with many more customers willing to switch providers. This will mirror and progress the revolution that has already occurred

<sup>6</sup> Turner, M. 2017. Goldman Sachs wants to become the Google of Wall Street. *Business Insider*. 6 April.

in terms of retail insurance, where use of price comparison websites in the UK, for example has resulted in much lower renewal likelihood on policies as customers search at each renewal date for the most advantageous product.

It is hard to predict the effect that this could have on traditional financial services or the speed. But both could be substantial. Amazon has shown the speed with which retail customers have been willing to adopt a new more convenient purchasing mechanism which offers monetary savings and greater convenience. Price comparison websites in the UK have also shown how quickly buying patterns for insurance or energy can change when better value can be achieved. Without regulatory impediments, and indeed with regulatory support through the design of the framework, this could snowball very quickly.

Over time, this could start to erode incumbents' retail and SME profits. The major banks are fast building their own response, but the challenge is to move flexibly given their existing product ranges, processes and so on. An existing player will not want to offer products that undercut its existing services.

This creates major strategic questions for existing banks. How quickly they should move to build a new range of customer interfaces, where they use the new potential to aggregate information rather than just being a provider? Or do they want to remain focused on their current products and customer interfaces in which case they will be a provider not a user of the information available?

### Conclusion

The whole process has the potential to create a tectonic shift in the landscape. However, the regulatory framework will affect the confidence in the new environment through the success of the protections built into it. Regulation will also affect potential development in other ways. Processes of certification of FinTechs (a digital ID for the third party) and authentication of information requests or payment requests by customers, which are cumbersome, will reduce take-up of new services. Likewise, lack of commonality through not requiring use of APIs could also damage the rate of progress – particularly if the attempt to use scraping as well as open APIs results in failure of processes because cyber defences in the banks are triggered. This will become more likely given the expected sharp increase in data requests. It is also possible that existing and highly regulated retail banking markets may not benefit fully from the potential developments because other regulations stand in the way. The choice of how FinTechs can interface with the banks, directly or through special intermediaries, could also potentially create barriers keeping some players out.

The benefits from the standpoint of the authorities lie in the increased flexibility of services provided to retail and SME customers in particular and much greater competition between players. This will almost certainly result in improved pricing and choice for consumers. With services provided on the back of aggregation of data from different bank accounts, retail and SME customers will also be able to track expenditure patterns and saving more effectively. Another goal is to open up the payments world to greater competition.





## Technological change and the future of financial intermediation

In London I am often asked to give talks about developments in the finance sector to a general audience. One question which routinely comes up is “What do people who work in the finance sector, in those large office blocks and in the City of London and Canary Wharf, actually do?” And the answer I give is that – to an extent that almost defies belief – “What they do is trade with each other.”

World trade in goods and services has expanded greatly since the Second World War. But today the volume of global trading in foreign exchange is a hundred times the volume of global trade in goods and services.<sup>1</sup> The total value of exposures under derivative contracts amounts to between two and three times the total value of all the assets in the world.<sup>2</sup> And when I wrote about this process of financialisation in 2014, I highlighted the activity of a company called Spread Networks in building a telecommunications link across the Appalachian Mountains to reduce the time to transmit data between Chicago and New York from 7.3 to 6.6 milliseconds. Since then, improvements in microwave technology have reduced the time required to something closer to the physical lower bound, which is the four milliseconds it takes for light to travel between the two cities.<sup>3</sup>

My description of this activity typically prompts further questions. The obvious one is “What is the purpose of all this activity?” And a more sophisti-

cated version of that question asks “What value-added can be gained from a group of people trading paper claims on existing assets with each other in secondary markets?”



Of course there can be no doubt that finance is indispensable to modern economies.<sup>4</sup> We need finance for four primary purposes. The payment system is the essential utility of finance, the mechanism by which we receive our wages and salaries, pay our bills and enable businesses to transact with each other. A second role of finance is to allow wealth management. We need to finance education when young, retirement when old, and we need to save in the intervening years in order to make these things possible.

Wholesale financial markets as they operate today are directed at two other functions: capital allocation, the process of directing funds from savers and investors to companies and borrowers and risk management, the business of

<sup>1</sup> Bank for International Settlements. 2016. *Triennial central bank survey of foreign exchange and OTC derivatives markets in 2016*. World Trade Organisation. *World Trade Statistics 2016*.

<sup>2</sup> Bank for International Statistics. 2017. *Semi annual derivative statistics*. June. Credit Suisse Global Wealth Report. 2016.

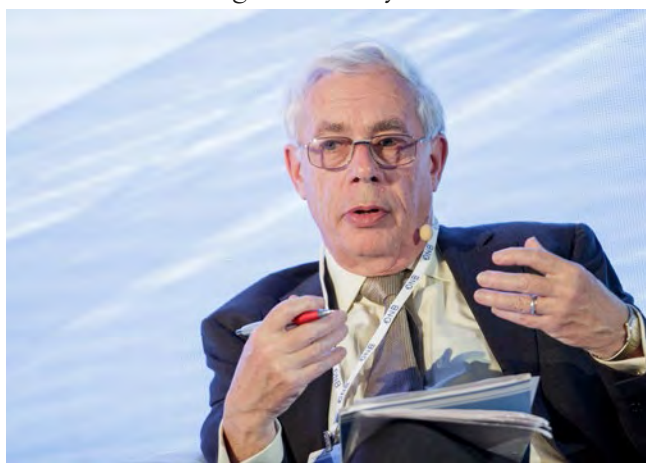
<sup>3</sup> MacKenzie, D. 2017. *A Material Sociology of Markets: the Case of “Futures Lag” in High-Frequency Trading*. Auguste Comte Memorial Lecture. Edinburgh. February.

<sup>4</sup> See, for example, the survey in Levine, R. 2014. *Finance and Growth: Theory and Evidence*. In: Aghion, P. and St. Durlauf (eds.). *Handbook of Economic Growth*. Elsevier/North Holland.

reducing the costs of bearing the risks inseparable from modern economic and social life.

My introduction to modern developments in finance came when I became involved in the process of reconstruction in the Lloyd's insurance market, following the near collapse of that market at the end of the 1980s.<sup>5</sup> Lloyd's came into being in the 17<sup>th</sup> century. The institution famously originated in Thomas Lloyd's coffee shop, where English gentlemen would gamble on many things, including the fate of ships and the state of tides. Lloyd's remains today the centre of the global marine insurance market, but by the 20<sup>th</sup> century had come to be predominantly a reinsurance market.

Lloyd's was above all the place to which brokers would bring idiosyncratic risks. The modus operandi was that a lead underwriter would price the risk and take a proportion of it. Other underwriters operating from what was known as "The Room", literally a large room, would follow that lead and determine what proportion of the overall risk they were prepared to take. The system worked on the basis of mutual knowledge and respect within the underwriting community.



<sup>5</sup> For a description of this crisis see Duguid, A. 2014. *On the Brink: How a Crisis Transformed Lloyd's of London*. Houndmills, Basingstoke, Hampshire: Palgrave Macmillan.

But by the 1980s, the market had changed. Aggressively entrepreneurial Lloyd's brokers realised that if you could sell reinsurance, you would also sell reinsurance of reinsurance. And reinsurance of reinsurance of reinsurance. In what became known as the LMX spiral, complex contracts were constructed which involve multiple layers of insurance, in which it was simply impossible to drill down and identify the structure of the underlying risks. All that could be done was to model some of these contracts and establish that in the past nothing would have been paid out on them.

I recall two particular moments of revelation as I learnt about these market developments. I asked how much of the growth in business, of which the market was so proud, had come in "through the front door", as distinct from being generated within the market itself. My surprise was not just that it took time to establish the answers, but that people were surprised by the question. Another salutary exchange was when I asked a particularly arrogant underwriter to explain why he had not "blown the whistle" on the colleagues whose incompetence he had been denouncing with such vehemence. His answer was simple. "Because they were willing to buy risks at prices at which I was delighted to sell them." The market had changed from one in which the process was primarily one of mutualisation of risks to one in which risks were being transferred from people understood a lot about them to people who knew little. The trading of risks within the market was not spreading these risks but concentrating them in the hands of those who did not realise what they were doing.

And so it proved when a series of disasters hit the insurance industry generally and the Lloyd's market in particular in the late 1980s. The first such incident was the destruction by fire of Piper Alpha, an oil rig in the North Sea. That loss was then the largest single marine insurance claim ever made, and it turned out that the total volume of claims at Lloyd's which resulted from it amounted to more than ten times the original value of the loss. People who had never heard of Piper Alpha had in fact insured it over and over again. And that was how some of the stately homes of England were emptied of furniture in order to meet the losses of Lloyd's names.

All this was preparation for understanding what was happening in the rapid credit expansion from 2003 to 2007. During that period I found myself asking "Who are the equivalent in credit markets today of those stately homeowners who did not understand the magnitude of the exposures which they had assumed?" In 2008, we found the answers to that questions; much of the exposure lay in large banks, many of them in Europe.

The widespread trading of credit exposures began with the securitisation first of mortgages and then of other loans in the 1980s. The shift in emphasis from syndication of primary issues to secondary markets in securities originated by a single lender directly paralleled the prior developments I had observed at Lloyd's. But these changes represented only a small part of the overall process of financialisation of Western economies, the putting of finance at the centre of economic life, which gathered pace steadily from the

1960's. The nature of equity markets changed also.

The equity markets with which we are familiar came into being in the 19<sup>th</sup> century to finance railways and railroads. Railways and railroads were capital intensive projects, and the capital required was specific to that particular use. There is little you can do with a railway except run trains on it. The savings needed were collected in modest amounts from large numbers of moderately well-off individuals. These individuals bought both equity and bonds in the new enterprises, and were provided with a degree of liquidity through expanded capital markets.<sup>6</sup>

This financing model, then closely bound up with imperialism and the development of the interior of the United States, was then extended to resource companies, and in due course to the manufacturing businesses which came to dominate Western economies in the course of the 20<sup>th</sup> century. The zenith was reached in mid-century – in the first Fortune 500 list in 1956 – nine out of the 10 top companies were manufacturers. Among them were three automobile companies and three steel companies.<sup>7</sup>

If one looks at the 10 largest companies by market capitalisation today, the picture has radically changed. The list is dominated by new economy businesses: Apple, Alphabet (Google), Amazon, Microsoft and Facebook. There is only one manufacturing company on the list and that, Johnson & Johnson, is a very different kind of business from the steel and automobile makers of 50 years before. Berkshire Hathaway, sui generis, includes manufacturing businesses among its collection of investments.<sup>8</sup> That com-

<sup>6</sup> Hannah, L. 2010. *The rise of the corporate economy*. Routledge.

<sup>7</sup> See [archive.fortune.com/magazines/fortune/fortune500\\_archive/full/1956](http://archive.fortune.com/magazines/fortune/fortune500_archive/full/1956).

<sup>8</sup> In May 2017, the others were JPMorgan Chase, Exxon Mobil and significantly Alibaba.

pany may be at once relic of the past and portent of the future - the era of the diversified manufacturing conglomerate is coming to an end, but the holding company and the private equity house which internalizes the process of capital allocation are direct responses to the excessive costs, burdensome regulation, and weak governance characteristic of modern public equity markets.

Apple's market capitalisation today exceeds USD 800 billion, and Alphabet the holding company for Google, is not far behind. For both these companies, operating assets account for less than USD 30 million of that value. Modern businesses like these employ very little capital, and such assets as they do use mostly need not be owned by the company that operates from them and typically are not.

As a source of capital for business, equity markets no longer register on the radar screen<sup>9</sup>. In Britain and United States, the countries with the largest equity markets, funds withdrawn from these markets through acquisitions for cash and share buybacks have recently routinely exceeded the amounts raised in rights issues and IPOs.

At the same time, savings have become institutionalised. Initially such institutionalisation took place mainly through the investment activities of pension funds and insurance companies. Today much of their activity has been outsourced and while pension funds and insurance companies are still important players, the equity investment chain is today dominated by the major asset managers Blackrock, Vanguard, Fidelity and their competitors. And sovereign wealth funds are an increasingly important fraction of public market equity ownership.

The paradox of modern capital markets is that although there is less and less need for market activity from the point of view of either the end users of finance, or the investors who are the ultimate beneficiaries of finance, the volume of market activity has increased exponentially. And yet policy towards capital allocation places more and more emphasis on markets. European regulation, centred inevitably around acronyms, finds M as its most frequent abbreviation, so we have *MAD*, the *Market Abuse Directive*, rather than *CAD*, the *Customer Abuse Directive*, as though it were the *market* rather than the *customer* which required protection. The centrepiece of European financial regulation is *MIFID*, the *Markets in Financial Instruments Directive*. And today the primary objective of European financial policy is to create a *Capital Markets Union*.

We have extensive discussion in Europe today of the promotion of "simple, transparent, standardised securitisation". It is intrinsic to securitisation that it is neither simple nor transparent. And the belief that mortgages could advantageously be standardised and securitised, perhaps with the assistance of government agencies, led more or less directly to the 2008 global financial crisis. The notion that securitisation is the answer to deficiencies in the availability of small business finance can only be promoted by people, whether policy makers or lobbyists for investment banks, who have no idea what is really involved in the provision of small business finance.

The growth of secondary market trading at the expense of an understanding of the underlying exposure led to disaster in the global financial crisis of 2008, just as it had earlier led to

disaster at Lloyd's. If we think for a moment outside the context of financial markets, we see how rare it is in the modern economy that transactions are anonymous; even our everyday purchases are not simple or transparent or standardised. For small value transactions we rely on the reputation of the seller, for larger value transactions we make our own specific enquiries.

The notion that through standardisation of financial transactions we can resist the universal tendency *away* from standardisation in markets of all kinds represents a fundamental misunderstanding of basic economics. Standardisation is not an answer to the problem of information provision in financial markets, nor is pervasive information asymmetry successfully resolved by insistence on the provision of detailed financial information on a standardised basis, whether in company accounts or key features documents.

I have described how excessive trading amongst intermediaries is created not solved the problems we encounter in markets for risk, markets for debt, and markets in equity securities. I believe it is time to raise question marks over the entire market based model of financial services provision. We should be talking about risk management and capital allocation without any presumption that markets are the best way of handling these issues.

It is instructive to look at the economic role that many of the new economy companies I described above now play. The primary role of intermediaries like eBay and Amazon is to enable people to transact with confidence with suppliers and providers of whom they themselves have no knowledge. Even more strikingly, Uber and Airbnb are innovative business models which have come into being to serve precisely this function; to replace traditional struc-

tures of regulation or lengthy and complex chains of intermediation by providing immediate verification of the reliability of both buyer and seller.



The rise of Uber and Airbnb is a forceful illustration that although we need less intermediation in financial markets than we have today, the right level of intermediation in future is not zero. Some people take the view that disintermediation through peer-to-peer lending and crowdfunding will transform the provision of finance to individuals and businesses. I am sceptical of this claim. The thesis I have been developing is that both investment and risk transfer are unavoidably heterogeneous, idiosyncratic transactions. In consequence, algorithmic scoring can never replace, although it may be able to assist, a qualitative and quantitative assessment of an experienced loan officer or shrewd investor. Like most people interested in business, I have never seen a business plan for a start-up which did not look superficially promising. It is only once you have seen 20 or 30 similarly promising proposals, and have experience of what happened to them that you are able to begin to distinguish effectively between the effective entrepreneur and the perennial optimist. I think the future of peer-to-peer lending is that the institutions which survive fraud,

<sup>9</sup> See the Kay Review, <https://www.gov.uk/government/publications/kay-review-of-uk-equity-markets-and-long-term-decision-making>.

losses and increased regulatory scrutiny will increasingly resemble the organisations which we used to call banks.

The appropriate number of intermediaries in finance is in most cases somewhere between one and two. An intermediary who genuinely adds value will generally be one who has some specialist knowledge of one or both of the end-users of finance – either the companies in which an equity investment takes place, the individuals will take out loans, and established corporate borrowers, or the depositors and investors whose savings are necessarily the ultimate source of such finance. A few minutes on a trading floor today demonstrates that the principal knowledge many intermediaries have is that the behaviour of other intermediaries.

When I was a schoolboy in Scotland in the 1960s, joining the Bank of Scotland or the Royal Bank of Scotland was a career for the boys in my class who were not going to get good enough grades to go to leading universities. Even when a few years later I began my

teaching career at Oxford, careers in the City of London were mostly for undergraduates who were not academically distinguished but nevertheless socially polished and well-connected. All that has changed, and not altogether for the better, as was evident when the Bank of Scotland and the Royal Bank of Scotland failed in 2008, after three centuries of prudent success, under the stewardship of able individuals with good degrees from the finest universities and business schools.

Larry Summers, former president of Harvard and US Treasury Secretary, once observed that finance had once been the preserve of people whose primary skills were those of good companions at the 19<sup>th</sup> hole of the golf course, but had become the province of people with the sophisticated mathematical skills required to price complex derivatives.<sup>10</sup> Summers, with skills better adapted to solving differential equations than conviviality at the 19<sup>th</sup> hole, noted this shift with evident approval. I am not so sure.



<sup>10</sup> Summers, L. 1985. *On Economics and Finance*. In: *The Journal of Finance* 07/1985.



Session 4

The capital markets of the future

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## The capital markets of the future: positive versus normative aspects

Capital markets are a key element in today's financial system. Their development is also central in shaping the overall characteristics of the financial system of the future. This is to say, it is worth thinking about where capital markets are heading for, what the underlying driving forces are and what the possible consequences might be.

Before the crisis, it was common wisdom to distinguish between capital market-based, Anglo-Saxon financial systems and continental European, bank-based systems, with various authors emphasizing pros and cons of each system. As the financial crisis started in 2007 and evolved, views differed on whether capital markets or banks were mostly responsible for the financial crisis and its propagation. In fact, both sectors, including their interlinkages, had a massive impact.

In response to the crisis, the authorities substantially reinforced bank regulation, more than regulation of other areas of the financial industry, such as shadow banks. SUERF addressed the issue of *Shadow Banking: Financial Intermediation beyond Banks* in a SUERF Colloquium, jointly organized with Suomen Pankki, in Helsinki on September 14–15, 2017. Combined with the need for consolidation in banking, due to margin squeeze and cost pressures, capital market financing has gained in importance relative to bank financing in continental European countries over the past years. Corporate bonds are booming. Besides, securitization, which had been identified as one source of the financial crisis, has strongly expanded again meanwhile. Global M&A activity is also expanding strongly.

So, where are capital markets heading for? In investigating this question, two principal perspectives can be adopted:

A first, positive, perspective attempts to forecast what will most likely happen.

Several aspects are relevant, for instance:

- First, how will technological *game changers* such as artificial intelligence and algorithm trading affect asset management? What impact will the dismal performance of active asset management strategies and that by hedge funds have? Will the trend towards low-cost, standardized products such as Exchange-Traded Funds (ETFs) continue? How will the trend towards online brokerage and more explicit pricing of advisory services to different customer segments affect access to higher yielding investments?
- Second, what implications might the increasing importance of passively managed investment funds and ETFs have on systemic stability, if they encourage synchronized behavior? Would more global harmonization of capital market and shadow bank regulation contribute to systemic stability or the opposite?
- Third, on the *demand side* of capital markets, the question arises how central banks' future policies towards outright asset purchases will affect global demand for low-risk fixed income products on prices and yields. When and how will a tapering of purchases happen? How about reinvestment policies? How about the size of central banks' outright securities holdings in the longer term? How about their future monetary policy toolkit and balance sheet structure? Another important factor in a long-term perspective are of course pension systems: How will future needs to save privately for pensions – globally, not only in the developed world – influence the demand for securities?



- Fourth, on the *supply* side of capital markets, the future of sovereign borrowing is key. How will sovereign debt levels evolve over the longer term? How will debt sustainability be affected by an eventual normalization of interest rate levels? What will, in fact, likely be a future „normal“ interest rate level? How will the euro area sovereign debt evolve?

A second, normative perspective asks in what direction capital markets should develop.

- What role should capital markets and shadow banks play as compared to bank financing in the future? For instance, one might postulate that capital markets should grant broader access to finance also for medium-sized enterprises, through various forms of loan bundling, tranching etc. In the EU, the project of a *European Capital Markets Union* explicitly aims to further integrate capital markets across the 28 (or 27) Member States, in order to improve financing possibilities across the Single Market for financial services and capital.
- In the euro area, a long-debated theme is how to *standardize*, *pool* or *even mutualize*, in one way or another, euro area governments' debt financing, while maintaining incentives for fiscal responsibility.

- Another relevant topic is how to *improve market pricing and avoid exuberance*, booms and busts, and how to further improve *crisis resilience*.
- Of course, normative visions of what the capital markets of the future should look like, can differ considerably depending on whose vision we are talking about: „society“, borrowers (including governments), savers and investors, monetary policy makers, regulators and supervisors, and various types of financial firms might all have different normative visions.

Finally, these two – *forecasting* and *normative* – perspectives are linked with one another. Depending on one's judgement on what various stakeholders and interest groups regard as a desirable future for capital markets, and on one's assessment of the influence these groups may have on law and rule making, one might forecast in which direction regulation and supervision of capital markets might actually develop. This would in turn affect one's forecast of how capital markets will evolve. Conversely, based on one's forecasts on the likely secular development of capital markets due to long-term trends such as technology, demographics and government debt, one might conclude that measures should be taken to reinforce or contain certain tendencies.

Obviously, the subject of this session itself could easily fill a two-day conference. Instead, this session picks out two specific topics relevant for the future evolution of capital markets. Both papers contribute to the first, positive or forecasting, perspective by providing deep insights into the subject matter, thus allowing more informed forecasts on their potential usefulness and limitations. At the same time, both papers contribute to the second, normative, perspective on the future of capital markets, by identifying problematic

areas, by weighing pros and cons, and by offering solutions to the problems.

The first paper by *Professor Nikolaus Hautsch, University of Vienna*, addresses a complex topic which is seen quite ambivalently among economists, regulators and in the public debate, namely high frequency trading. In line with this ambivalence, Professor Hautsch will address both the costs and benefits of high frequency trading.

The second paper by *Professor David Yermack, NYU, Stern School of Business*, addresses the interesting topic of smart contracts. By making a breach of contract expensive, smart contracts increase the incentive to fulfil the contract and thus increase security to the parties of the contract, without requiring trust, and in this way also economize on contracting and enforcement costs. Taking a posi-



tive forecasting perspective – one might – due to their advantages, expect smart contracts to gain in importance in the future. Taking a normative perspective, one might even welcome this for reasons of efficiency, as long as possible risks are understood fully and taken care of.



## High-frequency trading: risks and benefits

### 1 Introduction

Nowadays a substantial part of trading activity in equity, derivative and currency markets is due to algorithmic high-frequency trading (HFT). The role and effect of HFT on financial markets is controversially discussed and in the center of attention of market operators, regulators, and market participants. This article briefly introduces to the concepts of HFT, reviews its developments through the last decade and summarizes the current state of discussion. It moreover gives an overview of current empirical evidence on the effects of HFT and provides an outlook on its future in light of upcoming regulation.

HFT is characterized as automated trading that employs (i) algorithms for order execution and automatic order routing, i.e., the distribution of (large) orders through time and across different market places, (ii) low-latency technology and co-location services, and (iii) high message rates. HFT is typically carried out by proprietary firms, hedge funds or broker-dealer proprietary desks. High-frequency traders (HFTs) use short holding periods and do not take significant over-night positions. They neither take highly leveraged positions, but face rather low margins per trade, while making profits by executing many (small) trades through a day. Accordingly, they typically focus on highly liquid assets.

A central aspect of HFT is to exploit speed advantage. A central requirement is that the server of the HFT firm is co-located, i.e., it is placed in near distance to the server of the exchange. Exchanges offer this as a paid service, and promise certain latencies. Likewise, HFTs pay for high-speed connections between different market places. While fiber-optic cable connections have been used in the early days of HFT (around 2005), microwave connections and laser

links are the current state of the art and push the latency, i.e., the time it takes for a signal to travel from point A to point B, close to natural limits induced by the speed of light.



HFTs perform various kinds of strategies where speed advantages, low reaction times and the ability to post (and cancel) a large amount of orders within very short time periods, are beneficial. One major strategy is market making, i.e., providing liquidity on both sides of the market. Accordingly, HFTs post limit orders on the best ask and best price level and earn the bid-ask spread, similarly to designated market makers in classical floor trading, see, e.g. Demsetz (1968). In some markets, liquidity providers additionally earn a liquidity rebate offered by the exchange to reward market participants for providing market making service. This incentivizes HFTs to serve as passive liquidity suppliers in possibly many transactions.

Other examples are order detection strategies. In many markets, posted limit orders are partly or entirely hidden. The motivation for hiding an order is to get protected from front-running and to avoid price impact, i.e., unfavorable market movements as a reaction to a posted limit order, see, e.g., Cebiroglu, Hautsch and Horst (2014). For HFTs it is beneficial to identify hidden orders placed in

the spread as they induce lower transaction costs. A common way to identify hidden liquidity is to post so-called immediate-or-cancel (IOC) orders that are automatically canceled if they do not get executed. An obvious downside of such strategies is that they create substantial message traffic with high order-to-trade and cancellation ratios. For instance, on Nasdaq, up to 90%–95% of all posted limit orders are canceled shortly after submission and thus get never executed.



Another important strategy is statistical arbitrage. Traders try to make profits by exploiting temporary inconsistencies in prices between different exchanges or assets. Due to a high market fragmentation, such strategies are particularly pronounced in the U.S.A. Other dominant strategies are latency arbitrage, exploiting direct market access and the possibility to receive market data a few milliseconds earlier than other market participants. With such a speed advantage it is possible to react faster on corresponding trading signals or to anticipate order flow that is automatically routed through smart order routers.

Momentum ignition strategies involve posting and cancelling a large number of trades and orders in a particular direction in order to trigger a price movement and to cause other algorithms to react on it. HFT firms have established a posi-

tion earlier on and can benefit by leveraging the subsequent price movement. “Spoofing” is a more extreme form of it, where orders are posted with the intent to cancel them before they get filled. This is a manipulative strategy, which is illegal. A further example for an illegal strategy is “quote stuffing” with the aim to increase the message traffic, such that the bandwidth and thus the access of other market participants is slowed down.

## 2 Discussion and history of HFT

The role of HFT is controversially discussed. The public discussion and media coverage is dominated by the view that HFT degrades the function of the market, discriminates non-HFTs, makes markets less stable and wastes resources by an unreasonable technological arms race. The most famous critique comes from Michael Lewis in his book *Flash Boys* (Lewis, 2014). According to Lewis, “speed traders prey on retail investors and rig the stock market”. Likewise, Stiglitz (2014) argues that HFT steals information rents and that markets are ultimately too active and too volatile. He asserts that there is no social value as HFT degrades the market function.

Public perception, however, often tends to regard HFT as an isolated phenomenon disconnected from general developments in the trading landscape. In fact, HFT is a consequence of technological progress and regulatory changes during the last decade. The starting point was the change from classical floor trading to electronic trading and the introduction of ECNs in the 1990s. In 1998, the U.S. Securities and Exchange Commission (SEC) passed the Regulation Alternative Trading Systems (so-called Reg. ATS) to restrict the monopoly enjoyed by NYSE and NASDAQ in the U.S.A. This was the starting point for an increase of market fragmentation. In 2001, U.S. stock exchanges began quoting

prices in decimals instead of fractions, bringing down the minimum spread. In 2005, the SEC passed the Regulation National Market System (Reg. NMS) requiring trade orders to be posted nationally and not on individual exchanges (“trade-through rule”). Simultaneously, in Europe, the Markets in Financial Instruments Directive (MiFID) introduced a principles-based best execution regime compared to the rules based U.S. approach. This opened the door for Smart Order Routing. In 2007, new market access models have been introduced. Some market participants obtained “direct market access” without sufficient control mechanisms on the validity of orders. Finally, regulation allowed exchanges to introduce co-location and proximity services. Hence, unequal market access has been systematically established.

Regulation thus established a level playing field for HFT. Accordingly, the extent of HFT rapidly increased since 2005. In 2010, HFT accounted for approximately 56% by volume of the entire equity turnover in the U.S., see, Agarwal (2012). In Europe, this percentage amounts to approximately 38% in 2010. Since 2009/10, the extent of HFT in U.S. and Europe equity trading declines and ranges between 40% and 50% in 2014. Similar developments and quantities are observed in U.S. futures trading and FX trading. In Asia, the extent of HFT is generally lower, while in China HFT basically does not exist.

In public perception, HFT is often associated with male-functioning algorithms getting out of control as, e.g., in case of the Knight Capital Group on August 1, 2012, or with (flash) crashes, such as the flash crash on May 2010, where leading U.S. indices dropped by nearly 10% within a few minutes. While incidences based on male-functioning algorithms seem to be an existing (though low) operational risk which typically

mostly harms the HFT firms themselves, there is no convincing evidence for HFT causing flash crashes, see, e.g., Kirilenko et al. (2017). In fact, recent empirical research predominantly shows that HFT improves liquidity and market efficiency, thus showing a positive effect of HFT. Hendershott et al. (2011) find that algorithmic trading enhances the informativeness of quotes. Hasbrouck & Saar (2013) show that increased low-latency activity decreases spreads, increases displayed depth and lowers short-term volatility. Menkveld (2013) stresses the role of HFTs as high-frequency market makers. Brogaard et al. (2014) show that HFTs facilitate price efficiency. Hence, the criticism of HFT degrading the market function is empirically not necessarily confirmed.

Nevertheless, some evidence supports more critical views. While Kirilenko et al. (2017) find that HFTs did not trigger the May 2010 flash crash, it is shown that HFTs are nonetheless not helpful in stabilizing markets in such a situation. The authors find evidence for latency arbitrage and inventory changes of HFTs being positively related to contemporaneous price changes. Thus HFTs tend to trade in the direction of the market, which is contrary to “classical” market making. Budish et al. (2015) argue that the high-frequency trading arms race is a symptom of flawed market design and that the re-introduction of (high-frequency) batch auctions would be a favorable alternative to continuous trading.

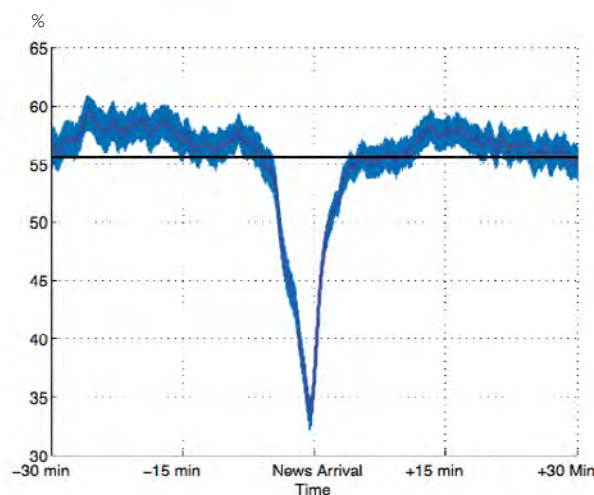
## 3 Empirical evidence

Hautsch, Noé and Zhang (2017) (henceforth HNZ) provide evidence on the role of HFTs as market makers in Bund Futures trading at the derivatives exchange Eurex. HNZ exploit access to proprietary order-level message data with member ID and trader ID allowing for an institutional HFT identification. In addition, they

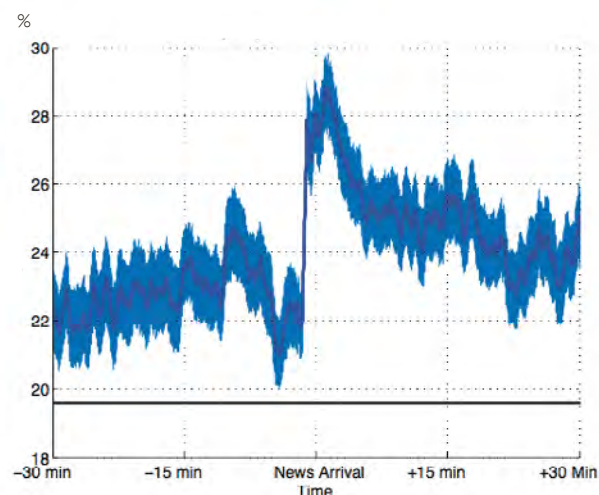
Chart 1

### HFT Liquidity in the Bund Futures market

#### HFT Liquidity supply participation rate



#### HFT Liquidity demand participation rate



Source: Chart reproduced from Hautsch, Noé and Zhang (2017).

Note: HFT liquidity supply participation rate (left) and demand participation rate (right) in traded contracts through 60 minute windows around scheduled macroeconomic announcements with extreme price movements in Eurex Bund Futures trading, 2014–2015. Averages across announcements with shaded areas indicating 95% confidence intervals. The solid line is the overall mean across all trading days excluding the one hour window around the release.

employ a statistical identification of HFT activity by considering trading desks with a given number of order submissions per day, low end-of-day positions and very short order life times. This allows for a quite precise identification of activity stemming from HFTs and non-HFTs. HNZ particularly focus on turbulent market periods during periods around scheduled macroeconomic news announcements.

Chart 1 shows the development of liquidity supply and liquidity demand participation ratios around scheduled news announcements creating large price changes. The liquidity supply and demand participation ratio corresponds to the percentage of trading volume where liquidity is supplied and demanded, respectively, by HFTs. In general up to 60% of all liquidity supply in the market stems from HFTs. In contrast, less than 25% of all trades are *initiated* by HFTs. Thus, HFTs are rather passive and tend to do more market making (i.e. liquidity provision) than aggressive trading (i.e. liquidity demand). The only exception

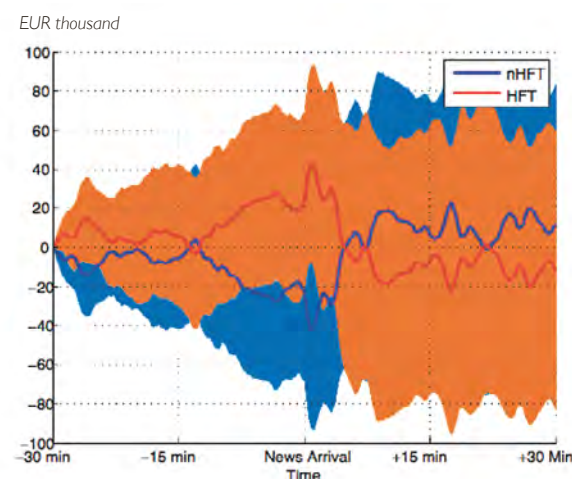
is shortly before the news arrival. In the last minute before the news is released, HFT liquidity supply drops from roughly 50% to less than 35%. At the same time, their trading strategies become more aggressive and they significantly increase their liquidity demand. Hence, in periods where uncertainty becomes very high and the risk of a limit order becoming mispriced peaks, HFTs considerably reduce their inventory and at the same time increase their trading activities, presumably trying to exploit latency arbitrage.

As documented by HNZ, this is also reflected in the bid-ask spreads as a measure for trading costs in the market. They show that bid-ask spreads, where HFTs make the market on both sides are generally lower than bid-ask spreads originating from order submissions by nHFTs. Shortly before the news arrival, however, HFT-implied bid-ask spreads widen by approximately 25%. While this behavior is widely in line with the behavior of a “classical” (designated) market maker, such a drop in liquidity provision can happen very rapidly.

Chart 2

### Trading profits of high- frequency trades in the Bund Futures market

#### Positioning profit



Source: Chart reproduced from Hautsch, Noé and Zhang (2017).

Note: Profits through trade positions (left) and through market making during 60 minute windows around scheduled macroeconomic announcements with extreme price movements in Eurex Bund Futures trading, 2014–2015. Averages across announcements with shaded areas indicating 95% confidence intervals.

#### Net spread

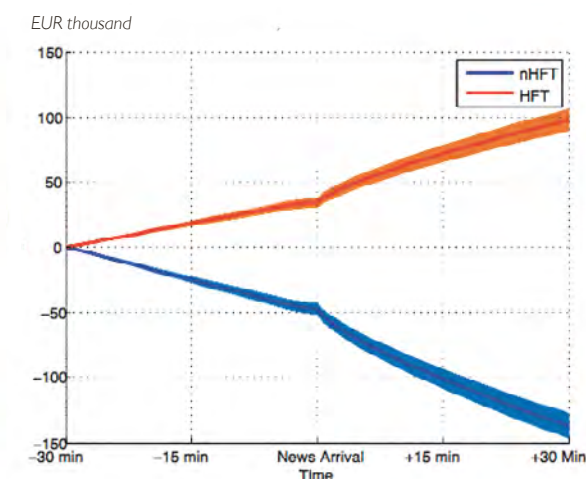


Chart 2 gives the average profits and losses of HFTs and non-HFTs during the 60 minute period around an announcement under the assumption of an initial inventory of zero 30 minutes before the news release. The red curve in the left picture gives the average profit made by the entire HFT activity in periods around news announcements. The blue curve indicates the average profits and losses of all non-HFTs. The two pictures are based on a decomposition of the overall (average) profits into the profits from pure market making, i.e., earning the bid-ask spread (chart 2, right picture), and the profits by active directional trading through this period (chart 2, left picture). Correspondingly, during the hour around a news announcement, HFTs in the Bund future market earn on average close to EUR 100,000. Conversely, non-HFTs lose up to EUR 130,000.<sup>1</sup> Chart 2, however, shows that basically all the profits made by HFTs during this period result from liquidity provision. Likewise, non-HFTs repeatedly pay the

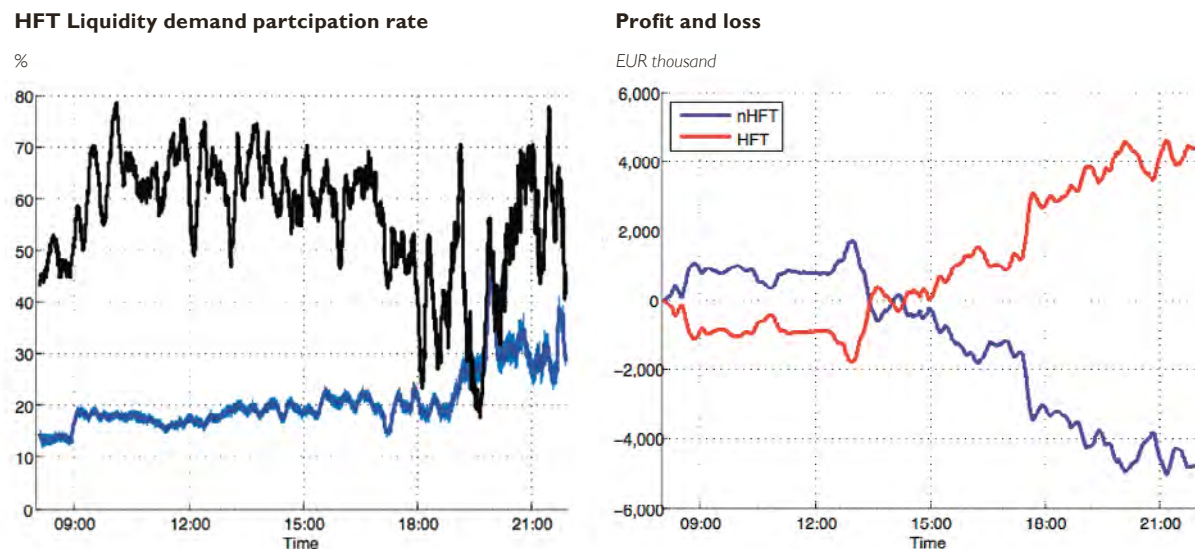
spread as they predominantly act as liquidity demanders. Hence, these results seem to suggest that HFTs serve as high-frequency market makers and just take over the function of designated market makers, standing ready to supply liquidity whenever needed and earning the bid-ask spread. HNZ, however, show that this conclusion can be misleading.

Chart 3 shows HFT activity from 9:00 a.m. to 21:00 p.m. on the day after Brexit (June 24, 2016). The black line is the proportion of all trades initiated by HFTs, whereas the blue curve is the corresponding proportion on “normal” days without any particular news events. We observe that on this day, the order aggressiveness of HFTs is significantly higher than during periods around scheduled news announcements. Hence, on such a day of high market turbulence, HFTs do *not* serve as passive market makers but are heavily involved in directional trading. This behavior is in stark contrast to the behavior of a “classical” (designated) market maker.

<sup>1</sup> The fact that the losses of non-HFTs are higher than the gains of HFTs is due to the existence of trading fees. As non-HFTs tend to initiate trades much more often than HFTs, non-HFTs face significantly higher transaction costs.

Chart 3

### HFT liquidity demand and trading profits in the Bund Futures market after the Brexit decision



Source: Chart reproduced from Hautsch, Noé and Zhang (2017).

Note: Left picture: HFT participation rate in liquidity demand on June 24, 2016 (black line). The blue line presents the average across normal trading days. Right picture: Total profits and losses by HFTs and non-HFTs on June 24, 2016 in Eurex Bund Futures trading.

The right picture in chart 3 displays the profits and losses by HFTs and nHFTs. Hence, HFTs earned approximately EUR 4 million on this day. As shown by HNZ, these profits, however, predominantly result from active (directional) trading but *not* from market making. Further evidence provided by HNZ shows that HFTs obviously do not replace “classical” designated market makers but differ in an important respect: HFTs (rapidly) change their strategy according to the market situation. In a situation where trading opportunities through latency arbitrage come up, they become aggressive and exploit their speed advantage. Then, market making functionality can be severely limited.

Currently, it is still very unclear what the effects on volatility and market stability in such extreme situations might be. It is still widely unknown whether HFT increase the risk of tail events and increase volatility on turbulent days, as the day after the Brexit. More research is clearly needed to gain a better understanding of the possibly dangerous sides of HFT.

#### 4 Future of HFT – regulatory perspectives

Current evidence shows that the extent of HFT will decline due to increasing costs of infrastructure, increasing competition among HFTs and the introduction of alternative trading systems which partly rule out HFT, e.g. via dark pools, or so-called “speed bumps”, where market access is artificially and randomly delayed, such that millisecond speed advantages disappear. According to estimates by Kaya (2016), the overall HFT revenues in the U.S. decline from approximately USD 7 billion in 2009 to less than USD 2 billion in 2014. Though the very glory times of HFT in 2009 seem to be over, it is not expected that HFT will disappear. As long as trading designs are not systematically changed, HFT will remain an integral part of electronic trading and should be understood as a consequence of market evolution and past regulation. Correspondingly, the future of HFT will strongly depend on upcoming regulation.

In fact, currently there exists severe regulatory uncertainty. In the U.S., as a

response to the May 2010 flash crash, the SEC introduced trading pause regulation preventing further flash crashes. In the same year, the Dodd-Frank legislation restricted the so-called proprietary trading of banks and the SEC (Security Exchange Commission) issued a ban on “naked” (unfiltered) market access. Current developments go into the direction of more monitoring, recording and registration of HFT activity. Since 2015, the SEC forces certain HFT broker-dealers to register with the Financial Industry Regulatory Authority (FINRA) strengthening the SEC’s oversight of proprietary firms. In 2015, the CFTC proposed rules for a regulation of automated trading (Reg AT), governing certain HFT practices.

In Europe, MiFID II will become in force in 2018. MiFID will require HFT firms to provide details on the nature of algorithmic trading strategies, trading parameters, and risk controls. There will be specific obligations for trading venues in terms of monitoring, circuit breakers, capacity requirements, pre-trade and post-trade transparency and manual “kill functionality”. HFT firms will also have to test the conformance of their trading systems and algorithms. There will be algorithm-tagging rules in order to identify market manipulation. Finally, HFTs have to fulfill certain obligations if they want to pursue market making strategies.

There are, however, potential regulatory pitfalls. First, there might be too much focus on monitoring, registration and (massive) data collection. Though it opens up the possibility to investigate potential market manipulation and to detect fraud, it will require substantial resources to process and analyze this massive data. Currently, it is unclear whether this will be efficient and effective. Second, in the MiFID II regulation, it is unclear how to implement all the

planned details on risk control and the testing of algorithms. Third and most importantly, current regulation plans are too rigid for market making. Empirical evidence, as discussed above, demonstrates that HFT market making is beneficial for market quality and other market participants. Regulation thus should try to strengthen these strategies and thus to preserve the benefits from HFT while simultaneously mitigating risks. Hence, a negative scenario could be that of a too rigid and misguided regulation, which will reduce HFT, but will also reduce market quality in terms of lower liquidity, higher transaction costs and higher volatility. HFT and liquidity will flee into other – potentially non-regulated – markets while we are confronted with high (maybe too high) regulation costs.

Ideally, technological innovation should go hand in hand with smart regulation. For instance, the idea of limiting latency differences is a good way to stop the arms race for speed and to reduce predatory trading and a major amount of harmful HFT strategies. Such an artificial delay of trading, a so-called “speed bump”, is the major concept of the exchange IEX, which has been officially approved by the SEC in June 2016 and is a growing exchange that is even partly supported by HFT firms themselves. With such a speed bump (on IEX it is 350ms), HFT market making could be still a beneficial strategy, while the downsides of HFT, such as predatory trading and the arms race for millisecond speed advantages could be limited. In combination with a well-balanced use of “circuit breakers” and general safeguards, we could accept HFT as a “normal” integral part of modern trading, which would settle down to a moderate level and will predominantly concentrate on strategies which are favorable for market quality, such as liquidity provision.

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# Smart contracts and corporate governance

## 1 Introduction

Smart contracts are commercial agreements implemented by the use of machinery and computer technology. As first described by Szabo's (1997) treatise, "The basic idea behind smart contracts is that many kinds of contractual clauses (such as collateral, bonding, delineation of property rights, etc.) can be embedded in the hardware and software we deal with, in such a way as to make breach of contract expensive." The author points out the smart contracts are hardly new, with the mechanical candy vending machine, introduced in 1880s Britain, representing perhaps the earliest example.

Advances in information technology have made smart contracts more and more common in routine commerce. Today, the advent of blockchain technology and its implementation on flexible contracting platforms such as Ethereum have greatly expanded their potential use.

Smart contracts automate the performance by one or both sides to an agreement, and typically they cannot be rescinded or interrupted without the consent of both parties. Szabo (1997) offers the example of a consumer automobile loan in which the car serves as collateral and the borrower agrees to a fixed number of monthly payments. If the borrower misses a payment, a computer would remotely and automatically shut off the borrower's access to the car's ignition system; a more up-to-date example would probably have the car drive itself autonomously back to the lot of the lender.

The certainty of performance of a smart contract offers clear potential benefits. In the case of the vending machine, negotiation costs between buyer and seller are driven to zero, and the buyer has no need to worry about strategic default or other forms of

moral hazard by the seller. In the car loan example, verification and enforcement costs disappear, since the lender does not need to hire a lawyer to go to court and obtain a lien to repossess the collateral from the borrower, and then hire a repo man to retrieve the vehicle. In this case, the seller does not need to worry about strategic behavior on the part of the buyer.

This screening out of moral hazard behavior will have the effect of removing from the market those parties who may intend to default on their obligations, improving the credit quality of the overall pool and driving down the cost of capital. In short, by guaranteeing performance, smart contracts reduce the need for trust in commercial relationships. Trustless contracting has become a common theme motivating the creation of digital currency and other blockchain applications.



At the same time, smart contracts certainly create new risks and problems. In the example of the car loan, one would not want the ignition to autonomously deactivate if the borrower is operating the vehicle on a crowded highway at rush hour, for instance. One might also not want to rule out strategic non-performance in all states of the world, as shown by Posner's (1973) famous popularization of

the idea of “efficient breach” of contracts, a foundational concept in the Law and Economics literature.

## 2 Smart contracts in corporate governance

Jensen and Meckling’s seminal (1976) article on agency costs describes the firm as a “nexus of contracts” between suppliers of capital, skilled and unskilled labor, raw materials, customers, and other groups. The growing interest in smart contracts naturally leads to the question of how corporate governance might change if more and more of these relationships become automated. Some applications, such as self-executing derivative securities, are easy to anticipate, while others, such as self-enforcing labor agreements or employment contracts, may be far off but could also offer opportunities for joint gains between contracting parties. Like any new or emerging technology, smart contracts surely pose risks that may not yet be understood.

### 3 Three examples

In this section, I discuss three simple applications of smart contracts in corporate governance, in the areas of derivative securities, secured debt, and equity share registration. These examples are meant to be introductory and only hint at the possibility for more elaborate smart contracts.

#### 3.1 Financial derivatives

Many aspects of a firm’s capital structure involve contingent claims that can be exercised or extinguished under certain future conditions. In some cases, these involve a choice by the security holder; representative examples would include executive stock options or convertible debt, either or which may be converted to shares at a certain fixed price during a limited

future exercise period. Other derivatives are intended to execute automatically if certain conditions are satisfied; these include instruments such as credit default swaps, which pay off to outside investors if a company defaults on its debt, and Contingent Convertible (“CoCo”) debt securities, which might be issued by a bank and convert into equity if the bank’s equity falls below the regulatory minimum requirement.

In all these examples, the exercise decisions could easily be automated by smart contracts. If a choice by the security holder is required to trigger the exercise, the smart contract could be programmed to execute when certain optimality conditions are achieved in the marketplace. This would overcome well-known problems in which investors sometimes exercise options or convert debt at sub-optimal times. If conversion of a security is contingent on a future event, again a smart contract could be used to verify the contingency continuously and automatically execute the conversion if the contingency is ever met. This would save costs of verification and potential litigation, while also avoiding strategic behavior sometimes seen in the marketplace to forestall the triggering of contracts.

#### 3.2 Corporate debt

Companies often pledge collateral and make various balance sheet commitments as conditions of obtaining loans. If a company cannot stay in compliance with these loan covenants, in theory a process should begin in which the lender can obtain title to the collateral and demand repayment of the remaining loan balance. In practice, companies have recourse to judicial bankruptcy procedures that often forestall the lender’s recoveries and provide legal incentives for the borrower and lender to renegotiate.

A smart contract could short-circuit the bankruptcy process by automatically conveying collateral from borrower to lender if a covenant is violated. In principle, compliance could be monitored in real time, and not just on the four days of the year in which a firm publishes its balance sheet. The contract could also execute other financial transfers and governance changes immediately if a default event occurs.

While the description above is quite general, the reader should see immediately that smart contracts can potentially resolve financial distress much more quickly and cheaply than the judicial processes that operate in most countries. Contracting around the judicial resolution of financial distress has for years been a closely studied topic in the finance and governance literatures. With self-executing smart contracts, many costly negotiating strategies involving brinkmanship and risk-shifting might be precluded, generating net savings that could be shared ex ante by the borrower and lender.

#### 3.3 Share registration

Over centuries, stock markets have evolved elaborate systems for the custody, lending, and voting of shares of stock. Many investors delegate these tasks to brokers, for reasons that include cost savings, tax avoidance, privacy, and simplicity. The involvement of these custodians as intermediaries between companies and their own shareholders has led to many problems in areas such as payment of dividends and accurately tabulating votes, as described by Kahan and Rock (2008).

A recent fiasco involving the 2013 management buyout of Dole Food Co. vividly illustrates the weaknesses of the current share registration system in the U.S.A. After years of litigation over the buyout price, a court in Delaware in



2017 increased the per-share buyout price from USD 13.50 to USD 16.24. Owners of more than 49 million shares made legal claims for the increased payment, but the company had less than 37 million shares outstanding. Causes of this large discrepancy still remain partly unexplained, but observers have blamed the difference on the decentralized custodial system, in which each brokerage essentially keeps track of its own investor accounts and often permits shares to be lent out to short sellers. A short seller then sells the shares to other investors, without the knowledge of the ultimate owner whose shares are held in custody. In the case of Dole, there appear to have been millions of shares sold short, and the short sellers rather than the company should be liable for the increased payment of USD 2.74 per share. However, the buyers of these shares had no idea they were buying from short sellers, and they would have applied for payment from the company. All of this should be sorted out by the intermediary brokerages, but with the passage of four years, the failures and mergers of various firms, and the unexpectedly generous court decision, it has proven impossible to locate all the responsible parties.

Smart contracts seem like a straightforward solution to the types of problems seen in the Dole example and at

other companies. If a share of stock existed virtually on a blockchain, it could be embedded with smart contracts that could, variously, transfer dividend payments from the account of a short-seller to the account of the buyer, sell securities when margin calls are triggered against leveraged investors, and prohibit the double-voting that frequently occurs if shares are lent out by a custodian without knowledge of the true owner.



#### 4 What could go wrong?

Smart contracts have many potential risks. They could autonomously execute in situations that neither party anticipates nor would wish for, causing irreversible losses or collateral damage to third parties. They may invoke other smart contracts, in a sequence that causes a cascade of escalating losses or so-called “death spiral” of a firm. The ground rules for interrupting smart contracts or resolving disputes *ex post* are very unclear, and perhaps non-existent.

Purists sometimes take a “code is law” view of smart contracts, implying that the parties must follow the consequences of the contract’s written code if disagreements or unforeseen circumstances lead to outcomes that either party regrets. This viewpoint leaves no room for intervention by courts, and it puts a great burden upon the two par-

ties to inspect and fully understand the written code underlying a contract before they implement it. In practice, it may not be possible for the parties to exclude courts from intervening if and when smart contracts run amok, and they may potentially assign liability not only to one or both of the parties, but also to programmers, blockchain hosts, and other entities involved in creating or providing the platforms for smart contracts.

An object lesson exists in the experience of TheDAO, a “decentralized autonomous organization” on the Ethereum blockchain that became the target of a successful hack in 2016. A DAO is essentially an organization run by computer code, with no human managers or employees. TheDAO was an ambitious attempt to create a decentralized venture capitalist that would facilitate a voting process for investors to select from a menu of potential start-up investment proposals.

TheDAO astonished investors by attracting USD 150 million worth of investment (in ether tokens) in a 28-day crowdfunding period that began on April 30, 2016, despite warnings from observers and analysts that the underlying code left it vulnerable to hacking. As feared by these commentators, a theft did occur on June 18, with the attacker – who has still not been identified – draining about USD 60 million of ether from TheDAO into a cloned “child DAO.” Siegel (2016) prevents a lucid account of these events.

In the aftermath of this catastrophe, adherents to the “code is law” philosophy felt that TheDAO’s investors had learned a hard lesson about the need to inspect smart contracts carefully before entering into them. However, the sponsors of Ethereum, who technically had no role in TheDAO, decided otherwise, and proposed several possible in-

terventions. These included amending the Ethereum blockchain’s code to isolate the assets stolen by the hacker, so that they could not be moved or otherwise spent, or rewinding the blockchain itself to negate the transactions implemented by the hacker.

The latter approach, essentially “rewriting history” on the Ethereum blockchain, was ultimately supported by about 85% of the user community and was implemented. However, the 15% minority that disagreed continued to use the original Ethereum blockchain, renaming it “Ethereum Classic” and essentially creating a schism that caused two versions of the ether currency to begin circulating. The split has endured to this day; as of the date of this writing, the Ethereum currency has a market capitalization of about USD 21 billion, while Ethereum Classic’s currency is worth about USD 1.5 billion, both much higher than the USD 1 billion value of the original Ethereum at the time of the hack in June 2016.

This so-called “hard fork” in the Ethereum blockchain may have satisfied many normative tests of fairness, and it may even have resembled the outcome that a court would have imposed if litigation had occurred. However, it cre-

ated a troubling precedent, showing that the sponsors of a blockchain have the power to rewind it as a type of remedy if a smart contract runs off the rails. The conditions under which such interventions might occur in the future seem uncertain at best, and victims of smart contracts with unhappy endings will surely try to invoke them, citing the precedent of TheDAO.

#### Conclusion

Smart contracts, which use information technology for verification and execution, represent a promising facet of the Fintech movement. They may solve longstanding problems of cost and delay in contract enforcement, but their greater potential may be in screening from the credit markets potential borrowers who are predisposed to moral hazard problems such as strategic debt default. In the corporate governance area, smart contracts may reduce numerous agency costs that arise between investors, managers, and other parties. However, like any new technology smart contracts may be misunderstood and create new problems, and today’s markets are still in the early stages of discovering the potentials and pitfalls of these instruments.

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## 13<sup>th</sup> Klaus Liebscher Award 2017

On the occasion of the 65<sup>th</sup> birthday of Governor Klaus Liebscher and in recognition of his commitment to Austria's participation in European monetary union and to the cause of European integration, the Oesterreichische Nationalbank (OeNB) established in 2005 the "Klaus Liebscher Award". This award is the highest scientific distinction, the OeNB offers every year for up to two excellent papers on European monetary union and European integration issues written by young economists (up to 35 years) from EU member or EU candidate countries. The award is worth EUR 10,000 per paper. A panel of highly qualified reviewers referees the papers. The Klaus Liebscher Award was granted this year for the 13<sup>th</sup> time. Governor Nowotny and President Raidl presented the award and the award winners of 2017.

The winners of 2017 are *Jean-Marie A. Meier, London Business School* for his paper *Regulatory Integration of International Capital Markets* and *Filippo De Marco, Bocconi University*, for his paper *Bank Lending and the European Sovereign Debt Crisis*.

In his empirical paper, *Regulatory Integration of International Capital Markets*, Jean-Marie A. Meier analyzes the effects of an integrated regulatory framework for European financial markets on the financial system and the real economy. Using data from the process of the various EU regulatory steps to establish a single European capital market and a European market for financial services, he specifically examines the impact of this policy on the

access of listed companies to external financing as well as the impact on investment and employment. He finds quantitatively significant effects: In addition to a doubling of external financing through a Europe-wide regulation, there is also a significant increase in investment and employment.

In his paper, *Bank Lending and the European Sovereign Debt Crisis*, Filippo De Marco examines the impact of the interdependence between sovereign debt and the banking system on the real economy. Using data from the European sovereign debt crisis of 2010/2012, he analyzes the effects on the financing of loans from companies. The main mechanism that restricts bank lending to firms in a sovereign debt crisis is not the loss of valuation of government bonds, but the elimination of short-term refinancing opportunities through unsecured, short-term liabilities at US-based money market funds. These funding stops force the banks to either reduce equity or limit credit supply.





## The banking sector – fit for the future?

Looking back to 2016, the European banking industry suffered a significant setback. Revenues declined across the board, cost reductions were unable to keep pace and low interest margins kept away the industry from increasing interest income. As a result, net income fell by almost half. Banks resorted to aggressive de-risking, but a shrinking equity base meant that capital and leverage ratios stagnated for the first time since the financial crisis. By contrast, U.S. banks continued to grow and set a new record in terms of nominal profits, widening the gap to their European peers.

All in all 2016 was not a good year for European banks. Though the economy picked up speed in most countries, banks suffered a setback caused mainly by market turmoil at the beginning of the year, high litigation expenses and large write downs on loans and goodwill in the final quarter. But cost levels also remained stubbornly high.

On the revenue side European banks faced the same challenges as American banks.

This would not have been such a problem if banks had been able to reduce costs to the same extent, or if the cost of risk had continued to decline. Yet administrative expenses fell less than revenues. In addition, loan loss provisions, which had provided tailwind in the past three years, increased by 27%. Having reached the lowest level since 2007 in 2015, this pickup, which burdened specific European countries, was hardly a surprise given the modest improvement in loan growth.

With profitability that much under pressure, banks again resorted to de-risking, deleveraging and shrinking. Total assets fell by another 2%, and total equity declined by 3%.

The impact on risk-weighted assets (RWA) was even more pronounced. They were cut by 7% to EUR 6,600 billion, the lowest level since 2008, despite large-scale inflation from tighter regulation (Basel 2.5 and Basel III). Over this period, banks have slashed *more than EUR 1,000 billion in RWA, or 14%* – an impressive achievement.

The most spectacular figure, however, came neither from balance sheets nor the profit and loss statement: for the first time since the financial crisis, European banks on aggregate did not manage to strengthen their capital levels in the past 12 months, in spite of de-risking. The fully loaded *CET1 ratio remained flat at 12.7%*. Admittedly, capital ratios have risen enormously since 2008.

Still, many banks are not yet comfortably above levels for both measures which would provide them with substantial flexibility and freedom to either invest in business growth or return much of future earnings to their owners.

This also shows that the European banking industry is far from a position where it could easily absorb a significant further tightening in capital requirements. In this regard, the *effective standstill of the Basel IV discussions* following the U.S. election has provided some relief to European banks.



How does the situation of European banks compare with the performance of their peers in Austria?

Austrian banks' profits increased in 2016, but this rise was to a large extent attributable to lower risk provisioning.

Income from core business lines, such as interest and commissions income, was down on the previous year.

More precisely, all major components declined year-over-year. Interest income was under pressure due to the ECB-policy. Modest loan growth could not compensate the contraction of interest margins.

Banks seem to be unable to compensate for this even in part through a shift towards a more strongly fee- and commission-based business model. Despite efforts to increase income from accounts, cards, transactions and asset management, fees and overall commissions dropped due to reduced client activity in volatile capital markets over the course of the year. Similarly, trading income slumped.

Over the past few years, restructuring at individual banks has been a key driver of improvements in the Austrian banking sector's credit quality. That said, the amount of nonperforming loans, which are to a large part in the books of Austrian banks' CESEE subsidiaries, remains a burden for some banks that should be addressed proactively in order to support new lending.

But let us be clear: it should not be addressed at the expense of the public sector! It is definitely not the task of the Government to rescue the financial sector again and again.

The costs for stabilising the banking sector in and after the crisis have been tremendous and as a consequence we have agreed on a resolution framework to ensure that bail-out by taxpayer's money is not on the agenda anymore. And we are continuously strengthening

the regulatory framework to reduce the likelihood of failures in the banking sector.

Now it's up to supervisory and resolution authorities to apply the new or improved tool. And it is the task of DG COMP to assess whether the measures are in line with state aid rules or not.

If a bank is in deep, deep troubles, the authorities have to decide on the consequences. But it can't be the case that the bank asks for public support. It can't be the case either that authorities and institutions try to avoid decisions and try to pass the responsibility for actions to the next.

If it happens this way, ailing banks are being kept alive – and they will continue struggling for the rest of their life until severe measures will be taken. Alternatively the public sector has to step in again, but that's what I want to avoid for sure.

We need banks that are fit for the future and we need authorities that support the development of the sector.

One crucial element here is certainly the decision by the authorities on the capital provisions. A careful balance has to be reached between caring for risks and supporting the real economy, but I know that this trade-off is not easy to manage.

Taking a look at the Austrian sector, the *capitalisation of the Austrian banking sector has improved significantly* since the onset of the financial crisis. This trend continued 2016. However, domestic banks' capital ratios were still below the European average and its European peers.

The decline in operating profits accelerated banks' restructuring and adjustment measures as deemed necessary by the authorities but a lot of work is still waiting. For example, according to Eurostat the *population size per branch average* for all euro area countries was

2,170 people in 2016. In Austria it was 2,100, near this average. But in Belgium the population size per local branch reached 3,200, in Finland 5,600 and in the Netherlands 9,600.

But let me also mention some positive developments, as we were able to find a solution on the *Heta issue*. Looking at the individual figures the resolution seems to be successful: The *recovery ratio* increases from 46% to 64.4%. But I have to emphasize, a significant winner is also the Austrian banking industry, getting back its market presence especially in Germany.

But all in all, it seems that the *banks haven't done all their homework* yet and I really urge them to do so since they might see themselves confronted with more and more *growing competition* from other areas such as *FinTechs*.

Considering figures and the fact that FinTech start-ups and mobile banking are changing consumers' use of banking products the traditional banking model is threatened.

This is to say, the banks must prepare themselves for a changing environment. For this to be successful, they need to question their business models and make adjustments.

Some of them might be painful – but if these adjustments are postponed all the time, the day will be coming, when it will be too late to manage the turn around.

And please, *don't expect me then to step in and pay for the bank's inability to read the signals of time* and act accordingly.





Chair:  
Ernest Gnan, Oesterreichische Nationalbank  
SUERF  
  
Speakers:  
Nikolaus Hautsch, University of Vienna  
David Yermack, NYU Stern School of Business



Chair:  
Andreas Ittner, Oesterreichische Nationalbank  
  
Speaker:  
Paul Tucker, Systemic Risk Council |  
John F. Kennedy School of Government



44<sup>th</sup> OeNB Economics Conference of the  
Oesterreichische Nationalbank in  
cooperation with SUERF  
  
The Financial System of the Future  
  
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Session 5

Technological change and the future of cash





## Introductory statement: Technological change and the future of cash

Ladies and Gentlemen,  
Welcome to our morning session on *Technological change and the future of cash*. In this session, we are going to discuss new payment technologies and the future of cash.

As Aristotle once said: “Life requires movement.” Therefore, it is not surprising that payment behavior, which is part of our daily life, is undergoing changes as well.

Payment behavior is very important for the economy. It is important because it ensures there are sufficient and efficient payment options in all possible transactions. This means it is essential to identify possible dynamics and developments that will shape the future payment landscape.

At present, payment systems in Europe are experiencing lively growth in innovation. Noncash payment options have been increasing in recent years. The digital revolution offers faster means for making payments. We are talking about contactless transactions, instant payments and virtual currencies. The emergence of blockchain technologies indicates that further change may be on the horizon.

In light of these developments you might get the impression that cash has no future. What I am trying to say: Is cash fading away?

Before I hand over to our guests to address this issue, allow me to bring two arguments in support of cash:

*First argument:* People love cash – in particular in Austria. To prove that argument I can tell you that the amount of euro cash in circulation is now four times higher than it was when the euro was introduced.

*Second argument:* Cash is obviously more secure than electronic payment instruments. We all remember the

headlines in newspapers two weeks ago: A global cyberattack infected tens of thousands of computers in 99 countries. The hackers blocked computers and demanded a ransom of USD 300 in bitcoins from users seeking to regain access to their computer systems.

To quote Bundesbank President Jens Weidmann: “The question is no longer if a financial infrastructure or institution will be subject to an attack but rather when and how often.”

With this in mind, I would like to introduce our two distinguished speakers for this session, who will give us valuable insights into technological change and the future of cash.

First, a very warm welcome to our first speaker, *Mr. François Velde*, who is Senior Economist and Research Advisor in the Economic Research department at the Federal Reserve Bank of Chicago. He is an expert in the field of monetary history and theory.

Today, he is going to discuss the functionality of distributed ledger technologies – in particular virtual currencies – and the impact they might have on traditional payment systems.

Also a very warm welcome to our second speaker, *Mr. Helmut Stix*, who is Senior Expert in the Economic Studies Division at the Oesterreichische Nationalbank. His current research focuses on households’ reactions to financial crises, as well as on cash demand and payment innovations.

He has published papers in academic journals on topics like consumer cash usage across countries, why people save in cash, the choice and use of payment instruments, trust in banks during normal times and times of crisis, the determinants of financial dollarization, and inflation perceptions.

Helmut Stix<sup>1</sup>

Senior Economist  
Oesterreichische Nationalbank



## Is cash back?

### Assessing the recent increase in cash demand<sup>2</sup>

Contrary to predictions that demand for cash will decline with the increased availability and use of non-cash payment means, currency demand has increased in the euro area and the U.S.A. over the past 15 years. In this context, this short article summarizes recent findings from Jobst and Stix (2017), who look beyond the recent developments of the euro and the U.S. dollar by analyzing many economies and very long time series. Data on currency circulation from 2001 until 2014 for a sample of 70 economies reveals that the recent increase in circulation is not confined to international currencies like the U.S. dollar or the euro but can be observed in various other economies. Investigating evidence for the United States and Germany for the past 140 years shows that the recent increase is sizeable and compares to a similar upsurge in the wake of the 1930s financial crisis. Finally, in economies where currency demand increased, the increase typically took place after the start of the economic and financial crisis of 2007/08. Panel money demand models show that conventional economic factors like low interest rates can account for some part of the increase but leave a notable part unexplained, in particular in rich economies. While hard evidence is difficult to come by, we conjecture that cash demand was driven by the higher level of economic uncertainty pertaining since the financial crisis of 2008, which resulted in hoarding.

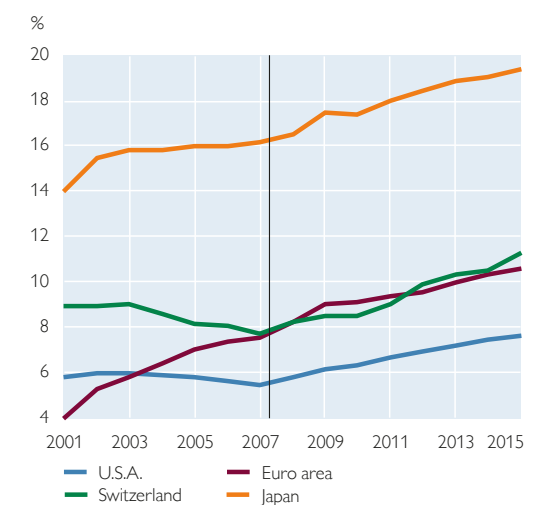
#### 1 Introduction

If we were to believe technology cheerleaders (c.f. BBC, 2015), cash is about to disappear. It has already almost done so in Sweden and it will do so everywhere else rather soon. Thanks to internet, mobile phones and NFC the use of cashless payment technologies in industrialized economies, which has already been progressing over the past decades (Amromin and Chakravorti 2009; Bagnall et al. 2014), is about to enter a fundamentally new phase.

This story, however, does not match up with the empirical evidence. People (still) hold enormous amounts of physical cash: In 2014, per capita holdings were around USD 4,000 in the euro area and the U.S.A. What is even more puzzling, in recent years cash circulation has gone up sizably in the euro area, the U.S.A., Switzerland and Japan, notably after 2007 (chart 1).

Both the magnitude of cash circulation and its increase over the past decade(s) raise crucial questions for central banks and economic policy makers alike: What

Chart 1  
Currency in circulation over nominal GDP



Source: Jobst and Stix (2017).

Note: The figures show currency in circulation to nominal GDP ratios for individual economies.

explains the puzzling size of cash circulation? Can the extent and the increase over time be explained by conventional economic forces, e.g. lower interest rates, or are there alternative explanations? What does the apparent demand for cash imply for plans to phase out or

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<sup>2</sup> The views expressed in this paper are exclusively those of the authors and do not necessarily reflect those of the Oesterreichische Nationalbank or the Eurosystem. We thank Professor Schneider (University of Linz) for sharing the shadow economic indicators and Tobias Himmelbauer for excellent research assistance.

at least restrict the use of cash as recently proposed by several economists?

In this short paper we summarize results of Jobst and Stix (2017). To assess and to understand recent trends, we suggest to analyze currency demand from a broader perspective by going beyond the literature's typically rather narrow focus on either relatively short time periods (e.g. the post-World War II period) or on relatively few economies (e.g. the U.S.A., the euro area, etc.). We extend the investigation back to the late 19<sup>th</sup> century for the United States and Germany. This perspective shows that the recent increase is sizeable and compares to a similar upsurge in the wake of the financial crisis of the 1930s. Second, we collected data on currency circulation from 2001 until 2014 for a sample of 70 economies. This perspective underscores that the recent increase is broad-based and can be observed in structurally different economies. The panel setting also allows us to econometrically study the recent drivers of cash demand. We show that conventional economic factors like low interest rates can account for some part of the increase but leave a notable part unexplained. While hard evidence is difficult to come by, our results support the conjecture that cash demand was driven by a higher level of economic uncertainty pertaining since the financial crisis of 2008.

## 2 Stylized facts on the recent upsurge in cash demand

Developments in the circulation of the U.S. dollar and the euro are unrepresentative for the circulation of cash at large. A significant part of U.S. dollars

and euros circulates outside their monetary area, which explains part of the high per capita holdings of these two currencies (Bartzsch, Rösl and Seitz, 2013; Judson, 2017; Assenmacher, Seitz and Tenhofen, 2017 for Switzerland). Potentially, the recent upsurge in the circulation of U.S. dollars and euros could have been due to international demand. To separate out domestic and international factors, we have to enlarge our sample. Specifically, Jobst and Stix (2017) have collected data from around 70 economies for the period from 2001 to 2014. In essence, the sample covers the richest economies in terms of their absolute economic size plus regionally important economies that were added for breadth of geographical coverage. Overall, all included economies account for about 96% of World GDP in each year from 2001 to 2014. Henceforth, this sample will be denoted as the "World".<sup>3</sup>

Four stylized facts emerge:

1. *Currency ratios diverge widely, but even in low-cash economies cash holdings per capita are difficult to reconcile with transaction demand.*

Per capita circulation ranges enormously from about USD 30 to 70 in African economies like Kenya, Tanzania, Uganda, Nigeria or Cameroon to USD 9,000 in Switzerland. Table 1 lists the 20 economies with the highest per capita values of currency in circulation both using market exchange rates (USD) and purchasing power adjusted exchange rates (PPP-USD). The euro area and the U.S.A. had a per capita circulation of around USD 4,000. This compares with values of USD 1,250 in Sweden and USD 1,520 in Norway, which are

<sup>3</sup> Aggregating economies raises the issue of which exchange rate has to be applied. In this paper, all results which refer to aggregations are based on USD exchange rates that are fixed as of 2006. This eliminates the impact of exchange rate movements that have occurred in the course of the economic and financial crisis. Jobst and Stix (2017) provide results on aggregations based on other exchange rates and find that results are largely unaffected, qualitatively.

Table 1

### Size of currency holdings in U.S. dollar in 2014

Country	Currency in circulation per capita	Currency in circulation per capita	Currency in circulation over nominal GDP
	USD	PPP-USD	%
1 Switzerland	9,009	6,024	10.5
2 Japan	7,257	7,303	19.0
3 Hong Kong	5,874	8,055	14.6
4 Singapore	4,546	6,685	8.1
5 Euro area	4,085	3,997	10.3
6 United States	4,059	4,059	7.4
7 Australia	2,565	1,853	4.2
8 Czech Republic	2,144	3,338	10.8
9 Denmark	2,127	1,574	3.4
10 Israel	1,927	1,721	5.1
11 Canada	1,781	1,562	3.5
12 Qatar	1,705	2,556	1.9
13 Hungary	1,634	2,880	11.7
14 Norway	1,525	1,016	1.6
15 Kuwait	1,507	x	3.2
16 Azerbaijan	1,450	3,221	18.4
17 South Korea	1,409	1,731	5.0
18 United Kingdom	1,399	1,201	3.1
19 Saudi Arabia	1,396	3,001	5.4
20 Iceland	1,306	1,087	2.5

Source: Jobst and Stix (2017).

Note: The table shows per capita values of currency in circulation expressed in U.S. dollar, in purchasing power adjusted U.S. dollar (PPP-USD) and as a percentage of nominal GDP for the year 2014. The table shows the 20 countries with the highest values for currency in circulation (USD).

the countries considered as frontrunners in electronic payments. But even in these countries, per capita holdings are still very high and much higher than can be explained by transaction motives. Table 1 thus substantiates that international circulation alone cannot explain high per-capita holdings in some economies. Rather, cash must be hoarded in many economies and/or serve other purposes than pure transaction needs.

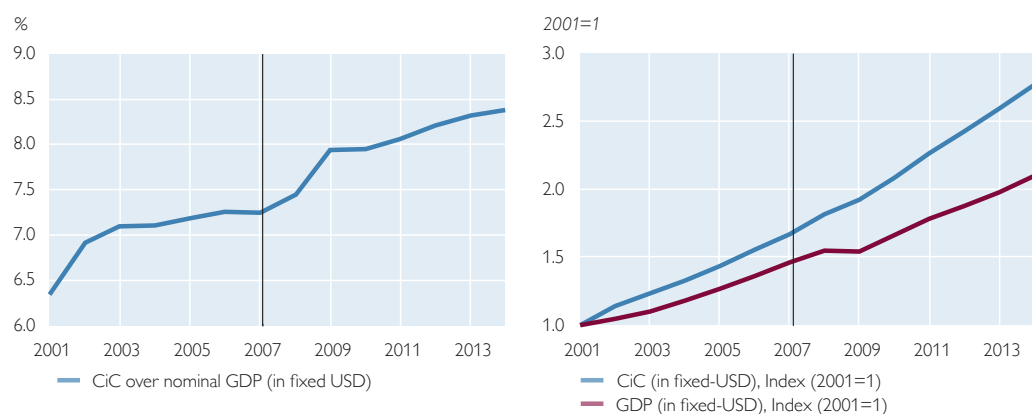
2. *Aggregate currency circulation at the world-level has increased.*

A related question raised by the recent increases in the circulation of U.S. dollar and euro is whether this phenomenon is restricted to international currencies or more broad-based. The left panel of chart 2 depicts the currency in circulation (CiC) over nominal GDP ratio for the aggregate of all economies in our

"World" sample. The ratio slopes upward throughout the period and a discernible level shift can be observed between 2007 and 2009. Part of the observed increase of the CiC over the nominal GDP ratio is the result of a declining GDP in the course of the global financial crisis. The right panel of chart 2 depicts the indexed temporal evolution of nominal CiC and nominal GDP. Nominal GDP remained roughly constant from 2008 to 2009 but increased afterwards. At the same time, nominal CiC increased from 2008 to 2009. Therefore, the ratio of these two variables increased from 2008 to 2009. However, in addition to this one-time level shift, the gap between CiC and nominal GDP was growing throughout the entire observation period. Given the presumed shift to non-cash payments, this increase needs to be explained.

Chart 2

### Currency in circulation over nominal GDP – “World”



Source: Jobst and Stix (2017).

Note: The figures show the currency in circulation to nominal GDP ratios (left panel) as well as the evolution of currency in circulation and nominal GDP (right panel). All figures refer to the “World” as specified in Jobst and Stix (2017). The aggregation is based on market USD exchange rates that are fixed at 2006. Sources and methods are described in Jobst and Stix (2017).

### 3. The increase in currency circulation can be observed for international and non-international currencies as well as for OECD- and non-OECD economies.

Chart 3 contrasts the development in the main economies that face overseas demand, United States (US), euro area (EA) and Switzerland (CH) with the development in the remaining economies. Among the remaining economies, three sub-aggregates are shown: (i) dollarized economies, (ii) non-dollarized economies that are not members of the OECD and (iii) non-dollarized economies that are OECD members. In the latter aggregate Japan has been excluded because of its large weight within this group.

The comparison shows that the increase in the CiC to GDP ratio is not confined to the international currencies – although the increase has been stronger for the euro, the U.S. dollar and the Swiss franc. In non-dollarized non-OECD member economies, there is an increase from 2008 to 2009 and a constant ratio afterwards. Among non-dollarized OECD member, the increase around 2008 is smaller but the positive trend has continued until 2014. The only exception to the general trend is provided by the dollarized economies.

Here the currency ratio increased until 2007 but declined afterwards. We conjecture that this increase is due to the benign economic conditions associated with the “great moderation”, i.e., low interest rates and increasing levels of trust in national currencies resulting in a reduction of currency substitution. From 2007 onwards, the trend apparently reverted as the ratio was first declining and then relatively constant.

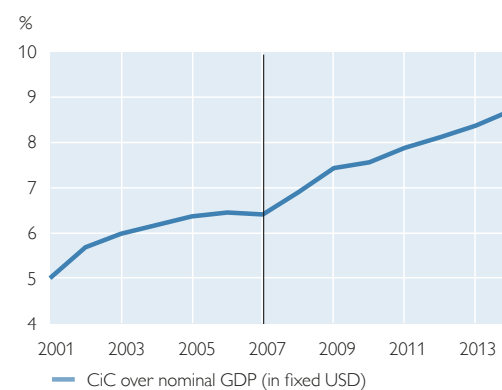
### 4. Also within country groups the increase in circulation is broad-based.

Last, the increase in aggregate circulation figures is not due to a handful of large economies but is broad-based. Chart 4 provides a summary of the temporal development of currency in circulation to nominal GDP ratios for individual economies. Specifically, we focus on the change in the ratios from 2004/05 to 2013/14 (both means of the two years) and show the relative proportion of economies in which the ratio increased by more than +10% as well as the proportion of economies in which the ratio decreased by more than –10%. In the sample of all economies (“World”), the unweighted mean (median) change is 17% (13%). One quarter

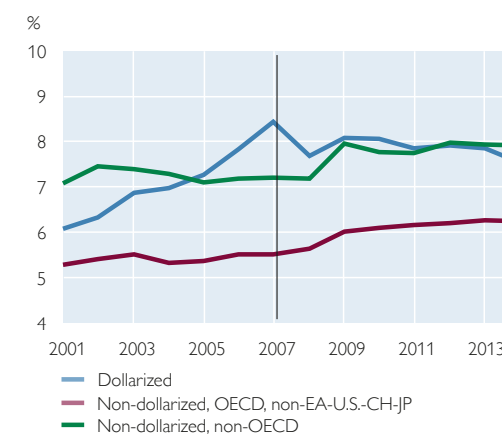
Chart 3

### Currency in circulation over nominal GDP – Subaggregates

#### Euro area – U.S.A. – Switzerland



#### Rest of the “World”

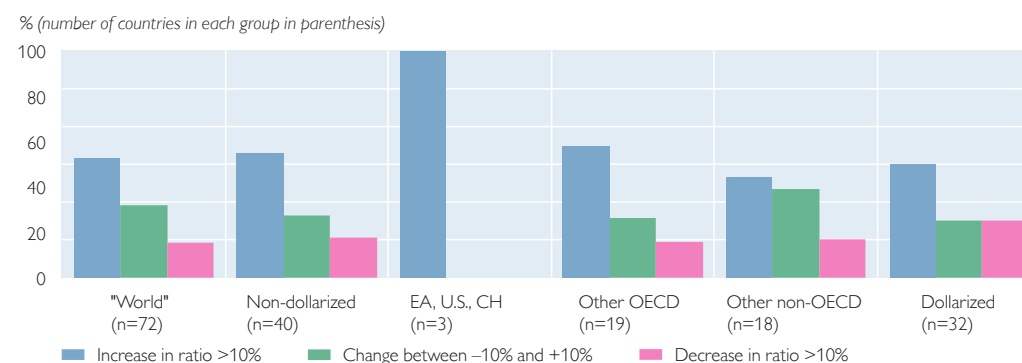


Source: Jobst and Stix (2017).

Note: The figures show currency in circulation to nominal GDP for various aggregates of economies. The left panel refers to the aggregate of the euro area, the U.S.A. and Switzerland. The right panel refers to (i) dollarized economies, (ii) non-dollarized non-OECD economies and to (iii) non-dollarized OECD economies excluding euro area, the U.S.A., Switzerland and Japan. The yen was excluded because of its high weight in this aggregate. All aggregations are based on market USD exchange rates that are fixed at 2006. Sources and methods are described in Jobst and Stix (2017).

Chart 4

### Changes in currency in circulation over nominal GDP ratios from 2004/05 to 2013/14



Source: Jobst and Stix (2017).

Note: The chart shows descriptive statistics about changes in the currency in circulation over nominal GDP ratios over the period from 2004/05 to 2013/14 for the “World” and several sub-aggregates. The blue bars depict the relative share of economies with an increase of the ratio by more than 10% (within each group). The purple bars show the relative share of economies with an decrease of the ratio by more than –10%. The group size is indicated in parenthesis. Averages are taken for 2004/05 and 2013/14 to reduce the effect of outliers.

of economies faced an increase by more than 37%. Chart 4 shows that the share of economies with an increase (blue bar) is higher than the share of economies with a decrease (purple bar). This holds for the “World”, for dollarized and for non-dollarized economies (the latter group is further separated in OECD and non-OECD members).

Overall, the descriptive account shows (i) that cash demand has increased in the “World” as a whole, (ii) that cash demand has increased not only in the euro area and the U.S.A. but in the majority of economies from 2003 to 2014 and (iii) that the increases cannot be assigned to only poorer or richer economies.

### 3 How does the recent upsurge compare historically?

In order to assess the significance of recent increases it is useful to put them into a long-run perspective. Chart 5 displays the ratio of currency in circulation over nominal GDP from the last quarter of the 19<sup>th</sup> century to 2015 for the U.S.A., Germany and the euro area.<sup>4</sup> In the following, we focus on the most important long-run trends.

The following main observations can be taken from chart 5:

1. Comparing the values of 1990 with those from around 1890 informs us that cash use has declined: from 13% to 6% in Germany and from 6% to 4% in the U.S.A.
2. However, the decline in currency demand is not uniform. World War II marks the strongest reversal in the secular downward trend; other events are World War I and the Great Depression.

3. Over the post-World War II period, there is a secular decline in currency demand. This is the time frame that is usually analyzed in studies on the use of currency. It is evident that the focus on only the post-World War II period biases the picture as CiC levels were exceptionally high after the war. There is large agreement as to the causes of the decline after World War II: increase in the dissemination of transaction accounts, the non-cash payment of wages, the increased use of payment cards and cheques and the dissemination of ATMs which allowed consumers to economize on cash balances (e.g. Krüger, 2016).
4. Since the mid-1980s, the long-run trend decline has come to a halt or even reverted: CiC has increased in the U.S.A. and in Germany. The increase in CiC after the mid-1980s

fits well to political/economic events (e.g. the breakdown of Communism, developments in Latin American economies) which fueled international demand for the U.S. dollar and Deutsche mark (Porter and Judson, 1996; Seitz, 1997).

5. Since 2007, CiC over nominal GDP has increased further in the U.S.A. and the euro area. The recent increases are large even if seen over a 150-year horizon. With the exception of World War II, there is only one episode with a comparable increase: the Great Depression, even though back then the increase was considerably steeper and more sudden than after 2007/08.

### 4 Reasons for recent increases in currency demand

There are four plausible arguments that could rationalize the increase in cash demand. First, after 2007/08 interest rates decreased in the majority of economies and reached near-zero levels in some economies. Second, some authors have argued that increases in shadow economic activities, tax evasion and/or higher shares of self-employed could be drivers of higher cash demand (Goodhart and Ashworth, 2014). Third, the increases could be a consequence of portfolio shifts either due to lower confidence in banks or due to increased uncertainty. This interpretation focuses on the asset (safe haven) role of cash. Note that this interpretation does not necessarily rely on the occurrence of banking panics as in the 1930s. Goodhart and Ashworth (2015 and 2017), for example, exclude banking panics as a driver of cash increases in some major economies. Fourth, Friedman and Schwartz (1963) argue that velocity tends to decrease in con-

tractions because agents' demand for cash is based on permanent income rather than period income. In this line of argument, cash holdings could be higher relative to GDP if agents have not adjusted their pre-crisis estimate of permanent income to the lower income growth that occurred after 2008.

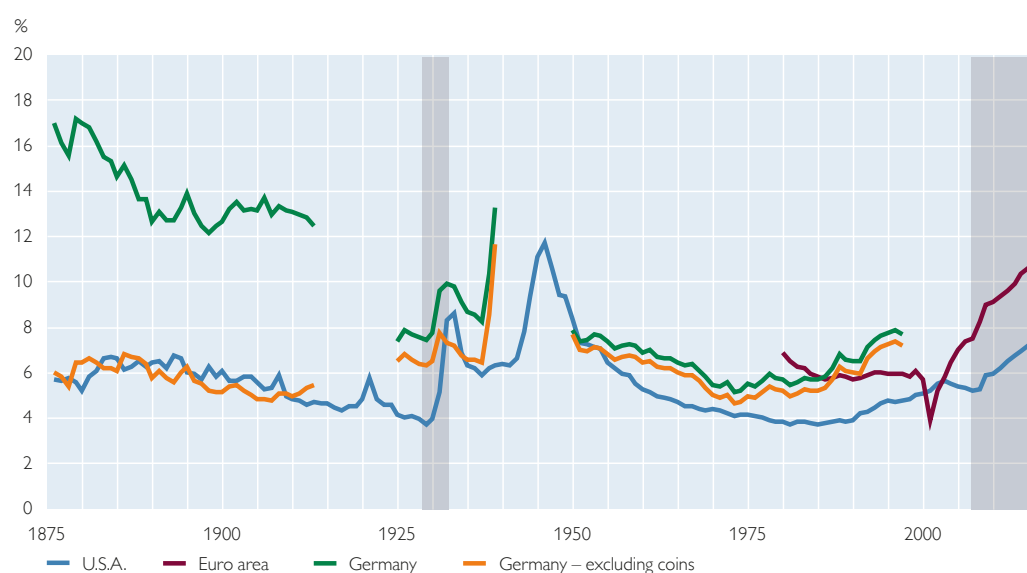
In order to analyze the relative importance of these factors Jobst and Stix (2017) estimate a panel money demand model where (log) real per capita cash holdings is related to (log) real per capita GDP, deposit interest rates and a measure of shadow economic activities.<sup>5</sup> In addition time dummy variables for the years after 2008 are employed to measure whether any shift can be observed after 2008 that cannot be assigned to the other independent variables. The panel estimation is based on a fixed effects model such that the focus of the analysis is on changes over time (with different levels in cash demand across economies being controlled for). Also, it is important to note that point estimates reflect an average effect across economies, not accounting for their relative size.

Given the difficulties in isolating the foreign demand component we omit the U.S.A., euro area, Switzerland, Singapore and Hong Kong from our sample such that all estimated effects primarily refer to domestic demand. Similarly, the estimations focus on non-dollarized economies only. The main results can be summarized as follows:

1. In general, estimated income and interest rate elasticities are within plausible ranges as found previously in the literature. This is reassuring as the economies that are included in the estimation differ substantially by their economic and financial devel-

Chart 5

#### Currency in circulation over nominal GDP in Germany, the U.S.A. and the euro area



Source: Jobst and Stix (2017).

Note: The shaded areas mark the period from 1929 to 1933 and from 2007 to 2015. The series for the euro area was constructed prior to 2002.

<sup>4</sup> Historically, in some countries a significant part of cash circulation consisted of specie coins. These are also included here in addition to banknotes. On the construction of the series see Jobst and Stix (2017). The euro series for the period from 1980 to 2001 reflects a synthetic aggregate of the future euro area members.

<sup>5</sup> This measure is based on Schneider (2017) and does not employ cash as an input in its computation.

opment.<sup>6</sup> For example, the income elasticity, which is allowed to vary across economies, is on average below one in higher GDP economies which suggest that there are economies of scale in the use of cash.

2. Interest rates are found to exert a significant negative impact on cash demand. Given the changes in interest rates after 2008, Jobst and Stix (2017) conduct various specifications to check for the robustness and to analyze whether the elasticity of cash demand changes as interest rates become very low (log-log, semi-log, different slopes after 2008, different parameters for interest rates below and above 1%). The findings suggest a saturation level of cash that agents are willing to hold even if interest rates are (very) close to zero. In general, this result implies that part of the increase in cash demand can be attributed to lower interest rates.
3. The use of (an incomplete proxy for) permanent income instead of period income as a scale variable renders the unexplained shift smaller but does not eliminate it.
4. No significant effect is found for the shadow economy indicator, suggesting that changes in shadow economic activities exerted no impact on changes in cash demand during the period under study. The reason for this finding is that the shadow economic indicator is declining in many economies over the sample period, while demand for cash is increasing.<sup>7</sup> As results represent an average effect across economies this does not mean

that changes in shadow economic activities might not have been of importance for cash demand in some economies as, for example, stated in Goodhart and Ashworth (2015). Moreover, it should be made clear that we focus on changes in cash demand and not on level differences across economies and that we just use one indicator of shadow economic activities.

The key question is whether the temporal evolution of GDP and interest rates can account for the observed increases in cash circulation. We find that results differ depending on the characteristics of the economies. For economies with below median GDP per capita, all of the changes (increases) can be explained by these conventional economic forces. However, for economies with above median GDP the time dummy variables that are included in the regressions indicate an upward shift after 2009 that cannot be explained by GDP or interest rates.

A natural next extension would be to include measures of trust in banks or perceived uncertainty and to study whether these variables account for the unexplained level shift. As such data are unavailable for the full sample, we conduct an indirect test by splitting the sample into groups of economies that (i) did not experience any systemic banking crisis in the post World War II period, (ii) experienced a systemic banking crisis in 2007/08 (but not before) or had (iii) experienced a systemic banking crisis before 2007/08 (but not in 2007/08).<sup>8</sup> The idea for the inclusion of the latter group is that memories of a crisis can have a persistent impact on financial behavior of individuals (Mal-

mendier and Nagel, 2011; Osili and Paulson, 2014; Stix, 2013) even if no crisis occurred in the specific economy in 2007/08. We then estimated the currency demand model for the first and third group and tested whether the time dummy variables remain significant. The approach suffers from relatively small group sizes. Moreover, there might be unobserved variables which affect cash demand that are correlated with the groups. Therefore, results are indicative only and cannot be interpreted as causal.

Yet, the estimation results are in line with expectations. In the group of economies without a systemic banking crisis no unexplained level shift is found. In the group of economies with a banking crisis before 2007/08 (but not in 2007/08) a significant level shift is found.<sup>9</sup> For the group with a financial crisis in 2007/08 (but not before), we could not estimate a model because of a small number of economies. On a descriptive scale, we note that three out of four economies had sizeable increases in cash demand after 2007/08. Overall, these results suggest that banking crises have had an impact on post-2007 cash demand.

## 5 Conclusions

The paper summarizes results from Jobst and Stix (2017) and provides some additional descriptive evidence. Findings show that cash demand has increased not only in the euro area and the U.S.A. but also in many other economies over the past decade.

The results from panel estimations for non-dollarized economies and for currencies that are not circulating internationally indicate that lower interest rates and the evolution of income

explain parts of the increase. However, in economies with a higher GDP, the increases after 2009 cannot fully be accounted for by these conventional economic forces. The increase in the use of cash cannot be explained by an increase in shadow economic activities either. Interestingly, the unexplained increase in cash demand can be mainly observed for the relatively rich economies – whereas one would expect a decline in these economies due to the proliferation of cashless payments (Bagnall et al., 2016). This result suggests that overall currency in circulation is dominated by hoarding and other motives rather than by transaction motives.

What are the drivers for the unexplained increase in cash demand? While many factors other than income and interest rates could be important for the increase in cash demand, empirical analysis is limited by the lack of good empirical measures. Therefore, any explanation of the unexplained increase in cash demand in higher GDP economies necessarily has to remain speculative. We conjecture that the financial crisis of 2007/08 and the subsequent turbulences in some economies have lowered confidence in banks and/or increased uncertainty, notably also in economies without a financial crisis. It is well possible that the increase in uncertainty, in combination with very low interest rates and thus low opportunity costs of holding cash, is an important additional reason for the increase in cash demand in many richer economies after 2009. In order to explain the observed pattern in cash demand, however, the argument requires a rather persistent increase in uncertainty/decrease in confidence and not just a short-term shock in 2008/09. Evidence from news-based indices (Baker

<sup>6</sup> A few economies with very implausible point estimates for the income (scale) elasticity were omitted from the sample.

<sup>7</sup> For example, it declined in 30 out of 32 OECD economies from 2003 to 2014. Although cash demand estimations omit the euro area it should be noted that an increase of shadow economic activities is only found in Cyprus, Spain and Portugal. In the U.S.A, U.K. and Japan there is a slight decrease.

<sup>8</sup> The separation of economies into these groups is based on Laeven and Valencia (2012).

<sup>9</sup> With regard to the effect of the financial crisis of 2007/08, results depend on the functional form of money demand (log-log or semi-log) and are not unambiguous.

et al., 2016) indicate that economic policy uncertainty increased substantially in 2008 and remained at elevated levels, at least in Europe.

To conclude, Friedman's and Schwartz' (1963) emphasis on the key importance of sentiment seems to be alive and well: *"The more uncertain the future, the greater the value of [the] flexibility [of cash] and hence the greater the demand for money is likely to be"* (p. 673). The fact that we still know so little about the underlying

reasons of the recent increases in currency demand highlights the dire need for more data and more research to better understand the people's use of cash in calm times and in times of crisis/uncertainty. Without a better understanding of this development, it does not seem to be a good idea to phase out physical currency and to replace it by electronic means of payments as has been advocated by some scholars (e.g. Rogoff, 2016).

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# Money and payments in the digital age: innovations and challenges

Information technology (IT) is having a growing impact on the financial industry. In some ways this is not new: computing power has been harnessed by banks and other financial intermediaries for decades. But now it is IT's ability to process information (the "I" part of IT) that is opening new avenues. Indeed, finance to a large extent is a matter of information, or lack thereof. In a frictionless world with no informational asymmetries and perfect record-keeping there is no place for financial intermediation. Now that increasing numbers of transactions are taking place in a realm (the Internet) where information can be acquired and exploited in novel ways, financial intermediation will be transformed.

This essay focuses on one early development, namely distributed ledger technology (DLT), starting from its use in creating a money-like asset, Bitcoin. I first briefly review the past of money, using the insights we can gain from this new technology into the nature of money. I then turn to DLT, exploring its basic features, asking what promise it really holds. I conclude with some thoughts on how central banks may have to react to these developments.

## 1 An overview of monetary evolution

### Tokens

Why does money exist? We can start from the classic presentation of the barter problem, whose earliest known formulation is nearly 2000 years old. The setting is one of decentralized interactions. You and I meet and we each have some good. But I want what you have while you do not want what I

have, which makes a direct, *quid pro quo* exchange impossible.

This problem arises only under certain assumptions. Some are natural: there is diversity in tastes and in goods, production and encounters occur at different times and cannot be synchronized. But the most critical assumption is the lack of information and record-keeping technology. If we had a ledger where we kept track of what everyone had exchanged, I could get what I want from you, inscribe it as a debit on my account, and later I give what I have to someone else and credit my account.

The classic solution, which allows many trades to take place that would not otherwise, is to use secure tokens that will embody your claim on society's resources arising from your act of giving me what I want. This is called money.

A new problem arises: how to make the tokens secure? Again, the classic solution is to make them costly to counterfeit, by using a costly material: gold or silver, which have been used to make coins since the 6<sup>th</sup> century BC.<sup>2</sup> While the exact origins of coined money are still obscure, coins have usually been produced in a standardized format and certified by political authorities, either directly or under license.

Tokens are now costly to counterfeit, but also costly to make as well. The real value of resources devoted to securing the tokens is roughly the value of the money stock's content, that is, the total real balances held by the economy, and this can be substantial.<sup>3</sup> There will naturally be a tendency to seek ways to economize on this resource cost.

<sup>1</sup> The views expressed here do not necessarily represent those of the Federal Reserve Bank of Chicago or the Federal Reserve System.

<sup>2</sup> Curiously, the very first coins were made of a mixture of the two metals, but within a hundred years pure gold and pure silver coinage came into use.

<sup>3</sup> The use of precious metal can also serve another purpose, which is to anchor the price level to the relative value of the metal used.



One method is to use cheaper tokens, made of a cheaper material such as copper (from the 15<sup>th</sup> century) or paper (from the 17<sup>th</sup> century). But counterfeiting becomes increasingly profitable as the cost of making the tokens is lowered relative to their value in exchange, so a combination of technology and enforcement is required to keep counterfeiters at bay. In the 16<sup>th</sup> century a new technology for minting coins gave governments a temporary advantage in making recognizably better struck coins and allowed them to experiment with token copper, sometimes on a large scale. Later, the introduction of paper money was also accompanied by the use of various techniques (watermarks, counterfoils, high-quality engraving, secret points) to defeat counterfeiters.

Another method is to transfer private liabilities. Suppose that debtor B owes 10 to A and also 10 to C. A can make a payment of 5 to C by instructing B to decrease the first balance by 5 and increase the second by 5. This transforms the debtor B into a “bank”, not in the sense of an intermediary between borrowers and lenders but in the sense of an agent whose liabilities are used in payments.<sup>4</sup> The prerequisites for such operations include an

efficient technology for keeping debt records, which becomes readily available with the adoption of double-entry book-keeping in the 13<sup>th</sup> century. Also needed is a technology for sending secure messages. The simplest technology is walking over to the banker’s office, but over time paper-based messages developed. The name we still use for them (“checks”) indicates that security was a concern from the very beginning.

The earliest centralized payment systems emerged when political authorities set up their own public banks, often-times making settlement legal tender and final.

### Recurring themes

From this terse overview of monetary history some recurring themes emerge.

One is that trust has always been at the core of money; and trust, ultimately, results from a lack of information. If I knew everything about your motives and your circumstances, I could predict your future actions and choose mine accordingly, without having to trust you. It is also lack of information that precludes nonmonetary (or credit-based) solutions to the lack of double coincidence and hence makes money useful. Understandably, then, technological advances that improve our ability to collect and use information can change both the degree to which money is useful and the form that useful money can take.

Another recurrent theme is that all monetary instruments have been subject to various forms of “attacks”. As soon as the first coins appeared in the 7<sup>th</sup> century BC, counterfeits appeared as well in the form of coins with a veneer of precious metal over a cheap copper core, and the race has been on ever since. There have been various

kinds of “attackers.” Most were seeking to make a profit, namely the difference between the market value of a real token and the cost of production of a plausible-looking token: the wider the difference, the greater the incentive. Less common but occasionally occurring were what one might call “malicious” attackers, typically State actors intent on impairing an enemy’s monetary system.<sup>5</sup> Finally, one might place in the category of “attackers” desperate governments impairing their own currency through debasement or inflation (either one seen as legal counterfeiting).

A final theme is the presence of a central authority. Historically, wherever there is money the State is not far away. That does not mean that privately issued currencies have not existed, but by and large they have either when there was no functioning State, or when the State tolerated these private issues. From the beginnings of coinage or soon after, coins were issued by political authorities (cities, kings). Roman law codified the notion that control of the currency was a regalian right, a prerogative of the sovereign, and this notion passed into both feudal law and Roman civil law of medieval Europe. It is true that weak sovereigns let feudal lords exercise the prerogative, but in most cases they regained control of the currency as their powers grew; or, if they did not, it was because they lost their sovereignty (as in the Holy Roman Empire). By the 19<sup>th</sup> century it became commonplace to think of currency as one of the marks of sovereignty, as symbolic as flags and anthems, even if States at times tolerated privately issued currencies, such as trade tokens and private bank-notes.

The State’s involvement took various forms. At the simplest and the ear-

liest, it was a mere form of certification: the central authority (or its designees) stamped its seal on standardized lumps of metal to certify the contents. Eventually it became the legal privilege to define what is, or isn’t, money, in legal terms, which can be seen as a standard-setting function, forming an unambiguous consensus on what will discharge debts, effect payments in transactions, or serve as a unit of account. Modern constitutions (such as the U.S. constitution) and legal codes make clear that money remains a regalian right.

## 2 Bitcoin and distributed ledger technology

Bearing these themes in mind, let us turn to recent technological changes that could affect the future of money.

### Bitcoin

We may start with Bitcoin because, although it is not the first attempt at creating electronic forms of currency, it is the first to reach widespread recognition and (in some sense) use.

Bitcoin was designed under the pseudonym of Satoshi Nakamoto and launched in 2009. It is a protocol for communicating over the internet, but a highly specialized one. Whereas SMTP transmits e-mails with few limitations on their content, Bitcoin transmits formatted messages about transactions between pairs of agents (sender and receiver). The design problem that Bitcoin solves is to transfer value *over the Internet*, by issuing and managing a quantity of monetary tokens, *without any central authority* but rather letting anyone transfer value or even issue and manage the tokens.

Bitcoin is remarkable. Monetary history abounds in examples of monetary tokens that are not explicitly backed



<sup>4</sup> In the Ripple protocol, the “rippling” feature potentially allows anyone to play that role in a given transaction.

<sup>5</sup> Examples include the British counterfeiting the French paper currency during the 1790s and the Germans counterfeiting British currency during World War II.

or managed by a central authority, but they usually are tokens with an alternative use: a gold coin can always be melted down and turned into something else. Conversely, there are many examples of tokens that are intrinsically valueless, but there is always an issuing entity, private or public, that is supposed to provide some convertibility, guarantee, or acceptability. Bitcoin is not only the first completely dematerialized token: it is unique in monetary history in being intrinsically valueless (there are no alternative uses to a bitcoin if the protocol ceased to be used) yet it is no one's liability.

I hasten to add that I view Bitcoin as a proof of concept rather than a fully-fledged currency: eight years after its appearance, and five years after it gained worldwide notoriety, the aggregate value of its stock is tiny compared to existing monetary stocks, its use in ordinary transactions remains limited. Its value remains extremely volatile, and (as of writing) seems to be sought either for speculative reasons or as a way to evade capital controls. There seems little chance for Bitcoin to become much more, at least in advanced economies.

Be that as it may, Bitcoin is at minimum a working prototype that has

brought attention to its underlying technology: *distributed ledger technology*, also called *blockchain*. I now describe its main characteristics, not just in terms of creating monetary tokens but also from a more general point of view.<sup>6</sup>

### Design elements

The original purpose of this technology is to ascertain and transfer property rights. These rights may be over assets that exist independently of the technology or not: the latter are called *native* or *on-blockchain* assets. Assume for now that the assets are well defined: what a native asset is will become clear shortly.

The concept of ownership is as follows: I own an asset X because everyone knows, and agrees, that I do. This differs from physical possession (e.g. cash) as well as from possession based on a registry (e.g., land). One way to formulate the process is recursive. Suppose that at some point in time T there is an agreed-upon state of the world, essentially a list of who owns what (a ledger). The technology provides a process for moving from T to T+1, which will consist in aggregating all valid changes of ownership. The result will be a new agreed-upon state of the world at T+1. The design correspondingly has three elements: a way to describe the state of the ledger, a language for transactions (changing ownership, in which cryptography will serve to verify identities of the previous and new owner, or sender and receiver), and finally a protocol for updating the ledger with validated transactions.

The third design element is the most difficult one, given the posited design problem. Updating the ledger means achieving a new consensus on who owns what. Each individual transaction can be easily evaluated by each

actor to ascertain that it conforms to the rules and to the last known state of the ledger. But in a decentralized and asynchronous system, how do we reach the new consensus? The problem arises when actors disagree after the fact on the order in which transactions were made, because this allows me to send two mutually incompatible messages, each valid on its own (“I cede my coin to A”, “I cede my coin to B”) and each believed by a fraction of the network. This is the so-called “double-spending problem” and it is due to the combination of both features, decentralization and asynchronicity. There would be no conceptual difficulty if multiple actors could get together at fixed times to evaluate all new transactions jointly (synchronicity), or if a single actor evaluated all transactions as they came in (centralization).

There are two broad methods of establishing consensus, representing two conceptual extremes. The first is to appoint a dictator who chooses the block to be added to the blockchain. The first approach sounds like a terrible idea, but the trick is that the dictator is chosen at random for each block. Of course, in a decentralized environment where actors know little or nothing about each other, we have to be careful in how the selection takes place: effectively, there is no list of registered voters from which to select the dictator, and a malicious actor could create multiple fake identities to increase the chances of being selected. One method is to require the candidates to pay a cost, so that the one who adds the new block is the winner in a costly lottery: this is called “proof-of-work” and is the concept used by Bitcoin. Another method is to require candidates to post collateral: this is called “proof-of-stake” and may come into use for Ethereum.

The lottery requires the solution to a numerical problem that can only be found by random guessing, and guessing requires time and effort (a process called “mining”); but verifying that the solution is correct is easy.

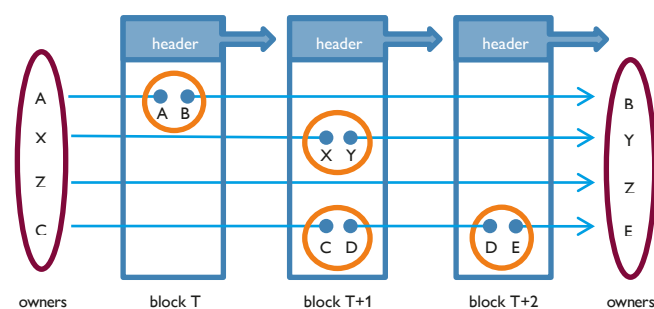


In either case the choice of the dictator is embedded in the rule that the longest blockchain (more exactly, the one embodying the most proof of work) is the valid one. The lottery is running continuously, and every time a node wins it broadcasts the new block, with proof of work (the solution to the numerical problem) included in it. If two nodes find the solution nearly at the same time and the network does not agree (because part of the network received one new block and the rest the other new block) there is temporary disagreement and a fork in the chain. But the lottery keeps running, nodes will keep adding to both ends of the chain until one becomes longer than the other.

The other general method of establishing consensus is to hold a vote on the contents of the new block. This may sound better than random dictators, but, as with political elections, it raises the preliminary question of who is entitled to vote. In general, it is difficult

Chart 1

### A blockchain



Source: Author's compilation.

<sup>6</sup> I will therefore not describe the specifics of Bitcoin any further, except by way of illustration.

to maintain the free access and anonymity of the bitcoin model in this case. The method will therefore be mainly implemented in “permissioned” networks, where access is restricted. This of course raises the further question of who “permissions” the network, but I will set that aside. Assuming, then, that potential voters are identified and vetted to some degree, we still have to deal with the asynchronicity of the network (not everyone is voting on the same thing, or at the same time) and with the possibility of malicious users, either because vetted users are impersonated, or because users are not willing to trust all other users blindly.



The classic solution to this type of problem, called the “Byzantine generals problem”, relies on multiple rounds of voting and an algorithm that is expected to reach consensus with very high probability. A high-profile example is the Ripple protocol, in which users do not trust all other users but a subset, specific to each user.

Whatever the method used, it is important to remember that trust is never eliminated, but rather displaced. Parties to a transaction need not trust each other, but, as in all monetary exchange, they have to trust the token exchanged:

<sup>7</sup> *Cleverly, Bitcoin’s money creation mechanism is used to compensate the costs of proof-of-work.*

in the world of DLT, trust in the protocol is what dispenses with trust between parties.

With the three design elements in place, we see that ownership ultimately rests on a sequence of valid transfers, starting from some point and ending with the current owner. This sequence is what uniquely defines each bitcoin, and the blockchain is the collection of all such sequences. When the creation of these starting points is part of the protocol these chains constitute assets “native” to the technology, whose essential property is that they can be transferred with the technology. As the protocol regulates the creation of new starting points, the chains of ownership are in restricted supply. Thus, a bitcoin is useful because it can be transferred and is in limited supply.

Bitcoins are monetary tokens, but of a new kind: just as medieval bankers received coins in deposit and replaced the hand-to-hand exchange of the coins with written operations on ledgers, Bitcoin dispenses with the physical token, but contrary to medieval bankers there is no single ledger. Also, Bitcoin replaces the natural scarcity of precious metals with the artificial scarcity of controlled money creation.<sup>7</sup>

#### **DLT: a solution in search of a problem?**

About two years ago the notoriety of Bitcoin generated growing interest in its underlying technology. But Bitcoin was designed to solve a particular problem: a monetary token on the Internet that does not rely on any central authority. Much of the interest in DLT does not come from anyone genuinely interested in that problem. Instead, many have been taken with the attractive properties of DLT, which include resilience, speed, decentralization, im-

mutability. But these properties are those of the solution to a particular problem. In many proposed applications, it is far from clear that decentralization and lack of trust are essential features of the relevant problem, leading to the nagging suspicion that DLT is a solution in search of a problem.

Furthermore, these desirable properties are not absolute or immutable: they arise from tradeoffs that might be resolved differently in other applications. I will cite a few. First, there is a tradeoff between scale and speed (or its inverse, latency). A truly decentralized or distributed system has to confront the problem of latency, because DLT requires full histories and multilateral transmissions of information, which implies amounts of data far beyond the needs of an equivalent centralized system (one hub talking bilaterally with many spokes). Second, DLT bases ownership on public information, that is, massive public disclosure. It is true that pseudonymity in Bitcoin mitigates the publicity,<sup>8</sup> but the tradeoff between information and privacy might be resolved differently in more restricted networks where participants are more readily identified. Third, Bitcoin’s recent history illustrates the tension between openness and governance. Bitcoin is open-source protocol that Bitcoin users use, nothing more. Changes to the protocol are in principle endorsed by consensus, but difficult or strategic decisions are difficult to coordinate and can lead to fragmentation and incompatible splits.<sup>9</sup> Finally, several properties are more limited than is often recognized.

<sup>8</sup> *On Bitcoin’s blockchain, parties to transactions are only identified by addresses (randomly generated strings of letters and numbers). The link to an individual exists only through the individual’s knowledge of the password associated with the address.*

<sup>9</sup> *I refer here to recent debates on raising the block size limit in the Bitcoin protocol.*

<sup>10</sup> *To erase the consequences of a faulty smart contract, part of the Ethereum community agreed to go back in time to an earlier version of the blockchain. This was not accepted by all and two versions of Ethereum now coexist.*

<sup>11</sup> *The failure of the Global Straight Through Processing Association in the 1990s is instructive.*

For example, a decentralized network may be more resilient to shocks that might affect individual nodes, but the protocol itself becomes a single point of failure. Likewise the record of ownership is immutable only to the extent that the consensus does not change. The events surrounding Ethereum in August 2016 are a case in point.<sup>10</sup>

Finally, it always bears repeating that even if arrangement B is better than the status quo A, the costs of moving from A to B might be greater than the gains. Many of the touted advantages of DLT (e.g., transaction, settlement, and reconciliation will be faster and more reliable) come from multiple actors using a common language to store and update information, not from DLT per se. These advantages have been obvious to industry participants for decades, and one might wonder if high transition costs are not the reason why they have not been reaped earlier.<sup>11</sup>

### **3 Central Banks and DLT**

Today central banks have a number of functions that could be affected by the development of DLT: among other things, they regulate financial actors, they often manage large payments systems, and they issue and manage outside money which is also the legal tender and unit of account.

As regulators, central banks are challenged in many ways by DLT. In the most extreme form of open consensus-based protocols, it is difficult to say who or what could or should be regulated. Here again Bitcoin’s experience, whether or not one counts is as a form

of money, has blazed trails and brought DLT generally to the front of regulators' minds. It has also shown that a good part of the Bitcoin community, especially those who provide additional services around the use of Bitcoin, have themselves sought legal clarity. More broadly DLT can change the risk profile of existing regulated actors, allow the emergence of new actors who perhaps ought to be regulated, and create new systemic risks. On this last point word on smart contracts is in order. Once transfers of ownership can be effected by lines of code, it is conceptually a small step to making transfers contingent on any variety of events either on-chain or (less easily) off-chain. The simplest example would be a transfer from A to B contingent on a prior transfer from C to D. Ethereum is to a large extent an attempt to extend Bitcoin's design to exploit the full potential of smart contracts. The recent history of algorithmic trading, high-speed trading, and occasional "flash crashes" make clear, however, the possibility for unintended consequences in a complex and partly automated system.

The other two functions of central banks, providing payments and legal tender, are possible avenues through which they might find themselves involved in DLT, either because of payments or because of legal tender. Even central banks that do not directly manage large value payments systems (LVP) do manage a "small value" payment system (SVP), namely physical currency. Payments systems, like any other way of doing things, should be improved when a more efficient technology comes along. The initial promise of Bitcoin was to offer a currency for the

age of the Internet. Perhaps metallic coins and paper notes, relics or vestiges of monetary history, are destined to be replaced, just as paper as physical support to convey information.<sup>12</sup> Some aspects of a digital currency, like the vast amounts of information it could generate, would be attractive to some (regulators, law enforcement, and economists!) but not others (those who see value in the anonymity that cash offers). Similarly, the ability to pay interest on currency could be attractive to policy makers because it could make monetary policy more potent; this ability might be welcome or not, depending on whether the interest paid is positive or negative. Of course, improvements to SVPs could come from the private sector, and if physical cash is destined to be replaced then central banks may only need to manage its gradual disappearance. But is physical cash doomed? It has resisted well to the emergence over recent decades of electronic means of payment, in part because the use of cash protects the privacy of individuals' transactions in ways that even the pseudonymity of Bitcoin cannot fully duplicate.

But other considerations might lead some central banks to investigate their own version of digital currency, whether for small or large payments. First, there might be a reluctance on the part of the public to deal only with inside money (liabilities of the private sector). Second, suppose that DLT becomes widely adopted in a variety of contexts to record and transfer ownership of assets. In such transfers the other leg will often be a settlement in cash. This "cash" will often be inside money, but as legal tender, the currency

provided by central banks is the ultimate final means of payment, and participants may well demand the option of settling in central bank money. But here again the key question remains: is a decentralized system needed to implement a digital version of a central bank's currency? The Bank of Canada recently concluded that the answer is not obviously positive.

#### 4 Conclusion

In summary, Bitcoin is in my view a remarkable achievement, although unlikely by itself to replace monies in well-functioning monetary systems. It has nevertheless offered an interesting prototype and has generated interest in its underlying principles with potential

applications to asset transfers. Central banks and regulators face a host of potential challenges, and the time may come soon when they will have to become involved in blockchains.



<sup>12</sup> The scroll was replaced by the codex, or book, in the early centuries AD; parchment was replaced by rag-based paper in the 16<sup>th</sup> century and wood-based paper in the 19<sup>th</sup> century. No doubt the emergence of paper money in the 17<sup>th</sup> century was facilitated by the availability of a support that was both cheaper than parchment and still offered devices (such as watermark) to hinder counterfeiting.

## Session 6

Fintech: opportunities and challenges for  
banks and regulators



## The FinTech Revolution: More important than the ATM?

*„...the most important financial innovation that I have seen [in] the past 20 years is the automatic teller machine.“*

*Paul Volcker (2009)*

*„...Something New Under the Sun?“*

*Mark Carney (2017)*

At the moment, the FinTech arena seems to be more prepared for stone age unregulated fighting as to serve as a “cooperative” playground in an advanced global community under the roof of common institutions, like the United Nations in the area of politics. What seems to be urgent today is to bring all relevant agents in markets targeted and affected by FinTechs together to discuss the consequences of the rise of FinTechs from different perspectives and in an encompassing way.

It is obvious – and not meant as a critique – that all agents acting in this FinTech arena have different preferences, different starting points and that they follow different objectives. For example, they are of very different age, come from different historical (often national) traditions, are extremely different in size, market share and product portfolio, concentrate on different functions and tasks. In the end, it comes as no surprise, that they see each other as coming from different tribes or even planets, not even sharing the same language to talk to each other. However, this becomes more complicated by the mere fact that their playing field is more or less the same, at least they are active in significantly overlapping markets addressing the same customer base potential to a large extent.

It is necessary to put the FinTech focus in a much broader context, in order to set the scene for a fruitful discussion and analysis of the many complex topics that will have to be tackled in this context. At least this is key with regard to the three main elements: (i) financial markets, (ii) the institutional setup as well as (iii) the importance of technical progress and historical developments. Therefore, it is also necessary to bring representatives of the different teams on the playground together to talk to each other in a constructive and neutral setting.

As a starting point for a much more in-depth analysis and for addressing different views on the subject, three elements of the much broader focus mentioned above may help to prepare the topic on the one hand but also to raise awareness of the issues on the other hand:

### **From a macroeconomic point of view.....**

.....quotes from three eminent economists may help to reveal the „character“ of the FinTech innovation in an economic sense and the potential consequences it might produce. Robert M. Solow (1987), the outstanding pioneer of growth theory, concluded in a historical New York Times Book Review article characterizing the nature of the technical progress of that time: „You can see the computer age everywhere but in the productivity statistics.“ Paul Volcker (2009) commenting on the crisis experience famously remarked as a criticism of financial innovation and the behavior of financial market participants: „...the most important financial innovation that I have seen [in] the past

20 years is the automatic teller machine.“<sup>1</sup> Last but not least and most recently Robert Gordon (2016) in his monumental book *The Rise and Fall of American Growth* writes: „The Rise and Fall of American Growth demonstrates that the life-altering scale of innovations between 1870 and 1970 cannot be repeated.“

What do these quotes want to tell us, do they have a common message? From an economic point of view the interesting questions are: What is the personal welfare enhancing benefit of a consumer or firm and what is the overall social benefit of, for example, a payment transaction executed in 2 seconds or less instead of 2 hours or 1 day? In fact, these are very tricky questions to answer and the measurable impact of these innovations on GDP and productivity is difficult to quantify, in particular as some (or many) of them come as process innovations without a price. At the same time, negative consequences for existing financial institutions in the form of market share losses and reduction in employment become much more directly visible and are easily to understand.

#### From a historical point of view.....

.....the core questions relate to the type of technical change we will or might potentially see as a consequence of the FinTech revolution. What Robert Gordon has in mind is innovation of the type of revolutionary change, which than has a significant impact on the whole society (general purpose tech-

nologies), on each individual as well as on overall GDP in the end. Will we see this type of revolutionary technical progress impact or will FinTechs simply complement what we have already seen over the last centuries, for example online banking and electronic communication.

Two well known photographs illustrate perfectly, what in particular Gordon but also Volcker have in mind. These two photographs compare the New York Easter Parade on the Fifth Avenue in 1900 and in 1913. In 1900, we see a crowd of pedestrians as well as a large number of horse coaches. In 1913, only a little bit more than a decade later, the Fifth Avenue is full of cars but there are no horse coaches anymore and significantly less pedestrians as well. This is an illustration of this type of revolutionary technical progress, which really changes everyday life and almost completely covers our entire social activities and shrinks the old technology to a minimum, to very specific uses only. In comparison, no horse coaches are left in 1913 and later on as a significant part of transportation. Although, we know that horses still exist and they play some role on the countryside, in sports and in leisure activities. A comparable general purpose technology might have been the introduction of electricity (or air transport), but it is surprising how few comparable examples come to our mind that really have changed our lives in a revolutionary way. Even if many of us might have the personal feeling that

<sup>1</sup> More in detail, here is the full quotation from the New York Post Website: „The most important financial innovation that I have seen the past 20 years is the automatic teller machine, that really helps people and prevents visits to the bank and it is a real convenience. How many other innovations can you tell me of that have been as important to the individual as the automatic teller machine, which is more of a mechanical innovation than a financial one?

I have found very little evidence that vast amounts of innovation in financial markets in recent years has had a visible effect on the productivity of the economy, maybe you can show me that I am wrong. All I know is that the economy was rising very nicely in the 1950s and 1960s without all of these innovations. Indeed, it was quite good in the 1980s without Credit Default Swaps or CDOs. I do not know if something happened that suddenly made these innovations essential for growth. In fact, we had greater speed of growth in the 1960s and more importantly it did not put the whole economy at risk of collapse.”

## The Easter Parade on the Fifth Avenue in New York as time went on

1900: Where's the car?



1913: Where's the horse?



Source: National Archives at New York City; Congress Library.

almost everything has changed completely during our lifetimes because of computers, internet, mobile phones and many other things more.

### From a regulatory point of view.....

.....it is very important to „preserve“ the potential economic dynamics created by FinTechs with regard to the impact of digitalization and other key drivers on the future financial system. At the same time, there is the need to provide a level playing field for all actors in the respective markets, for newcomers as FinTechs as well as for established financial institutions.

To a large extent, the modernization of the regulatory framework will shape the impact digital innovation and the appearance of FinTech companies will have on the financial system. At the current stage, many FinTech innovations do not fit easily in the existing regulatory framework. If we expect FinTechs to be more than a short-lived fad that will soon either wane or be absorbed by incumbents, regulation will have to address the challenge.

By doing so, regulation must navigate between two opposing threats associated

with financial innovation around digitalization: On the one hand, there is the threat of excessive competition, a use of innovation for regulatory arbitrage or speculative purposes, breeding instability by fostering excessive risk taking. A development, which we have seen many times in financial behavior in the past that has contributed to the creation of financial crises. On the other hand, there is the threat of rising market concentration induced by digitalization, for instance via integration of financial services by large online platform suppliers with oligopolistic market structures and a tendency to monopolize value added chains in the financial industry.

Due to the transnational nature of digital service supply and the existence of a European Single Market in financial services, an appropriate regulatory response will require either international coordination or has to be of a supranational character. As a result, a process has been started on the European level already to investigate the possible scope and shape of a common EU response. In March 2017, the European Commission has launched an encompassing consultation on the future regulatory and supervisory framework for FinTech.

In this context, a large number of fundamental theoretical and practical questions must be approached with respect to the goals of regulation in relation to digital innovation in the financial sector. There is a certain tendency in the current debate to frame the discussion in terms of whether new players will need to fit by and large into the existing regulatory framework or whether a tailor-made new framework has to be designed in order to suit and

foster new approaches of providing financial services, in particular new technologies.

Behind this dichotomy, there are different approaches on what the goals of regulation are and what the potential roles of FinTech and financial innovation in an existing financial environment in general are. There is a case for modesty with respect to ex ante devising a grand scheme for the future evolution of the financial industry by regulators and supervisors. Instead, as the path and the dynamics of changes in financial markets and to financial institutions cannot be known in advance, let new competitors try to convince authorities that they can and how they will contribute to these developments. Regulation is sometimes/often portrayed exclusively as a burden. That is certainly misleading in many respects. Overall, there is the expectation (or hope) that regulation and supervision contribute decisively to overall welfare of a society.

As history has proven on many occasions, at least the absence of an appropriate regulatory framework has led into situations of financial turmoil regularly. However, regulation also contributes to the legitimacy of market participants. In a trust-based market like the financial sector, driven by market expectations and characterized by intertemporal contracts, such legitimacy is a key factor for all suppliers to gain customer confidence. In order to obtain legitimacy provided by regulation, FinTechs have to demonstrate how they can contribute to and comply with the goals of financial regulation in their own interest.

In the wake of the Global Financial Crisis, the need for regulation and supervision to make competition in the

financial sector compatible with stability and overall welfare has been strongly underlined. Stakeholders expect authorities to ensure efficient financial services that add value to users and the economy without increasing risks. Two questions come to the forefront when these expectations are translated in the context of a broader financial system's view:

First, what and how can FinTechs and digital innovation contribute to these overall goals of creating value and welfare and what kind of regulatory and supervisory approach would fit best to maximize this contribution?

The second question concerns the more direct impact of digitalization on regulation and supervision, associated with the term „RegTech“. What can digitalization contribute to enhance the quality and efficiency of regulation and supervision?

### Summing up

Though the term FinTech is rather new, financial technology had already been a major phenomenon before the term FinTech became such a fascinating topic recently. This calls for particular analytical precision in dealing with all the related issues in a sophisticated way, as the rise of FinTech is seen as having the potential to “disrupt” (OECD, 2016) the financial industry. Without a doubt, questions to be addressed are challenging but they provide interesting opportunities as well. The main difficulty obviously is to find the right balance between the many relevant perspectives involved. In particular, decision makers should facilitate the positive innovation dynamics FinTechs obviously provide while safeguarding financial markets and institutions against negative and destabilizing developments at the same time.





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## Financial innovation – a regulator’s perspective

### 1 Making innovation happen

As regulator and supervisor of Austria’s financial markets the Austrian Financial Market Authority (FMA) is committed to make financial innovation happen – as long as it complies with the law. Our commitment to enabling innovation entails focusing on a dialogue for innovation and sharing our experience and expertise with stakeholders. We are keen to get more insight into new business models whilst ensuring financial stability and investor protection. We know that financial markets are at the forefront of digitalisation and either market participants will innovate or they risk to be out of business rather sooner than later.

FinTechs bring opportunities and challenges to banks and regulators. The FMA defines FinTech products as referring to innovations in the area of financial services that are based on information technology and that:

- are frequently but not necessarily developed by non-licensed companies;
- typically include interfaces to the systems of licensed enterprises; and
- have the potential of causing changes that permanently affect how the financial sector currently operates.

From our supervisory perspective, there is no such thing as a “typical FinTech” – some FinTechs are small start-ups with little legal knowledge, other FinTechs are part of blue chip companies authorised as banks or insurance undertakings with large compliance divisions. Our stance as FMA is very simple and very clear: we are completely neutral and will neither favour nor discriminate against any market participant. We are also strictly neutral when it comes to technology: all technological approaches complying with the law stand on an equal footing.

That being said, we are aware that businesses with less legal knowledge

need more guidance about regulation than others. The vast majority of our market participants is committed to complying with the law, but some need to understand better what the precise requirements are.



### 2 FMA’s FinTech Contact Point

To address the need for information we have established the *FinTech Contact Point* accessible via the FMA’s website: Not only do we provide easily understandable information about FinTechs including a practical “Navigator” that guides through regulatory questions, but entrepreneurs can also use our FinTech contact form to submit questions regarding their specific business projects to our experts: <https://www.fma.gv.at/en/cross-sectoral-topics/fintech/fintech-contact-form/>.

We are an integrated financial supervisor and thus have an in-house network of FinTech experts in all different areas of our competences: banking including payment services, insurances and securities markets. Depending on the specific business model, a dedicated ad-hoc team of experts answers the request as soon as possible. Our services understand that time is of the essence and are thus committed to provide speedy replies after having assessed the request. In the following dialogue the



entrepreneur has a single point of contact at the FMA to clarify all necessary aspects of his/her business model.

We are perceiving intensifying activity on the Austrian FinTech market: After being set up in October 2016, in the first six months of operation the contact point already evaluated 30 cases involving questions or business models related to FinTechs and provided regulatory feedback. We have held talks with about 40 FinTech stakeholders from companies which do not hold a license from the FMA and we are constantly in touch with the Austrian Economic Chambers (WKO) and other FinTech-interest-groups. Furthermore, the FMA organises serial FinTech network events to spread knowledge and raise awareness about FinTechs and their regulatory and supervisory environment. The FMA FinTech Contact Point cooperates closely with the Austrian central bank – the Oesterreichische Nationalbank (OeNB).

We do not believe that providing guidance about the current legal framework is enough. This is why the FMA has launched a “Call for Input” to detect

obstacles to digitalisation contained in the law as it reads today. Some regulations still require users of financial services to be physically present at the business premises or to provide paper copies with handwritten signatures. We believe that these requirements are outdated and should be modernised. We are inviting market participants as well as other interested stakeholders like academics or NGOs to give us input where regulation needs to be revised to allow for innovative digital solutions.

### 3 Regulatory change: online video identification

Whilst the FMA is committed to enabling useful innovation, financial stability and investor protection have to be ensured. A case where the FMA and the Ministry of Finance successfully amended the regulatory requirements to allow a very useful FinTech solution in the best interest of financial service providers and their clients is online video identification. Due to requirements for the prevention of money laundering and terrorism financing the Austrian Banking Act<sup>1</sup> stated that every new customer had to be identified while she or he is physically present. Having to be physically present at a bank’s premises can be quite cumbersome and difficult for some clients. To find a solution, the FMA was mandated to develop a legally sound approach to allow a digital form of identification while this process is fully compliant with the provisions for the prevention of money laundering and terrorism financing.<sup>2</sup>

The FMA has taken immediate regulatory action and has enacted the new

*Online Identification Regulation*<sup>3</sup> which allows online identification of new customers inter alia under the following conditions:

- The customer needs a video connection with a specifically trained staff of the service provider;
- The customer needs to show his/her official ID or passport so that the holograms as security features and the document number can be checked;
- The financial service provider has to perform the online identification in a dedicated room with access control and has to stop the procedure if either the customer or his/her ID or passport cannot be sufficiently verified.

### 4 Open regulatory questions: outsourcing of activities

With regard to online video identification the FMA was able to act immediately, because EU legislation was flexible enough – in some areas like payment services Union law is already “fit for FinTechs”. However, there are examples where important regulatory questions are still to be answered: The use of cloud computing services in banking is treated as an outsourcing of activities, but to date the relevant European legal framework contains only very high level guidance for credit institutions: The existing outsourcing framework is limited to the requirements of the CEBS-Guidelines on Outsourcing from 2006.<sup>4</sup> As the Capital Require-

ments Directive (CRD) (2013/36/EU) regrettably contains no provisions on outsourcing, the FMA has submitted a draft proposal to the European Commission regarding an amendment of the CRD to include provisions on outsourcing a year ago. Our draft aims at creating a level-playing field for outsourcing and efficient supervision. Therefore, we would welcome new and advanced common European rules for outsourcing institutions and service-providers. Meanwhile we are eager to see more guidance on the use of outsourcing and in particular cloud computing services from the European Banking Authority (EBA) and the European Central Bank (ECB). EBA recently published a consultation setting out its guidance for the use of cloud service providers by financial institutions<sup>5</sup>.

### 5 FinTechs are an international and European affair

FinTechs are high on the agenda of several European fora since 2016: see for example the European Supervisory Authorities’ report on automation in financial advice<sup>6</sup> and discussion paper on big data<sup>7</sup>, the European Securities and Markets Authority’s (ESMA) report on the distributed ledger technology applied to securities markets<sup>8</sup> and the EBA discussion paper on innovative uses of consumer data by financial institutions<sup>9</sup>. To represent FMA’s positions, our staff participates in the relevant

<sup>1</sup> Bundesgesetz über das Bankwesen (Bankwesengesetz – BWG), Austrian Federal Law Gazette I 532/1993 as amended.

<sup>2</sup> This was made possible because of the new Directive (EU) 2015/849 (4<sup>th</sup> AMLD), which is implemented in Austria by the Financial Markets Anti-Money Laundering Act (Bundesgesetz zur Verhinderung der Geldwäscherei und Terrorismusfinanzierung im Finanzmarkt), Austrian Federal Law Gazette I 118/2016.

<sup>3</sup> Verordnung der Finanzmarktaufsichtsbehörde (FMA) über die videogestützte Online-Identifikation von Kunden (Online-Identifikationsverordnung – Online-IDV), Austrian Federal Law Gazette II 5/2017.

<sup>4</sup> <https://www.eba.europa.eu/documents/10180/104404/GL02OutsourcingGuidelines.pdf.pdf>.

<sup>5</sup> <https://www.eba.europa.eu/documents/10180/1848359/Draft+Recommendation+on+outsourcing+to+Cloud+Service++%28EBA-CP-2017-06%29.pdf>.

<sup>6</sup> [https://esas-joint-committee.europa.eu/Publications/Reports/EBA%20BS%202016%20422%20\(JC%20SC%20CPFI%20Final%20Report%20on%20automated%20advice%20tools\).pdf](https://esas-joint-committee.europa.eu/Publications/Reports/EBA%20BS%202016%20422%20(JC%20SC%20CPFI%20Final%20Report%20on%20automated%20advice%20tools).pdf).

<sup>7</sup> [https://esas-joint-committee.europa.eu/Publications/Discussion%20Paper/jc-2016-86\\_discussion\\_paper\\_big\\_data.pdf](https://esas-joint-committee.europa.eu/Publications/Discussion%20Paper/jc-2016-86_discussion_paper_big_data.pdf).

<sup>8</sup> [https://www.esma.europa.eu/sites/default/files/library/dlt\\_report\\_-\\_esma50-1121423017-285.pdf](https://www.esma.europa.eu/sites/default/files/library/dlt_report_-_esma50-1121423017-285.pdf)

<sup>9</sup> <https://www.eba.europa.eu/documents/10180/1455508/EBA-DP-2016-01+DP+on+innovative+uses+of+consumer+data+by+financial+institutions.pdf>.

European working groups dealing with FinTech matters in particular at the ECB, ESMA, EBA and the European Insurance and Occupational Pensions Authority (EIOPA). We want to be part of the European effort to promote innovation through FinTechs and to keep the right balance with regards to investor protection and financial stability.

Many new FinTech-related initiatives are coming up – in 2018 the transposition of the Payment Services Directive (EU) 2015/2366 (PSD2) and of the Directive on security of network and information systems (EU) 2016/1148 (NIS-Directive) concerning measures for a high common level of security of network and information systems are due. More initiatives are in the regulatory pipeline concerning for example anti-money laundering and cybersecurity.

In order to formulate a comprehensive European policy on FinTechs the Euro-

pean Commission launched a consultation “Fintech: A more competitive and innovative European financial sector”.<sup>10</sup> The focus of the Commission was to promote a more competitive and innovative European financial sector through FinTechs and we fully share this goal.

## 6 Conclusion

Like every innovation, FinTechs bring risks and opportunities, the FMA is committed to ensure that financial markets can seize those business opportunities and provide safe and sound services to their customers. The FMA wants to enable innovative solutions through new FinTechs as well as through existing financial service providers and at the same time to safeguard investor protection and financial stability, making FinTech a success story – for businesses, regulators and especially the users of financial services.



<sup>10</sup> [https://ec.europa.eu/info/finance-consultations-2017-fintech\\_en](https://ec.europa.eu/info/finance-consultations-2017-fintech_en).



## Is the post-crisis financial system more resilient? What remains to be done?

This summer, it will be 10 years since the first phase of the global financial crisis started in August 2007.

I have looked through reports from early 2007. In April 2007, the *International Monetary Fund (IMF)* reported that “*favourable global economic prospects continue to serve as a strong foundation for global financial stability*”. However, the report did include a scenario analysis concerning subprime mortgages and financial stability.

When discussing risks to the global economy in June 2007, the *Bank for International Settlements (BIS)* noted that “*at least four sets of concerns can be raised, even if our capacity to calculate both their probability and possible interdependence remains limited.*” Later on BIS has been commended for issuing risk reminders on a regular basis ahead of the crisis. But overall, neither the world nor economists were in a crisis mode back then as these examples show.

The global financial crisis has had a profound impact on a range of issues. Financial market regulation has been stepped up in the advanced economies. Economics as a science has engaged in some serious introspection. We recognise today that macroeconomic models should be designed so as to better capture severe financial market disruptions and their consequences for the real economy.

The financial crisis has served as a reminder of the great losses of economic growth suffered during severe financial market disruptions. The stable functioning of the financial system is a precondition for sustainable economic growth. This should be borne in mind now amid all the criticism over the regulatory reforms.

Let us recollect the key causes and lessons of the financial crisis. They will help us appreciate the value for national economies of the regulatory reforms.

### 1 Causes and lessons of the global financial crisis: a synthesis

The causes of the financial crisis can be divided into three closely entangled categories: 1) underlying macroeconomic factors, 2) deficient monetary and macroprudential policies in the years leading up to the crisis and 3) problems of financial market development, regulation and supervision.

#### First explanation: Underlying macroeconomic factors

A key macroeconomic factor behind the crisis was the current account imbalances, especially between the United States and China. The abundant supply of external capital pushed U.S. long-term interest rates down.

In the environment of falling yields, pressure was put on developing new high-yield investment instruments, including subprime loans, which also enjoyed political momentum in the United States.



Another macroeconomic factor underlying the crisis was the time of the so called “Great Moderation”. This was largely ascribed to modern monetary policy.

Ever since the stock market crash of 1987, we had also become used to the central banks stepping in with liquidity injections, where necessary, to restore stability on the markets.

Although positive as such, these developments came with the downside of a false sense of security and a lower awareness of risk.

### **Second explanation: Non-existent macroprudential policies and deficient monetary policies**

The second explanation for the financial crisis relates to the non-existent macroprudential policies but, in hindsight, also to deficient monetary policies in the years leading up to the crisis.

U.S. monetary policy had been relaxed in response to the September 11 attacks and other millennium shocks. The accommodative stance of monetary policy was sustained by concerns over deflationary trends. Housing markets showed signs of overheating, but when the series of interest rate hikes began, this did not, in retrospect, seem to be effective enough.

Should more determined measures of monetary policy have been adopted



to burst the U.S. housing market bubble? According to Jan Tinbergen’s famous principle, a certain number of policy targets requires an equal number of policy instruments.

The challenge was that monetary policy had one tool to offer, but there were two objectives to meet, i.e. price stability and financial stability. There were no macroprudential tools in place for ensuring financial stability.

Banking regulation tools were, in principle, available, but decision-making was impaired by the fragmentation of the U.S. regulatory framework. Ben Bernanke, Greenspan’s successor, also addresses this issue in his memoirs.

As Finnish Parliamentarians met with Bernanke during his last week in office in Washington in January 2014, we asked him what was surprising or new about this crisis. His answer was that they knew that speedy interest rate cuts had to be made and a strong economic stimulus introduced. But they had not anticipated the complexity of international financial institutions.

### **Third explanation: Imbalances in financial market developments**

The third explanation for the financial crisis thus relates to the liberalisation of the global financial system, and problems relating to financial innovations and regulation.

The liberalisation of the global financial markets and deregulation intensified in the 1980s. This was partly a natural consequence of developments in information technology and the management of financial risks. An underlying factor was also the growing emphasis on the virtues of free markets in all areas of economic activity.

At the end of the 1990s, the Glass-Steagall Act was repealed in the United States. The Act had separated investment and commercial banking activities.

Moreover, the large Wall Street investment banks that had traditionally operated as partnerships were converted into limited companies one after the other.

More research on the role of these regulatory and structural changes in the development of the financial crisis would still be welcome, but it is quite likely that they increased risk taking.

As is now well-known, one of the changes that took place in banking in the pre-crisis decade was the increasingly widespread use of the “originate and distribute” business model.

This was justified by more efficient diversification of credit risks of bank loans. Unfortunately, it also broke the traditional link between borrower and lender, which led to a loosening of lending criteria.

This business model made use of the so called “off-balance sheet channel” which also had another motive: it enabled lower capital requirements, within the regulatory rules in force at that time, even though risks had remained virtually unchanged.

*Tim Geithner*, the first Treasury Secretary in Barack Obama’s administration, argues in his memoirs that the key cause for the crisis was the business model applied by investment and commercial banks, a model which was a combination of a low level of equity and very short-term market funding.

Regulation also allowed banks to use low-quality capital to fulfil part of the capital requirements, which did not provide a buffer against losses. This turned out to be a key mistake.

There is a broad consensus on Geithner’s views on both sides of the Atlantic. But what were the underlying factors that led to banks’ excessive leverage and an increase in short-term market funding?

According to one explanation, this was a case of the typical euphoria that

occasionally sweeps the financial markets. The euphoria was also fuelled by the aforementioned, seemingly benign macroeconomic environment that prevailed before the crisis.

The overheating was also fuelled by confidence in the ability and incentives of the major financial institutions to manage their risks.

I witnessed an historic debate on the matter in *Jackson Hole* in 2005, as the then Chief Economist of the IMF, *Professor Raghuram Rajan*, questioned the faith in self-regulating financial markets.

Professor Rajan analysed three problems: front-loaded bonuses gave incentives for higher risk-taking, too much confidence was placed in risk diversification, and it was believed that there would be an endless amount of liquidity available. He concluded that these developments have not made the global financial system safer; they have made it even riskier. He was criticised strongly, even called a Luddite. History has proven Professor Rajan right.

Finally, there was the problem of “too-big-to-fail”: financial institutions that had become too large and complex, with potentially excessive risk-taking incentives.

What has been done to prevent the recurrence of the problems?

## **2 Major changes in financial regulation and supervision**

At least four reforms in particular deserve closer attention.

- First, banks’ loss-absorption capacity has been significantly strengthened.
- Second, banks’ ability to withstand liquidity crises has also been strengthened. The global financial crisis began as a liquidity crisis when banks lost their confidence in one another. Banks have also been required to reduce the share of short-term funding in their funding profile.

- Third, no bank can be regarded as “too-big-to-fail” any more. Supervision and capital requirements have been strengthened the most for banks that are systemically important. Authorities have been granted new powers to resolve banks efficiently. In relation to that, requirements on banks’ total loss absorbing capacity have been introduced, especially in the form of debt that can be “bailed-in”.
- Fourth, the global financial crisis demonstrated that price stability-oriented monetary policy and supervision that controls individual financial institutions’ capital adequacy and risk-taking do not automatically safeguard financial stability. Authorities needed a stronger mandate to ensure the stability of the financial system as a whole.

Identification of risks alone is insufficient to prevent financial crises. The authorities also need macroprudential tools to react to financial system imbalances. Examples of these tools include counter-cyclical capital buffers and loan-to-value constraints.

### **Banking Union strengthens supervision and crisis resolution in Europe**

Although the seeds of the global financial crisis were sown in the United States, many European countries seriously suffered from the financial crisis and from the euro area sovereign debt crisis that came to a head thereafter.

Experiences from the financial crisis revealed that it was unsustainable to have integrated European banking and financial markets, on one hand, but nationally fragmented banking supervision and crisis resolution, on the other. If large financial institutions are engaged in significant cross-border activities, their supervision and crisis resolution must also be based on a broader framework.

As a result of the establishment of the Banking Union, today we have the Single Supervisory Mechanism (SSM) that has the mandate to ensure rigorous and consistent supervision of cross-border banks. At the same time, it draws on the local expertise of national financial supervisors. Secondly, the common crisis resolution framework aims to ensure coordinated and orderly restructuring of failing multinational banks.

There is some evidence that implicit government guarantees have recently declined. This means that markets have begun to take governments’ goals seriously.

However, the third element of the Banking Union, the common deposit guarantee scheme, is still incomplete. I will return to that at the end of the presentation.

### **3 Outlook for the future risks are changing**

Have the regulatory reforms been effective? There are good reasons to believe that global financial system has become more stable and safer post-crisis.

Even so, the risks threatening stability are like constantly mutating viruses. They often become more virulent when reacting to medication developed for earlier diseases.

Expressed in ice hockey terminology, the challenge of financial market supervision is ‘to skate in the direction where the puck will go next, not where it is now’.

Central banks have in recent years kept their policy rates at exceptionally low levels. Expansionary monetary policy has been indispensable in a world slowly recovering from the crisis.

As a side effect, low interest rates can increase incentives for risk-taking and feed the elevation of asset prices. Lending in some countries has begun to grow at a potentially excessive pace.

This is when macroprudential tools need to be deployed.

The financial industry is also undergoing change. The boundaries between banking and other corporate activity are blurring.

In addition, banks are being challenged by new market participants harnessing the latest technology. Digitalisation will bring benefits. Benefits also include new risks, some of which are still hard to identify.

On the other hand, in recent years, international financial activity has also become simpler in a sound way. A few examples: (i) Banks are engaged in short-term securities trading to a lesser extent than in earlier years. (ii) Many large international financial conglomerates have streamlined and simplified their structures. (iii) The use of complex, artificial financial instruments producing no real added value has declined. (iv) The markets for financial derivatives are more transparent.

Many of these changes have gone a long way in the direction suggested in the High-Level Expert Group’s report on banks’ structural reform, but not all the way.

### **Too much of a good thing?**

The following question has also been raised: have post-financial crisis regulatory reforms gone too far in the sense that they have become an impediment to economic growth?

A recent study argues that the recovery of bank stock valuations following the global financial crisis and the European sovereign debt crisis has been slow compared with previous crises (in spite of the recent development). The study suggests that the reason for this could be regulation.<sup>1</sup>

The regulatory reforms have been considerable, but time has also been granted for adapting to them. Meanwhile, the low interest rate environment may have presented challenges for profitability of some banks, depending on the interest rate linkages of their assets and the composition of their own funding.

However, it is essential that banks’ profitability cannot any longer be based on their own funding being supported by public safety nets, which enables high leverage and, through that channel, a seeming improvement in profitability.

Owners and investors need to be prepared for bearing the risks: both profits and losses. The new bank recovery and resolution legislation offers tools for a genuine transfer of risks to bank owners and investors in bank debt markets.

This may lead to bank owners and investors requiring higher risk premia in the future. There is, however, no return to times of ineffective regulation and the practice of taxpayers ultimately bearing the risks involved.

### **“Shadow banking”**

An important question in the assessment of post-crisis regulation is whether revised bank regulation drives banking and its risks increasingly to “shadow banks”. These are businesses that offer financial services and are engaged in activities resembling banking, but are subject to more relaxed regulation.

Shadow banks had a significant role to play in the build-up of the financial crisis, as part of banks’ actual risks did not appear on their own balance sheets, being hidden as off-balance-sheet items.

Various views on the management of risks in the shadow banking sector have been put forward since the crisis. Significant regulation of shadow banks

<sup>1</sup> Chousakos, K. and G. Gorton. 2017. *Bank Health Post-Crisis. Paper prepared for the Banque de France Financial Stability Review.*

has not been introduced so far. Instead, banks' links with the shadow banking sector are regulated more effectively.

This helps transform shadow banking into “resilient market-based finance”<sup>2</sup> that can stand on its own, and will not transmit excessive risks to the banking sector via either direct financial links or the fire sales-induced balance sheet channel.

In the United States, the Dodd-Frank legislation adopted following the financial crisis allows authorities to put under supervision a shadow bank that has become a system-level threat. This possibility does not exist in Europe for the time being.

SUERF and Suomen Pankki organise in September this year a conference on shadow banks; this provides a forum for discussing the theme more closely.

#### 4 Finalising the Banking Union

A key remaining task for Europe is finalising the Banking Union. As I already discussed above, two pillars of the Banking Union, single banking supervision and the bank recovery and resolution framework, have largely been implemented, but the third, single deposit protection, is unfinished.

A single deposit guarantee scheme has been a controversial issue, but I share the view that an insurance-type deposit protection implemented in an appropriate manner is a consistent element of Banking Union.<sup>3</sup> Most benefit

would accrue to small and concentrated banking systems with correlated banking risks among different actors.

The European financial system is highly bank-based with a relatively limited role for market-based financing. This structural feature adds to the fragility of the European financial system. For this reason, it is also important to implement the Capital Markets Union, which complements the Banking Union.

There are already signs of a recovery in risk capital investments in Europe. It is vital that we continue work to ensure that the expansion of promising new businesses do not face unnecessary barriers created by bottlenecks in financing.

#### 5 Concluding remarks

The financial regulation and market infrastructure reform agenda, initiated by G20 in the aftermath of the financial crisis has been a great achievement. We must not let regulatory “fatigue” bring it to a premature end. I share the view of Mario Draghi from January when he emphasized commitment to the completion of Basel III, in his capacity as the chairman of The Group of Central Bank Governors and Heads of Supervision.<sup>4</sup> At the same time, we need to be clear, to the extent possible, as regards what remains to be done, in order to facilitate existing and new financial institutions' planning for their future investments.

I thank you for your attention.



<sup>2</sup> See M. Carney. 2017. *What a difference a decade makes*. Bank of England speech.

<sup>3</sup> See e. g. the report by a working group chaired by Dr. Antti Suvanto. *Improving the resilience of Europe's Economic and Monetary Union*. Ministry of Finance Publications – 37b/2015. Finland.

<sup>4</sup> *Finalising Basel III reforms*, Press release 3 January 2017. Basel Committee on Banking Supervision. [www.bis.org/press/p170103.htm](http://www.bis.org/press/p170103.htm).





### **Thomas Drozda**

Thomas Drozda was sworn in as Federal Minister by President Heinz Fischer on 18<sup>th</sup> May 2016. He took office as Federal Minister for Arts and Culture, Constitution and Media on 25 May 2016. Born in 1965, Mr. Drozda earned a degree in business administration and economics from the University of Linz. After completing his studies, he worked as a general manager at „Trotzdem“, the publishing house of the Austrian Socialist Youth organisation in Vienna; shortly thereafter, he worked in the Economic Studies Division at the Austrian central bank (Oesterreichische Nationalbank). In 1993, Mr. Drozda became an economic policy advisor in Federal Chancellor Franz Vranitzky's cabinet, where he was responsible for budgetary, fiscal, social, youth and family affairs; from 1996 onward, Mr. Drozda's remit was expanded to include the field of arts and culture. From 1997 to 1998, he continued his career as an economic and cultural policy advisor to Federal Chancellor Viktor Klima. Mr. Drozda went on to serve as the business manager at Vienna's Burgtheater from 1998 to 2008, and from 2007 to 2014 he was also a member of the Board of the Austrian Broadcasting Corporation (ORF) Foundation. In 2008, he became the Chief Executive Officer at Vereinigte Bühnen Wien, which operates three prominent theatre venues in Vienna.

### **Ernest Gnan**

Ernest Gnan has been Head of the Economic Analysis Division of the Oesterreichische Nationalbank in Vienna since 1999. He is a member of the European Central Bank's Monetary Policy Committee, and is also an adjunct professor at Webster University in Vienna, teaching courses on economic analysis. During 1998, Ernest Gnan served as deputy

head of the Foreign Research Division of the Oesterreichische Nationalbank, and from 1995 to 1997, as an economist in the Secretariat of the Foreign-Exchange Policy Sub-Committee at the European Monetary Institute (a forerunner of the European Central Bank). He is a former national expert in the Directorate General for Monetary and Financial Affairs at the European Commission in Brussels, and a former investment fund manager at Genossenschaftliche Zentralbank in Vienna. Ernest Gnan received a master's degree in commercial sciences and a Ph. D. in Economics at the University of Economics and Business Administration in Vienna.

### **Nikolaus Hautsch**

Nikolaus Hautsch is Professor of Finance and Statistics at the Faculty of Business, Economics and Statistics at the University of Vienna. He was educated at the University of Konstanz (Master of Economics in 1998) where he also earned his Ph. D. (summa cum laude) in 2003. After several years of professional experience as assistant professor and associate professor at the University of Copenhagen, he became Professor of Econometrics at Humboldt University in Berlin from 2007 to 2013. Among other professional activities, he served as Vice Director of the Center of Applied Statistics and Economics at Humboldt University and as Director of the Berlin Doctoral Program in Economics and Management Science. Mr. Hautsch is an honored Elected Fellow of the Society for Financial Econometrics and received the Dornier dissertation research prize in 2004. His research interest include among others financial econometrics and empirical finance including high-frequency finance. Professor Hautsch is married and has two children.

### Andreas Ittner

Andreas Ittner was appointed Vice Governor of the Oesterreichische Nationalbank (OeNB) on July 11, 2013, and is responsible for the Executive Directorate Financial Stability, Banking Supervision and Statistics. Ittner joined the OeNB in 1983. He was a member of the OeNB's Governing Board from September 2008 prior to his appointment to the post of Vice Governor. In his capacity as Vice Governor, Ittner is the accompanying person of the Governor at meetings of the Governing Council of the European Central Bank (ECB). In addition, Ittner holds numerous national and international functions related to banking supervision, e.g. in the General Board of the European Systemic Risk Board (ESRB), the Board of Supervisors of the European Banking Authority (EBA) and in the Supervisory Board of the Austrian Financial Market Authority (FMA). Previous positions at the OeNB include that of Director of the Financial Stability and Bank Inspections Department.



### Patricia Jackson

Ms. Jackson is a Non-Executive Director of the digital challenger bank Atom and chairs the risk committee. She is also a Senior Adviser at EY and a member of the global regulatory network. Patricia joined EY in 2004 as the Partner lead-

ing the banking risk practice and then later financial regulatory advice. She leads projects with the major banks globally on all the risk types as well as Basel III and stress testing. She is also increasingly involved in risk governance issues including developing an approach to setting and embedding risk appetite and risk culture. Prior to this, she was the Head of the Financial Industry and Regulation Division in the Bank of England and represented the UK on the Basel Committee for Banking Supervision for 7 years, leading the global QIS studies and calibration of Basel II. She is a Trustee of CEPR and on the Council of SUERF. She is also an Adjunct Professor at Imperial College. Ms. Jackson has published a wide range of papers on market and credit risk and bank capital. She edited a book on Risk Culture and Effective Risk Governance published by Risk Books September 2014.

### Clemens Jobst

Clemens Jobst is a Lead Economist at the Oesterreichische Nationalbank (OeNB) and Research Affiliate at CEPR London. After under-graduate studies at the University of Vienna and the University of Illinois at Urbana-Champaign, he earned a doctorate at Sciences Po Paris in 2007. He joined the OeNB as an economist in 2007 and serves also as lecturer for monetary history at the University of Vienna. His research interests include monetary policy implementation, both past and present, and the history of central banking. His research has been published in the Cambridge Journal of Regions, Economy and Societies, the Economic Journal, the European Review of Economic History and the Journal of Economic History among others. In 2016, he published a history volume of the Austrian central bank from its foundation to the present day, which he has jointly authored with Hans Kernbauer.

### John Kay

John Anderson Kay (born 1948) is a British economist. Kay was educated at the Royal High School, Edinburgh University, and Nuffield College, Oxford. He is a visiting Professor of Economics at the London School of Economics and has been a fellow of St John's College, Oxford, since 1970. After ten years as a tutorial fellow in economics, he established the independent think tank, the Institute for Fiscal Studies. In 1986, he became a Professor at the London Business School and founded London Economics, a consultancy firm. He was the first director of Oxford's Said Business School from 1997 to 1999. Mr. Kay has served as a director of Halifax plc and of several investment companies. In 2012, he presented a substantial report to the British government on reform of the equity market. Kay was appointed Commander of the Order of the British Empire (CBE) in the 2014 New Year Honours for services to economics. Kay has also served as a member of the Council of Economic Advisers to the First Minister of Scotland from 2007 to 2011.

### Michael Kumhof

Michael Kumhof is Senior Research Advisor in the Research Hub of the Bank of England. He is responsible for co-leading this new unit, and for helping to formulate and carry out key parts of its research agenda. His previous position was Deputy Division Chief, Economic Modelling Division, IMF, where his responsibilities included the development of the IMF's global DSGE simulation model. His main research interests are the quantitative evaluation of monetary reform proposals, modelling the role of banks in the macroeconomy, the role of economic inequality in causing imbalances and crises, and the macroeconomic effects of fossil fuel depletion.

Michael taught economics at Stanford University from 1998 to 2004. He worked in corporate banking for Barclays Bank from 1988 to 1993. His work has been published by AER, JME, AEJ Macro, JIE, JEDC, JMCB, EER and the Journal of Macroeconomics, among others. Dr. Kumhof is a citizen of Germany.

### Klaus Kumpfmüller

Klaus Kumpfmüller was born in Schärding, Upper Austria, on 29 November 1969. He graduated in Business Administration from the Vienna University of Economics and Business Administration and the Johannes Kepler University in Linz. From 1994 to 1995 he was a cabinet staff member of the State Secretary at the Federal Ministry of Economic Affairs. He then changed to Raiffeisenlandesbank Oberösterreich AG in 1995, where he worked as Key Account Manager for institutional customers. In 2002, he changed to HYPO Oberösterreich to become Director of Key Account Services and, additionally, Managing Director for several of the bank's holding companies. In 2011, he became a Member of the Management Board at the Austrian Federal Financing Agency (OeBFA), a position he held until he joined the FMA. In 2013, the Federal President appointed Klaus Kumpfmüller as new member of FMA Executive Board of the Financial Market Authority FMA for a term of office of five years. Klaus Kumpfmüller is member of the Board of Supervisors and member of the Management Board of the European Securities and Markets Authority (ESMA).

### Erkki Liikanen

Mr. Erkki Liikanen MPolSc. (Econ.) has been Governor of the Bank of Finland since 2004. He is currently serving his second 7-year term. Mr. Liikanen, a former EU Commissioner,

Ambassador and Minister of Finance is one of the longest serving members of the Governing Council of the European Central Bank. He is Chairman of the ECB Audit Committee with a mandate to enhance the corporate governance of the ECB and the Eurosystem. He is also Governor of the International Monetary Fund for Finland. In 2012, Mr. Liikanen chaired a High-level Expert Group proposing structural reforms to the EU banking sector. At the European Commission, Mr. Liikanen was responsible for Enterprise and Information Society and earlier for Budget, Personnel and Administration. In all, Mr. Liikanen was a member of the European Commission for almost ten years. In the early 1990s, Mr. Liikanen was head of the Finnish Mission to the European Union. Before commencing his international career, Mr. Liikanen was Minister of Finance for Finland. Mr. Liikanen is so far the youngest person ever to become a member of the Finnish Parliament, starting his parliamentary career in 1971 at the age of 21. Mr. Liikanen is an economist by training. He holds a master degree in Political Science (Economics) from the University of Helsinki. He also holds honorary doctorates from the University of Technology, Finland (2003) and Aalto University School of Economics, Finland (2011). Mr. Liikanen is married to Hanna-Liisa Liikanen Ph.D. They have two daughters.

#### **Peter Mooslechner**

Peter Mooslechner became a Member of the Governing Board of the Oesterreichische Nationalbank on May 1, 2013. Born in Bruck an der Glocknerstraße (Salzburg) in 1954, he studied economics at the Johannes Kepler University Linz (JKU), where he also received his doctoral degree in 1981. After having worked at the JKU's Institute of Public

Finance, Peter Mooslechner held a research position at the Austrian Institute of Economic Research (WIFO) from 1981 to 1996, exploring currency-, balance of payments- and money and credit-related topics. In 1996, he joined the OeNB as Head of the OeNB's Economic Analysis Division. In 1999, he was promoted to Director of the Economic Analysis and Research Department. Peter Mooslechner represents the OeNB in numerous national and international bodies (e.g. on the Board of the Austrian Economic Association (NOeG) and in the International Relations Committee (IRC) of the ECB). Peter Mooslechner has taught economics at a number of Austrian universities (Linz, Innsbruck, Salzburg and Vienna University of Economics and Business) and has published extensively on a broad spectrum of economic policy issues. His recent research has dealt with microeconomic aspects of household wealth and debt, economic policy during the financial crisis and monetary and exchange rate policy in Eastern and Southeastern Europe.

#### **Ewald Nowotny**

Ewald Nowotny is the Governor of the Oesterreichische Nationalbank (OeNB) and a Member of the Governing Council of the European Central Bank (ECB). Before taking on his current position in September 2008, Ewald Nowotny held a number of high-level positions in financial institutions. He was CEO of the Austrian BAWAG P.S.K. banking group from 2006 to 2007, served as Vice-President and Member of the Management Committee of the European Investment Bank (EIB) in Luxembourg from 1999 to 2003, and, between 1971 and 1979, was first a Member and then President of the Governing Board of Österreichische Postsparkasse (P.S.K.). Moreover, from 1992 to 2008, Ewald

Nowotny served on the supervisory boards of several banks and corporations and was a member of the OeNB's General Council from 2007 to 2008. Ewald Nowotny was born in Vienna, Austria, in 1944. He studied law and political science at the University of Vienna and economics at the Institute for Advanced Studies (IHS) in Vienna. In 1967, he received his doctorate in law from the University of Vienna. He served as a professor at the University of Linz and at the Vienna University of Economics and Business, where he was also Vice-Rector for Financial Affairs. Ewald Nowotny was Vice President of the Austrian Economic Association and is a Member of the University Board of the Vienna University of Economics and Business.

#### **Kurt Pribil**

Kurt Pribil was born in Vienna in 1957. He has been a Member of the Governing Board of the Oesterreichische Nationalbank (OeNB) since July 11, 2013. He studied business administration at the Vienna University of Economics and Business and received a Ph. D. in 1983. In 1982, Pribil started his career in the OeNB's International Division; from 1988 to 1991, he acted as the OeNB's representative in Brussels. From 1991 to 1999, he served as economic adviser to Wolfgang Schüssel during the latter's terms as Federal Minister for Economic Affairs and Vice Chancellor. Shortly upon his return to the OeNB, Kurt Pribil became Head of the Foreign Research Division, a position he held until 2001. He then joined the Austrian Financial Market Authority (FMA) as member of the FMA Executive Board. Since 2013, Mr. Pribil has chaired the supervisory boards of Casinos Austria AG (CASAG), Oesterreichische Banknoten- und Sicherheitsdruck GmbH (OeBS), Münze Österreich AG (MÖAG), Geldservice Austria GmbH



(GSA), IG Immobilien Invest GmbH (IG) and Betriebs-Liegenschafts-Management GmbH (BLM).

#### **Thomas Puschmann**

Mr. Puschmann is Head of Swiss FinTech Innovation Lab at the University of Zurich. The Swiss FinTech Innovation Lab is a cross-disciplinary research program on the global phenomenon of innovation in the financial industry induced by Financial Technology. The lab's goal is to conduct research on the topic of digitization in the financial services industry together with participants from the whole value chain, including banks, insurers, providers, regulators, and various other organizations and associations from the FinTech ecosystem. Dr. Puschmann is also a visiting scholar at the Massachusetts Institute of Technology in Cambridge, USA. Previously, he was a member of the board of ESPRIT Consulting and The Information Management Group.

#### **Doris Ritzberger-Grünwald**

Doris Ritzberger-Grünwald was born in Vienna (Austria) in 1961. She obtained her Master's degree in social and economic sciences from the University of Vienna in 1985, completed the Program in Economics at the Institute for Advanced Studies (IAS) in Vienna in



1987 and obtained her Doctoral degree in social and economic sciences from the University of Vienna in 1991. Following a period as research assistant at the IAS from 1987 to August 1988, she joined the Oesterreichische Nationalbank in 1988, where she started as an economist in the Economic Analysis Division and then moved to the Foreign Research Division. After an interim position as assistant to a Member of the Governing Board she returned to the Foreign Research Division as special adviser, to be promoted in 2000 to the post of Deputy Head of Division. From June 2002 to April 2013, she served as Head of the Foreign Research Division. In May 2013, she was appointed as the OeNB's chief economist (Director of the Economic Analysis and Research Department). Her fields of policy-oriented research include monetary policy, economic growth, convergence issues, inflation, the enlargement of the European Union and the European Monetary Union, with a special focus on Central, Eastern and Southeastern European Countries. She is a member of the Monetary Policy Committee of the European Central Bank and an Executive Board Member of the Joint Vienna Institute.

### Hans-Jörg Schelling

Hans Jörg Schelling is an Austrian entrepreneur and politician (ÖVP) and took office as Minister of Finance of the Republic of Austria on September 1, 2014. After graduation of the State Secondary School in Feldkirch in 1972, he studied Business Administration at the University of Linz, finishing his studies with a doctoral degree in 1982. In 1981, Hans Jörg Schelling started his professional career as assistant of the management of Leiner/Kika Group, becoming Managing Director in 1988. In addition, Mr. Schelling founded the Independent Management Consultant Schelling GesmbH that he managed until 2014. In 1992, he took over the management of XXXLutz GmbH. After a restructuring of the company, he became Member of the Supervisory Board in 2005. Amongst others, Mr. Schelling was Managing Shareholder of the Big Deal Marken und MarketingberatungsgesmbH (1999–2014) and Managing Director, XLA GmbH Wels. Before becoming Minister of Finance, Hans Jörg Schelling held several public positions e. g. Vice President of the Austrian Federal Economic Chamber, Member of the Austrian National Council, Chairman of the Managing Board of the Main Association of Austrian Social Security Institutions, Chairman of the Supervisory Board of Volksbank AG, Chairman of the Supervisory Board of the Austrian Social Security Pension Fund.

### Martin Summer

Martin Summer is Head of the Economic Studies Division at the Oesterreichische Nationalbank (OeNB). Before joining the OeNB in 2000, he worked as a lecturer at the University of Vienna, the University of Birmingham and the University of Regensburg. He also worked as a visiting researcher at the Bank of England and the Financial Markets Group

of the London School of Economics in 2004. His research interests are banking regulation and systemic risk, financial stability and financial economics.

### Helmut Stix

Helmut Stix is research economist at the Oesterreichische Nationalbank. His current research focuses on households' reaction to financial crises, as well as on cash demand and payment innovations. He has published in academic journals on topics like consumer cash usage across countries, why people save in cash, the choice and use of payment instruments, trust in banks during normal and crises times, the determinants of financial dollarization, and inflation perceptions. He studied at the University of Vienna, from where he received his doctorate, and at the Institute for Advanced Studies (IHS, Vienna), where he completed a postgraduate program in economics. From 1996 to 1999, he worked as a "Universitätsassistent" (assistant professor) at the Department of Economics at the University of Vienna. In 1999, he joined the Economics Studies Division of the Oesterreichische Nationalbank. He was research visitor at the Department of Political Science at the University of Minnesota and at the Bank of Finland.

### Sir Paul Tucker

Sir Paul Tucker joined The Systemic Risk Council as Chair in December 2015. He previously served as Deputy Governor at the Bank of England (2009–2013) and as a member of the G20 Financial Stability Board's Steering Group. During his time at the Bank of England, Tucker was a member of the bank's Monetary Policy Committee, Financial Policy Committee (vice chair), Prudential Regulatory Authority Board (vice chair), and Court of Directors. Internationally, he was a

member of the steering committee of the G20 Financial Stability Board, and chaired its Committee on the Resolution of Cross-Border Banks. He is a Senior Fellow at Harvard Business School (HBS) and a former Senior Fellow at the Mossavar-Rahmani Center for Business and Government at Harvard Kennedy School. In 2014, Tucker was granted a knighthood for his services to central banking. In addition to his work at Harvard, he currently serves as a director at Swiss Re, a leading global re-insurer, and was recently elected to the board of the Financial Services Volunteers Corps (FSVC).

### François Velde

François Velde is a senior economist and research advisor in the economic research department at the Federal Reserve Bank of Chicago. Velde's primary research on monetary history and monetary theory has been published in numerous journals. His research topics include medieval currency debasements, the monetary history of the United States, dollarization in Argentina and the macroeconomics of the French revolution. In 2002, Velde and Thomas Sargent co-authored the book *The Big Problem of Small Change* (Princeton University Press), which studies how monetary systems in Western European economies evolved in response to recurring shortages and depreciation of small change. Prior to joining the Chicago Fed as an economist in 1997, Velde was an assistant professor of economics at Johns Hopkins University. He is currently a visiting lecturer at the University of Chicago. Velde earned an undergraduate degree at the École Polytechnique in France and a Ph. D. in economics at Stanford University.

**David Yermack**

David L. Yermack is the Albert Fingerhut Professor of Finance and Business Transformation at New York University Stern School of Business. He serves as Chairman of the Finance Department and Director of the NYU Pollack Center for Law and Business. Professor Yermack teaches joint MBA – Law School courses in Restructuring Firms & Industries and Bitcoin & Cryptocurrencies, as well as Ph. D. research courses in corporate governance, executive compensation, and distress and restructuring. Professor Yermack has been with NYU Stern since 1994. His primary research

areas include boards of directors, executive compensation, and corporate finance. Professor Yermack has published more than 25 articles in leading academic journals in finance, accounting, economics, and law. He is a Faculty Research Associate of the National Bureau of Economic Research and has been a Visiting Scholar at the U.S. Federal Reserve Bank. Professor Yermack received his Bachelor of Arts in Economics (1985), Master of Business Administration (1991), Juris Doctor (1991), Master of Arts in Business Economics (1993) and Doctor of Philosophy in Business Economics (1994) from Harvard University.



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