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POLICY DEPARTMENT
ECONOMIC AND SCIENTIFIC POLICY **A**



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**Financial Innovation and
Monetary Policy: Challenges and
Prospects**

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In-Depth-Analysis



DIRECTORATE GENERAL FOR INTERNAL POLICIES
POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

Financial innovation and monetary policy: Challenges and prospects

IN-DEPTH ANALYSIS

Abstract

Financial innovations are expected to gradually reshape the financial sector. This paper describes recent technological developments and their possible impact on monetary policy and financial stability. A focus is put on the prospects for digital currencies, which potentially have the most profound implications for monetary policy. We find that privately issued digital currencies could transform the present financial system substantially, if they gain considerable market shares, while there may be a benefit from currency competition in disciplining monetary policy. The introduction of a central bank digital currency would also challenge the present fractional reserve system at its core and could finally lead to a more stable financial system.

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EXECUTIVE SUMMARY

- Many of the technological developments in the financial services sector (FinTech innovations) do not seem to have direct implications for monetary policy. They might, however, affect financial stability.
- FinTech entrants have been especially active in the area of payment services. Here one can distinguish between those which refine the existing monetary and banking system (such as PayPal which is still connected to traditional accounts at fractional reserve banks) and those that set up rival value tokens (such as Bitcoin which is based on the blockchain technology and attempts to be a currency in its own right).
- A blockchain can be implemented either as a permissionless system (which removes the reliance on trusted counterparties to verify accounts) or a permissioned system (in which only certain parties are allowed to contribute to the ledger). Permissioned systems have the potential to be much cheaper and faster but rely on trust in the record-keeping nodes of the system.
- Internet-based peer-to-peer lending and crowd funding platforms have spread after the financial crises and are expected to experience continued strong growth in the coming years. The implications of these developments in investment and financing on monetary policy are limited as they do not involve the creation of money.
- The automatization in the area of investment management has made great strides and could contribute to better outcomes for customers. The impact of adopting so-called robo-advisors on market volatility is probably limited.
- Big data is playing an increasingly important role in various segments of the financial sector, especially financial services and insurance. While there is a vast potential of benefits, including better informed investment decisions or improved risk assessment, there is the danger of falling victim to statistical fallacies.
- High-Frequency Trading (HFT) strategies offer improved price discovery and market liquidity, although some strategies are accused of reducing the value of information production in financial markets.
- FinTech innovations directly affect the conduct of monetary policy in the case of currency competition from private digital money issued outside the banking sector. Even if a full-fledged alternative currency does not develop and the current monetary system prevails, the option of privately issued digital money may diminish the room to manoeuvre for monetary policy. While there is the view that the possibility of central banks to engage in expansive monetary policies in times of economic trouble could be unduly restrained, the disciplining element of competition from private digital money can be expected to reduce the window for abusing the money production privilege, which is wide open when the production of money is monopolized.
- A digital currency could also be issued by the central bank and potentially substitute for bank deposits as the main form of money holding of households and businesses. This would challenge the present fractional reserve system at its core. Increased instability of monetary aggregates and credit supply would be a possible outcome, if market participants shifted liquidity pro-cyclically between digital money and bank deposits. Commercial banks would increasingly have to rely on other funding sources than deposits, so that this disruptive change to the fractional reserve system could finally pave the way for a more stable financial system.

1. INTRODUCTION

The notion “Fintech” (combining “Financial Services” and “Technology”) describes the more recent wave of technological developments in the financial sector.

Whenever certain bank activities can be complemented with digital technologies in order to provide financial services in a new, cheaper, better or more convenient way, Fintech firms can potentially step in to gain market shares and potentially disrupt long-lasting profitable business models of banks. Usually, Fintechs are organized as start-up firms outside of established banks, since banks are hesitant to “cannibalize” their own products from within the same organization, and since required skills to succeed as technological innovators often do not overlap much with skills of regular bank employees. As a consequence of the latter, a substantial proportion of bank jobs will probably be eliminated in the future. Nevertheless, Fintechs are not necessarily direct competitors of banks, but may also offer complementary services and cost-efficient products that banks can potentially adopt.

Financial innovations are expected to gradually reshape the financial sector and call into question the role of banks as financial intermediaries.

Financial innovations are not only important to customers (who may benefit from better and cheaper services) and banks (whose goal is to increase cost-efficiency and to offer state-of-the-art financial services to remain competitive), but also to central banks and regulators, who have to foresee possible consequences for financial stability and monetary policy. This paper is primarily interested in discussing these possible challenges and prospects of new technological developments for monetary policy. In particular, both privately and publicly issued digital currencies have the potential to disruptively change our financial system and reshape the functioning of monetary policy.

The paper describes recent technological developments in the financial sector and their impact on monetary policy, and discusses the potential impact of digital currencies.

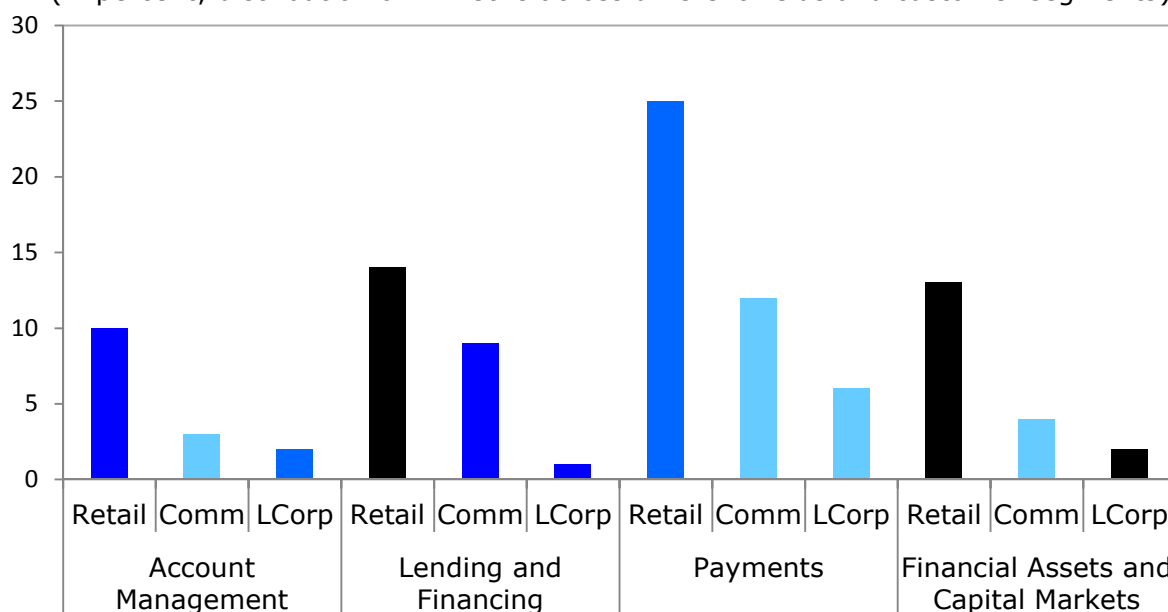
We concentrate on FinTechs, while developments in financial engineering (derivatives, securitization, etc.) are not considered. Five Fintech segments are discussed with an eye to potential direct implications for monetary policy and their potential effects on financial stability. In the second part of the paper we focus on the prospects of digital money, since this is the area within FinTech that could have the most profound implications for monetary policy in the future. In the discussion of digital currencies we distinguish between provision by the private sector and by the central bank, respectively.

2. RECENT DEVELOPMENTS IN FINANCIAL INNOVATION

2.1. Payments and brokerage

New ways to facilitate payments and the transfer of assets have been some of the most visible areas within financial technology. This is unsurprising insofar as they are often consumer facing and see large parts of the population as potential users of their services. In 2015, more than 40 percent of FinTech activity has been in the payments sector alone, with retail as the largest customer group. At the same time, only a moderate share of traditional banking revenues is earned in this area. Therefore, the entry threat in other segments (such as Retail Lending and Financing as well as Financial Assets and Capital Markets) may prove to be proportionally more worrisome (see Figure 1).

Figure 1: Customer Segments and Products of Leading FinTech Companies
(in percent; distribution of FinTechs across different fields and customer segments)



Comm: Commercial includes SMEs; LCorp: Large Corporate includes large corporates, public entities, and nonbank financial institutions

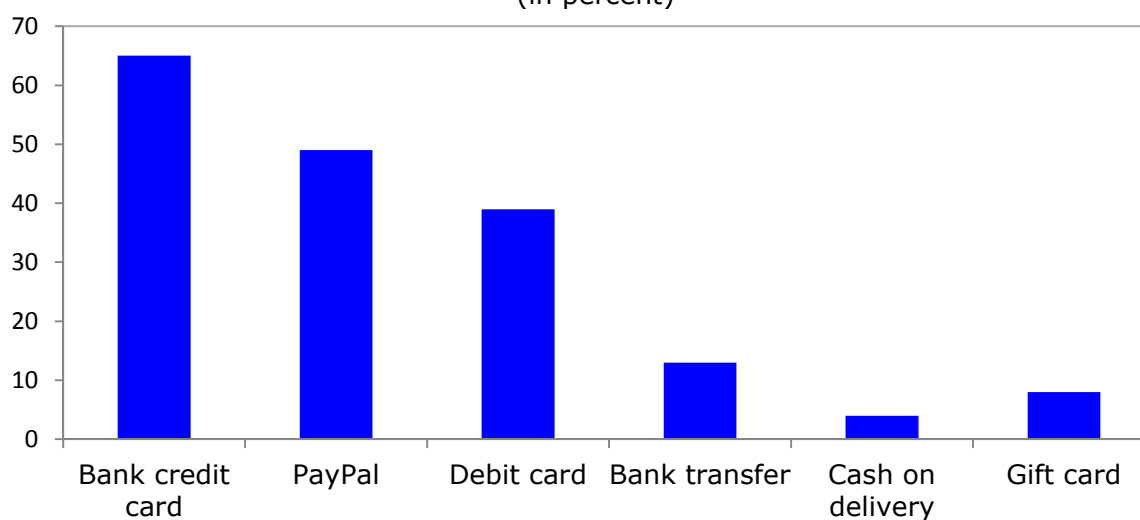
Segments' share of global banking revenues: <5% (light blue), 5-7% (medium blue), 7.5-10% (dark blue), >10% (black)

2015 data; based on 350+ most well-known cases (may not be fully representative);

Source: McKinsey.

Some of these innovations build directly upon the existing banking system without introducing substitutes for traditional forms of money: in these cases banks continue to provide accounts to corporations and households, leaving the fractional reserve system in place. This means that monetary aggregates remain largely unaffected and implications for monetary policy are limited. Here, the contribution of the FinTech innovators (such as PayPal) consists of a reduction in transaction costs by, inter alia, speeding up payment processes and increasing the security of authorization procedures, or by providing customers with better information about their various accounts. Entrants who wish to compete with traditional banks in this area have recently been helped by the Payments Services Directive II (European Union 2015), which took effect in January 2016 and strives to improve Third Party Providers access to banks' systems. These new payment methods are now used in a considerable share of transactions, especially in the growing area of online retail (see Figure 2).

Figure 2: Preferred Online Retail Payment Method
(in percent)



2016 data for Western Europe; **Source:** Statista.

With the introduction of the blockchain technology for the exchange of tokens (often called coins), digital money has risen to prominence, but substantial challenges – especially regarding their scalability – remain. Blockchain-based systems have two key features: they are digital and they allow the maintenance of a so-called “distributed ledger”. The first feature (which they share with other forms of digital money) supports the facilitation of debits and credits to users’ accounts via the internet. The second feature means that there is no longer a need for a central party to keep all accounts up-to-date. Rather, a network of decentralized nodes engages in the verification of all transactions and balances. Here, one can distinguish between permissionless and permissioned blockchains (Koning 2016). In a permissionless system, everyone can become a so-called miner and engage in the task of keeping the blockchain up-to-date. Since this requires the performance of expensive¹ calculations to deter would-be manipulators, these miners’ efforts are typically rewarded with newly minted tokens². Under the current Bitcoin protocol, for instance, the capacity of the currency to accommodate transactions is limited in terms of volume and timeliness. In contrast, permissioned systems grant only selected parties the authority to contribute to updating the ledger. Since it is easier to hold these parties to account, permissioned blockchains allow much easier updating procedures and correspondingly higher transaction throughputs than permissionless systems.

The blockchain technology can be implemented with a wide range of different attributes. Since the introduction of Bitcoin in 2009, which at a current market capitalization of roughly 30 billion dollars³ is still the most successful variant⁴, hundreds of competing coins have been set up. Different blockchains can follow different protocols. For instance, Bitcoin is only pseudonymous rather than anonymous. Therefore, it lacks essential benefits provided by cash, namely the protection of privacy and against censoring, which should be kept in

¹ Since Bitcoin scales the difficulty of the mathematical problems to be solved in proportion to the processing power engaged in mining, staggering amounts of energy can be expended in this process.

² Even so, such systems are not always completely immune to attacks on the ledger. If one party manages to gain control over more than 50% of the decentralized network’s mining power, it could introduce fraudulent changes.

³ According to <http://coinmarketcap.com/all/views/all/> on 11 May 2017.

⁴ However, in 2016 Bitcoin transaction volumes were still three orders of magnitude smaller than VISAs (Velde 2016).

mind when contemplating possible replacements for physical notes and coins. But entrants in the consumer facing currency markets are not the only parties intrigued by the possibilities of the blockchain. For example, a consortium of established financial services providers⁵ proposed the introduction of the so-called Utility Settlement Coin to speed up the clearing of central bank reserves. In principle, the ownership and transfer of all kinds of assets could be recorded on blockchain systems. However, the value proposition of such systems probably would not be to shift verification from established players to a large network of decentralized nodes but rather an increase in settlement speed. The innovators in this area would probably also hope to derive profit from the market power they could gain, since blockchains for certain assets would in effect be network goods. This means that, once such a blockchain is established, everyone would have an incentive to conduct their trades on it, since most potential counterparties would also be there. This in turn allows the provider of the blockchain to collect considerable fees or other compensation.

2.2. Investments and financing

Internet-based peer-to-peer lending and crowd funding platforms have spread after the financial crisis and are expected to experience continued strong growth in the coming years. The new opportunities provided by information technologies, combined with stress in the traditional banking industry and the low interest rate environment, paved the way for innovative lending and borrowing options in the form of peer-to-peer (P2P) lending and crowd funding. While P2P lending involves the transfer of potentially sizeable funds from one lender to one borrower, crowd funding typically means raising a relatively large sum in the form of small contributions from a big number of people. P2P and crowd funding platforms with low operating costs match lenders and borrowers online, bypassing banks, and offering simplified and quick procedures and better interest rate conditions for both borrowers and lenders. Currently, P2P platforms are among the fastest growing segment in the financial services sector. Several studies expect continued growth at rates of around 50 percent per annum over the next 5-10 years (Bajpai 2016). In 2015, the global P2P market was estimated at around \$100 bn and the total alternative finance market (including equity-based crowd funding) at close to \$150 bn. Two thirds of the market were in China, where P2P-financing seems to be a particularly attractive alternative to bank-based financing, given the heavy regulation and rigidity of the traditional financial sector. In the US and the UK, there is also a sizeable (and fast growing) market for P2P financing, whereas the market share was still relatively small in other countries, with less than half a billion of market value in Japan and France, respectively (P2P Finance News 2017).

Higher yields for lenders and lower costs for borrowers come with higher risk, which can be reduced by imposing transparency standards and light-touch regulation. While conditions for lenders may look attractive from the perspective of achievable interest, lenders are incurring higher risk compared to deposits because loans are generally unsecured. The EBA concludes that funds provided by lenders with crowdfunding platforms do not qualify as deposits eligible for protection under a deposit guarantee scheme (EBA 2015). In response some peer-to-peer platforms have developed funds to compensate lenders in the event of a borrower default. However, crowd funding introduces the risk that the crowd funding platform defaults. To address this risk, a crowdfunding platform could be required to ensure that loans would continue to be administered in case the platform goes out of business, or to provide insurance coverage for default. One of the major challenges is managing fraudulent activities and malpractices as they may result in loss of investor confidence and trust. Another issue is potential underestimation of risk by the lender, resulting from a lack of financial literacy or asymmetric information. In an unregulated environment there may also arise a moral hazard problem similar to the one in the originate-

⁵ Including BNY Mellon, Deutsche Bank, ICAP, Santander, and UBS

to-distribute schemes that surfaced during the financial crisis (Dombret 2016). To this end, crowdfunding platforms could be required to comply with certain disclosure requirements, including detailed information of the extent to which a risk assessment has been performed. It should, however, remain clear that there is no bail out to be expected in case of failure. Across the globe, financial regulators have increasingly started to monitor and regulate alternative finance platforms, including in China where in 2016 the government issued an aggressive set of measures to restrain the spread of problematic online lending platforms.

Internet-based P2P-lending and crowd funding may be a chance for developing countries to bypass the bottleneck of lacking a mature traditional financial system.

So far P2P lending and crowd funding are mainly a developed economies phenomenon, although the World Bank (2013) sees these platforms as a chance for facilitating growth in less developed countries as they could “leapfrog” the establishment of traditional and strongly regulated capital market structures. Crowd funding and commercial P2P lending are similar to forms of alternative finance more established in developing countries, such as microloans and social P2P-lending, in that they provide access to capital for parts of the population that cannot access it through traditional channels. It, however, lacks the predominant social objective and is characterized by its reliance on the internet.

The implications of the new developments in investment and financing associated with FinTech are limited as P2P lending and crowd funding do not involve the creation of money.

There may, however, be an impact on the velocity of money circulating which should be monitored. With respect to stability concerns the new forms of internet-based financing may have a favorable impact as no deposit money is at stake in case of default in contrast to the case of traditional funding through a bank. While some regulation of P2P and crowd funding platforms is warranted in order to improve transparency and facilitate appropriate risk assessment by investors, it is probably unwise for governments to interfere beyond “light-touch” regulation. Providing an environment conducive to the build-up of trust and transparency will be in the interest of the platforms as it should be in the interest of investors. Higher levels of government involvement would reduce the dynamism of the market on the one hand and would risk raising the perception of an ultimate government safety net on the other hand, thus increasing the potential moral hazard rather than reducing it.

2.3. Financial advisory and asset management

FinTech has made considerable inroads in the field of investment management.

Innovations such as the automation of financial advice (“robo-advisors”) have reduced costs of and improved access to financial planning services in recent years, leading to considerable growth in this area. Worldwide, 67 percent of “High Net-Worth Individuals” were willing to use automated advisory services in 2016, up from 49 percent in the year before (Capgemini 2016). But the wealthiest are not alone in taking advantage of these new products. Capgemini (2017) found in a 2016 worldwide customer survey that in the segment of investment management, 17.4 percent of respondents exclusively used non-traditional firms and an additional 27.4 percent used both traditional as well as non-traditional firms. In general, the uptake was higher among the more affluent, the tech-savvy, and the younger. Furthermore, Asian countries tended to be among the vanguard in terms of adoption whereas European countries on average lagged behind. While FinTech in this area is likely to gain market share in this segment, some financial overseers have started to worry about the regulatory implications. For example, the spread of robo-advice and similar services could potentially lead to excess volatility as well as an increase in pro-cyclical investment behavior as a result of herding, especially if algorithms were to be highly correlated (Carney 2017). However, even if such irrational herding behaviour were to occur, this could immediately

introduce profit opportunities for other algorithms to take the opposite side against those trading at excessive prices. These profit opportunities should lead to market entry until they are competed away. There also are concerns regarding consumer protection, but Philippon (2016) points out that for FinTechs to be welfare enhancing, they only need to improve results as compared to traditional advisors. He argues that this should be eminently possible, since they are typically cheaper and can avoid a lot of conflicts of interest that plague traditional players in this field. Furthermore, regulators may have an easier time overseeing readable algorithms⁶.

2.4. Data analytics

Big data is playing an increasingly important role in various segments of the financial sector, especially financial services and insurance. Big data, i.e. the use of huge datasets in the fields of predictive analytics and behavior analytics, has been a buzzword in the financial sphere for a number of years now and is now widely used. Investment banks and asset management firms base investment decisions on the analysis of voluminous data sets, often in combination with algorithmic trading. In banking, predictive credit risk models that use large quantities of payment data are being adopted. Financial services companies are looking to leverage large amounts of consumer data across multiple service delivery channels to uncover consumer behavior patterns and increase conversion rates. An important application of big data is in insurance where it can improve risk management, but is also feared to result in excess product differentiation (demutualization) with potentially negative effects on risk profiles and profit volatility (Derez 2016).

Significant challenges with respect to Big Data remain. An important issue with the uninhibited collection of unstructured data from various sources, including social media and applications in mobile devices, is privacy. In the context of financial services, the most important concerns relate to the statistical techniques that are used to analyze the data, which need a high degree of sophistication in order to obtain accurate results, which in turn need to be interpreted with care (Harford 2014).

2.5. Trading

High-Frequency Trading (HFT) has gained considerable market share. HFT is characterised by very fast connections to market places and the use of algorithms that execute trades without human involvement⁷. On European equity markets, HFT accounts for about one quarter of the overall trading volume (Villeroy de Galhau 2016). However, there are signs that the expansion of HFT has reached the limits of profitability for now (Deutsche Bank 2016). There is some concern that particular HFT trading strategies can reduce the value of the production of tradeable information and increase adverse selection in financial markets, thereby decreasing their efficiency (Foucault 2016). However, HFT also provides benefits in the forms of improved price discovery and market liquidity, which must be weighed against potential drawbacks before considering appropriate policy responses (DeClerck 2016).

⁶ However, by itself this comprehensibility is not assured for all types of computer code.

⁷ This second component is sometimes considered separately under the designation of Automatic Trading (AT). AT is sometimes accused of contributing to so-called "flash crashes". The litigation of this issue is beyond the scope of this paper.

3. FOCUS: DIGITAL CURRENCIES

3.1. Private digital money and currency competition

Money is the generally accepted means of exchange that once emerged as a product of the free market. To assess the prospects of privately produced digital forms of money, it is useful to recall the origin and nature of money. Money once emerged as a product of the free market (Menger 1892). While the progressing division of labour allowed for increasing productivity via gains from specialization, direct trade (good X, offered by person A, in exchange for good Y, offered by person B) became more and more difficult as the condition of the double coincidence of wants (i.e. the supply of A matching the demand of B and vice versa) became less and less likely. By engaging in indirect trade via a general means of exchange (money, M) the complexity in the trading process (transaction costs for searching and matching) was drastically reduced. By using money, A can now offer X to anyone in exchange for M and then use M to buy Y from B (with buying meaning offering M to person B in exchange for Y). In a social process of experimenting and learning, money evolved out of the more marketable (liquid) commodities that were traded more frequently and could thus be more easily exchanged into other goods and services. Irrespective of its concrete form, being the generally accepted means of exchange is the peculiar characteristic of money. The functions as unit of account and as store of value are of a subordinate nature only. As the most pervasive good, money constitutes a good category sui generis. It is neither an object of consumption (it does not directly satisfy human needs) nor a means of production (the productivity of money does not depend on its quantity).

As long as money circulates as commodity money – either as money proper (coins) or money certificates (fully covered notes and demand deposits) – money can be provided in a competitive way without the need for central coordination. The money supply is then endogenous to the extent that the purchasing power of money corresponds to the production cost of the reserve medium (e.g. gold). Minting increases the utility of money but in a competitive monetary regime the value differential between minted money and the money stuff (seigniorage) remains very slim. Even in a free banking environment that legalizes fractional reserve banking (partial coverage of notes and demand deposits),⁸ the deviation of the money supply from the stock of reserves remains limited because – in the absence of a central bank (or a cartel of commercial banks) – individual banks are exposed to the risk of bank-runs which will keep reserve ratios at reasonable levels.

The monopolization of money opens a window for excessive money production. Legal tender laws change the monetary environment substantially. The monetary authority is then able to create purchasing power out of thin air (i.e. exploiting the now much wider scope for seigniorage). This privilege creates a potential conflict of interest between providing a stable means of exchange and using money issuance as a financing instrument for the government. In the history of money, this privilege has often been overstretched. Governments in conjunction with the banking sector have a long record of exploiting their money monopoly over the centuries leading to the crash of most of all paper money systems so far.

Today, the provision of money is organized as a public-private partnership between central banks (public part) and commercial banks (private part) and tends to be inherently unstable. Only central bank money is legal tender. The quantity of money in circulation (cash and demand deposits) is mainly backed by financial claims (granting of credit) of the banking system on the real sectors of the economy. Demand deposits (privately produced money by commercial banks) represent the lion's share of today's money supply.

⁸ On the legal aspects of fractional-reserve banking see Huerta de Soto (2012), Chapter 3.

These deposits are backed by central bank money to a small extent only, which contributes to the latent fragility of the system. A financial crisis occurs once the trust in the solvency of a critical share of the debtors of the banking system fades. With the assets in the balance sheets of the banks becoming dubious so does the money supply, since failure of a bank threatens the demand deposits on the liability side of her balance sheet. This risk reflects that the high elasticity of money and credit creation runs in both ways. While it allows to expand the money supply out of thin air, it might also shrink the money supply abruptly. In recent years, all major monetary authorities (in the US, UK, Japan, euro area) heavily intervened in securities markets (mainly for sovereign debt) and increased their monetary bases to an extent so far unseen in peacetime leaving the world on unknown monetary territory. In particular, it is unclear whether the quality of central banks assets as collateral for high powered money will enable the monetary authorities to absorb liquidity whenever this should become necessary to keep inflationary pressure under control. The longer the money press is employed to fight problems that are non-monetary by their very nature, the more money users are likely to become aware of the potential risks and the more they have good reasons to look for means of exchange other than legal tender. This might bring the debate on the denationalization of money back on the agenda (Hayek 1976).

Currency competition via private digital money might come from issuers beyond the banking sector. While the inherent fragility of the existing monetary system may lead users of money to look for alternative forms of money, this demand-side effect alone is not enough. It also takes potent entrepreneurial players on the supply-side. The situation today differs from scenarios underlying earlier discussions of private money provision because the available technologies are different. Computers, mobile phones, or some other electronic devices may replace our wallets anyway. This reduces transaction costs for handling multiple currencies dramatically. Electronic payment systems will not only substitute coins and bank notes, but will also simplify the handling of multiple currencies by offering integrated network bridges. This gives all providers of world-wide electronic platform technologies the opportunity to supply a means of payment that is both digital and ubiquitously available.

Unless digital cryptocurrencies like Bitcoin massively increase their market share in terms of global turnover their relevance for monetary policy will remain limited. So far, most popular forms of electronic payment systems (e.g. PayPal accounts) are still linked to legal tender money accounts, but it is perfectly possible that this link disappears once better alternatives for reserve media arise. Bitcoins – neither linked to legal tender nor backed by any reserve medium – show that people around the world are already searching for alternative means of payment that are no longer restricted by government policy. Given the current fragile monetary situation it is unclear whether and – if so – when this possibility might materialize. So far, actual use of Bitcoin as a medium of exchange is rather negligible compared to regular currencies with close to 300,000 worldwide transactions per day.⁹ Moreover, digital currencies like Bitcoin in their present form lack certain desirable characteristics of exchange media, as their external value is extremely volatile and their acceptance is rather limited to a small fraction of online businesses, including dubious shadow economy purposes. But, as multiple currencies can coexist, it is possible that people start with experimenting with alternative currencies on a limited scale first and then extend the use of these currencies later, if they turn out to be more suitable than the currently used credit-backed money. As soon as more and more of people start using private digital currencies instead of legal tender and bank deposits, the implications for monetary policy would be substantial: Alternative currencies would have to be considered in the assessment of monetary aggregates, and issuers of private money would initially be entirely unregulated.

⁹ See <http://www.coindesk.com/data/bitcoin-daily-transactions/> (19 May 2017)

Guaranteed convertibility of private digital money could boost acceptance and reputation-building while also promoting initial stability. Clearly, one possibility to immediately increase acceptance would be to a credible guarantee of free convertibility of digital currency tokens into some regular currency like the US dollar (underwritten for example by some large private corporation). Then, this currency would be as stable as the US dollar from the start and people would begin using and accepting this “money”¹⁰, as long as the issuers promise to freely convert any requested amounts into US dollars remained credible. (At a later stage, after the currency has gained the trust of money users, this promise of convertibility could in principle be revoked in favour of a floating exchange rate.) To the extent that users used the tokens as a (temporary) store of value, the private issuer could enjoy seignorage gains. However, the issuing corporation would basically act like a US bank, whose sight deposits are also freely convertible into dollar, with the difference that the bank is subject to strict regulation. The firm would probably have to obey the same regulations soon, even if the deposits are formally denominated in terms of some token. Electronic money could also be fully collateralized by physical reserve media like gold making legal tender obsolete. From the start, this privately produced money would be truly global (making full use of the network good characteristics of a universal medium of exchange) and free from direct political control.

Even within the current monetary system the option on privately issued digital money may limit the conduct of monetary policy. The substitution of the current monetary system by privately provided digital currencies would totally change the monetary landscape making traditional monetary policy obsolete. Clearly, this is an extreme scenario. However, even if for the time being privately issued digital currencies remain a niche product they may nevertheless exert an effective influence on monetary policy. In their roles as potential competitors private money producers narrow the scope of action of the monetary authorities because they offer an alternative means of exchange that people can opt for should the trust in the capacity of the central bank to stabilize the existing money erode. It is in this sense that Hayek once put forward the proposal for currency competition (Hayek 1978). What he had in mind was not the idea of ending up with a multitude of privately issued currencies, but to make use of the instrument of potential competition to discipline the incumbent money producer. However, today the handling of multiple, electronically managed currencies is much easier than in the 1970s when coins and banknotes were still an indispensable element of the monetary system.

The repercussions of privately issued digital money could be immense. The questions raised by a scenario of reprivatisation of money are manifold and too complex to be covered decently in this paper. The most important of them may be grouped along the following lines:

- Should private sector entities be allowed to control the supply of money, a good that lies at the heart of economic activity, or is provision of a universal means of exchange an activity in which provision by a sovereign is more efficient, much like the legal system or national security? Would private currencies be subject to speculation and high volatility? Or can private entities in a competitive environment provide more useful and stable money than governments, keeping in mind that private firms can safely be entrusted with the provision of most other goods and services (e.g. food)?
- How will governments respond when private companies challenge their money monopoly? Will they grant them the necessary protection of the civil laws or will they rather use their rule setting monopoly to prevent the emergence of private money in the first place? Do they have a choice, particularly if digital money accounts are

¹⁰ Since the coupling between new token and existing money would be very tight, it is debatable whether the new token should even be called a money in its own right.

located beyond national borders on the internet? Will there be strong public support for the freedom of using whatever currency individuals prefer? What does private money imply with respect to the problem of high sovereign debt in many countries?

- Does free banking depend on a physical reserve medium at all, or are purely virtual currencies (like Bitcoins) workable alternatives? If not, what would be the most suitable reserve medium for global free banking? Will gold – made digitally fungible – become the money of the world again? What are the transition scenarios?
- Who are the most likely big players in a global landscape of free banking? Is data mining a strong enough incentive for today's digital network giants to enter the market or will specialized so far hidden champions make the race?
- Free banking would leave the traditional banking industry as a financial intermediary. Are modern banks ready for this or do their business models crucially depend on the fiat money privilege?
- How important is the fractional reserve privilege granted to commercial banks that implies extremely elastic credit creation and destruction? Is this elasticity an enabler for economic growth or rather an economic destabilizer? What are the regulatory requirements for free banks? Is free banking more robust because it is less complex or is such a vision unrealistic thinking?

3.2. Fedcoin: Implications of a central bank digital currency

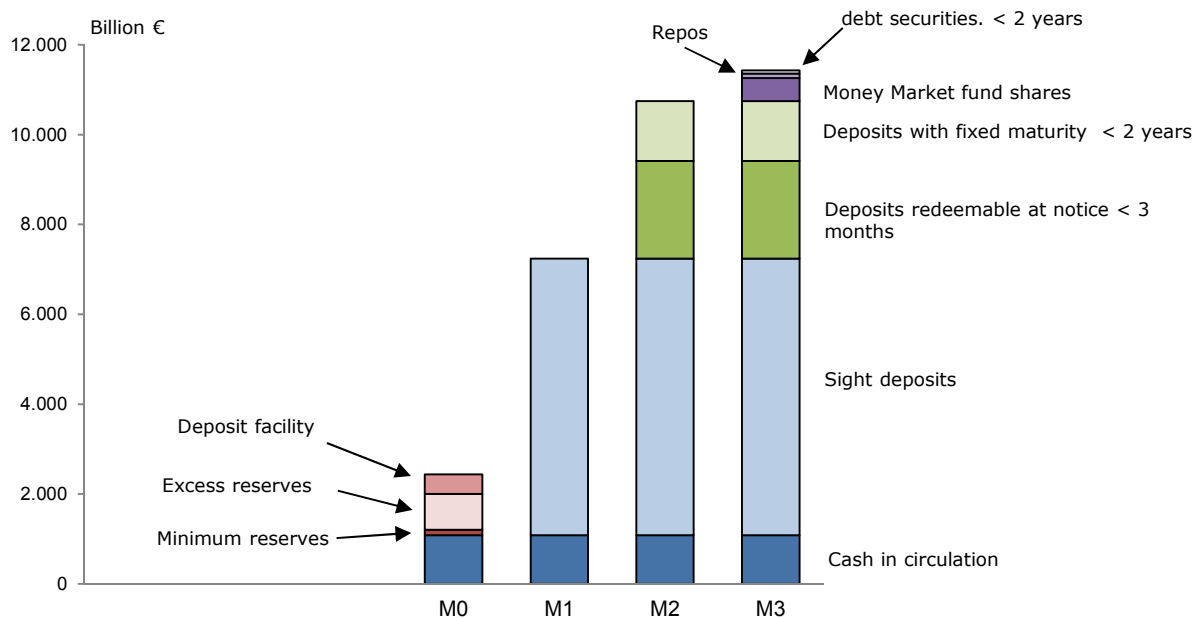
With a central bank digital currency (CBDC), the broader public could be granted access to non-tangible central bank money. Recent developments of cryptocurrencies based on distributed ledger technology initiated a debate about the possible issuance of a "central bank digital currency" (Koning 2016, Broadbent 2016, Smets 2016, Raskin und Yermack 2016). Inspired by the success of Bitcoin, the term "Fedcoin" has also been used to describe such a publicly-issued digital currency. As the value of Bitcoin has been quite volatile in the past, which is certainly not a desirable property of a currency, the central bank could guarantee free convertibility of Fedcoin units to cash at a fixed rate of 1:1 and thereby ensure the same degree of price stability as the official currency.

Digital currency units would be a third form of central bank liability beyond cash and reserves. In the current banking system, money issued by the central bank can be held as cash or reserves. The former (cash) is accessible to anyone, the latter (holding reserves) is only accessible to banks. If non-banks intend to hold non-tangible money, they have to rely on deposits at commercial banks. In essence, such fractional reserve deposits represent claims against commercial banks, instead of claims against the central bank. By introducing Fedcoins, households and businesses would be enabled to hold non-tangible central bank money, i.e. direct claims against the central bank. Basically, base money would be extended to a third form of central bank liability beyond cash and reserves (unless Fedcoins replace reserve holdings). In practice, the central bank would guarantee convertibility between Fedcoin units, cash and reserves at a fixed rate of 1:1:1. Whenever cash is exchanged for Fedcoin, the amount of circulating cash would be reduced and the amount of digitally issued Fedcoin units would be increased (and vice versa).

The possibility to hold cashless claims against the central bank is not entirely new, but recent technological developments made it a realistic option. Broadbent (2016) points out that even without blockchain technology, the central bank could in principle grant more people access to non-tangible central bank money, and Koning (2016) provides several examples why this is not an entirely new situation. On the other hand, the central bank could issue a cryptocurrency and still exclude non-banks from using it. Still, the introduction and maintenance of a CBDC certainly became simpler and more efficient due to recent

technological developments, even though broad access to holding direct claims against the central bank is not directly linked to blockchain technology.

Figure 3: Monetary Aggregates in the euro area



Sources: European Central Bank, own representation. Monthly data, as of January 2017.

A digital currency issued by the central bank could potentially substitute bank deposits as the main form of money holding of households and businesses, by which the present fractional reserve system would be challenged at its core. With a CBDC, there would be freedom to choose between holding liquidity as central bank money (Fedcoins) or as bank deposits. So far, about 80 per cent of M1 is held as sight deposits in the euro area (Figure 3). As soon as holding money on a Fedcoin account (and transferring it) is convenient, safe and frictionless, combined with low cost for this service, a growing number of people and businesses would probably prefer to hold their liquidity as Fedcoin units. As a consequence, commercial banks would increasingly lose the ability to attract deposits. So far, sight deposits have been a major and reliable source of funding for commercial banks. In fact, an integral part of the business model of banks consists of collecting short-run deposits and granting long-run loans (maturity transformation). If a substantial share of depositors actually transferred their money to the Fedcoin system, the fractional reserve banking system would be challenged at its core.

If bank customers transferred deposits to their Fedcoin account, the short-run impact on commercial banks would be similar to a bank run. In order to withdraw money from the banking system, people would not even have to line up in front of ATMs. Instead, liquidity could be conveniently transferred at home via online banking from the bank account to the Fedcoin account. Nevertheless, the impact on the balance sheets of that bank would be the same as in a classical bank run, even though pictures of upset customers lining up at the front desk are left out. Therefore, introducing a CBDC probably comes with a side effect of increasing the likelihood of such a disruptive event. Banks would have to replace withdrawn liquidity with new means of (re)financing, for example by selling assets (probably in a fire sale), attracting other deposits or issuing own bonds (in a rather difficult

environment) or by receiving direct credit from the central bank. In the end, the central bank would probably be required to provide sufficient liquidity.

Over time, maturities of assets and liabilities in banks' balance sheets would match better than in the current system. Given the expected loss of sight deposits, the open question is to what extent banks would have to cut back on their lending, or if they would be able to maintain the current level of lending by attracting sufficient new sources of funding, for example additional deposits of longer maturity or issuing bonds or equity. If banks would have to partly reduce their lending, the result would be a dampening effect on the real economy. This, however, need not be a negative if lower lending would ultimately lead to less pronounced booms and busts in the credit cycle. Furthermore, the current maturity mismatch of banks' assets and liabilities would be reduced by the substitution of short-term funding through deposits with longer-term financing instruments. As a result the structural stability of the banking sector would be improved.

If a substantial number of money holders permanently switched to Fedcoins, base money would increase sharply and the central bank could realize higher seignorage gains. If market participants found and maintained a new balance with relatively less bank deposits and correspondingly more Fedcoins, base money would increase sharply and permanently. Given that the monetary aggregate M1 currently consists of approximately 20 percent cash and 80 percent deposits in the euro area (Figure 3), the share of deposits would be partly replaced by Fedcoins. These circulating Fedcoin units, however, belong both to M0 (as they are issued by the central bank) and M1 (as they can be used for retail payments) just like cash. Therefore, base money (M0) would increase with every market participant that decides to hold Fedcoins. With a substantial increase in base money, the central bank balance sheet would have to be expanded through additional asset purchases and additional loans to commercial banks. As a consequence of an increasing interest-bearing portfolio on the asset side, central bank seignorage would increase significantly (as would the risk of losses from central bank held assets). Clearly, the expected increase in central bank revenue mirrors the fact that commercial banks would lose a major source of cheap funding.

A central bank that successfully introduces a digital currency potentially gains a lot of importance. If a major central bank actually introduced a CBDC along with safe access via internet and convenient payment methods, accessible to anyone around the globe, demand for this currency would probably increase on a global scale. The currency would probably increase its role on foreign exchange markets, as an international reserve medium, and as an alternative currency for countries in macroeconomic turmoil. Seignorage of that central bank would increase sharply with the issuance of vast amounts of non-tangible central bank money. Central banks probably conduct research of how to implement a digital currency using blockchain technology having in mind a possible first mover advantage, which clearly increases the probability that a CBDC will actually become reality at some point in time.

If market participants shifted liquidity pro-cyclically between Fedcoin accounts and bank deposits, increased instability of monetary aggregates and credit would be a possible outcome. The perceived risk of fractional reserve deposits is usually higher in times of financial stress than in normal times. So we can expect resources to flow out of banks in times of crises, and back as soon as risk aversion is back to normal. This pro-cyclicality of bank funding would probably transmit to credit supply, rendering it even more pro-cyclical than in the current system. Moreover, the central bank would have to compensate for increased variability of liquidity needs in the banking system. The availability of Fedcoins could impair financial stability (Smets 2016). If the degree of instability turned out to be substantially elevated, the problem would have to be tackled with additional regulatory measures. For example, a significant increase of the minimum reserve ratio on sight deposits would certainly facilitate dealing with fluctuating deposits, since whenever

liquidity flew out of the bank, substantial reserves would automatically unlock on the minimum reserves account. In the limiting case of 100 percent reserve backing for deposits (Fisher 1936), banks would not be funded at all with sight deposits any more, neither in times of financial stress nor in normal times.

A simultaneous abolishment of cash would relax the zero lower bound restriction of monetary policy. So far, it was implicitly assumed that a CBDC were to be introduced as a complement, rather than a means to replace cash. However, if cash were abolished simultaneously, the impact on monetary policy would be even more severe: Until now, an effective lower bound on nominal interest rate policy prevails due to the option of withdrawing cash and “receive” a nominal return of 0 percent. Unlike cash, Fedcoin units could easily be charged with positive and negative interest rates. Without a way out of the banking system (cash), people would be forced to accept even negative interest rates, so that the effective lower bound would be removed. The central bank would see an improvement in its ability to affect economic activity in low interest rate environments, at least as long as competition from other currencies is limited.

Attempts to abolish cash would certainly face strong political resistance, so coexistence of cash and Fedcoins is much more likely for the time being. Cash plays an important role in the life-long experience and payment habits of most people, and many businesses still rely on cash as a main or only accepted means of payment. Moreover, cash payments do not leave a digital trace, nor can cash stocks effectively be controlled by government institutions. Therefore, availability of cash is desirable for criminals and tax evaders, but can also be regarded as institutionalized freedom from government influence and control that many people would certainly prefer to maintain. Finally, it would require a political majority to legally abolish cash, which so far appears to be well out of reach. Any attempt to abolish cash would certainly face strong political resistance. Therefore, a more likely path to a cashless society would start with introducing a CBDC while cash is still available, so that people get used to the new and convenient means of transaction. While Fedcoin and cash coexist, the government could go on canceling larger denominations of cash in order to relax the policy restriction of the zero lower bound. Koning (2016) also discusses the option of a cryptocurrency design that allows for non-traceable anonymous transfers. Once market participants trusted the digital currency, and once digital payments were accepted almost everywhere, the government could actually consider abolishing cash entirely. If anything, however, this appears to be a rather distant prospect.

The interest rate on Fedcoins would set a lower limit for interest to be paid on bank deposits. Money holders would choose between bank deposits and Fedcoins. To attract any depositors, banks would have to provide competitive terms and conditions for bank deposits compared to Fedcoin accounts, plus a risk premium to offset the reduced safety of fractional reserve deposits. So the rate of return on Fedcoins (including the degree of convenience), plus the bank’s perceived risk premium, would be an effective lower bound for the required rate of return on bank deposits. As long as the bank account offered sufficiently good conditions, liquidity of the average depositor would remain in the bank. This implies: in addition to the prevailing effective lower bound on nominal interest rates due to the existence of cash, a lower bound for rates on risky deposits would also be implicitly imposed on the banking system. The latter lower bound would probably be most relevant at times when the interest rate on Fedcoins was distinctly in positive territory.

Overall, a digital currency issued by a central bank can be a disruptive technology that potentially challenges the fractional reserve system. Anyone would be given the option to hold and transfer direct claims against the central bank. The current banking system on a fractional reserve basis would be challenged at its core, as soon as market participants increasingly held liquidity in the new digital currency accounts instead of bank accounts. To

avoid recurrent instability of the entire banking system as liquidity flows pro-cyclically between commercial banks and Fedcoin accounts, commercial banks would probably be required to come up with a new business model, in particular with respect to more reliable funding sources compared to deposits. As the fractional reserve character of the current banking system can be a major source of instability, such a disruptive change is not necessarily a bad development, but could finally pave the way for a more stable financial system.

4. CONCLUSIONS

Financial innovations are expected to gradually reshape the financial sector and call into question the role of banks as financial intermediaries. Many of the technological developments in the financial services sector (FinTech innovations), such as internet-based peer-to-peer lending and crowd funding platforms, automation of financial advice or High Frequency Trading techniques, do not seem to have direct implications for monetary policy. They might, however, affect financial stability and therefore warrant close monitoring.

FinTech innovations directly affect the conduct of monetary policy in the case of currency competition from private digital money issued outside the banking sector. Even if a full-fledged alternative currency does not develop and the current monetary system prevails, the option of privately issued digital money may diminish the room to manoeuvre for monetary policy. While there is the view that the possibility of central banks to engage in expansive monetary policies in times of economic trouble could be unduly restrained, the disciplining element of competition from private digital money can be expected to reduce the window for abusing the money production privilege, which is wide open when the production of money is monopolized.

A digital currency could also be issued by the central bank and potentially substitute for bank deposits as the main form of money holding of households and businesses. This would challenge the present fractional reserve system at its core. Increased instability of monetary aggregates and credit supply would be a possible outcome, if market participants shifted liquidity pro-cyclically between digital money and bank deposits. Commercial banks would increasingly have to rely on other funding sources than deposits, so that this disruptive change to the fractional reserve system could finally pave the way for a more stable financial system. If central bank digital money were to replace cash as well, then central banks would gain the ability to reduce interest rates below the current effective lower bound, provided entry of competitors is restricted.

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