Policy Contribution
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The next generation of digital currencies: in search of stability

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Executive summary

- **FOUR MAJOR DEVELOPMENTS** have challenged the status quo and reopened the debate on the forms that money will take in the future: 1) use of cash as a medium of exchange has declined; 2) distributed ledger technology (DLT) has led to the emergence of thousands of digital cryptocurrencies; 3) some global tech giants are planning to provide private digital currencies to their billions of users in the form of stablecoins; and 4) in turn, public authorities are thinking about providing their own digital currencies to the general public.
- **THESE DEVELOPMENTS RAISE** questions about the implications for financial stability, the transmission of monetary policy and financial intermediation. This Policy Contribution focuses on the consequences stablecoins and central bank digital currencies could have.
- **STABLECOINS, SUCH AS** Facebook's Libra, differ from earlier generations of cryptocurrencies in three fundamental ways. First, they would start with large networks of users and global accessibility, two pivotal features for the critical uptake of a new currency. Second, given the current limitations of DLT, including in terms of energy efficiency, new stablecoins would rely on (more) centralised systems to validate transactions. Third, stablecoins would focus particularly on reducing the volatility in the value of the new currency.
- **THESE NEW FEATURES** of stablecoins attempt to correct some of the critical deficiencies identified in first-generation cryptocurrencies, which meant they did not acquire the main functions of money. However, new stablecoins raise other questions and potentially create new problems. One issue could arise from the more centralised (permissioned) validation system, which could lead to collusion problems. Another issue could arise from the reserve system that is supposed to ensure the stability of stablecoins, such as Libra, which could be incompatible with the profit maximisation behaviour of a private issuer.
- **FACEBOOK'S LIBRA PLAN** has been a wake-up call to central banks and governments which, afraid of losing their monetary sovereignty, have renewed their interest in central bank digital currencies (CBDCs) as a potential solution. CBDCs could make private digital currencies less attractive and slow down their adoption.
- **BUT THERE ARE** other reasons to give the general public access to central bank liabilities. One important reason to provide CBDCs to citizens is that if cash disappears, citizens will lose direct access to sovereign money. Another benefit of the introduction of CBDCs is that monetary policy could be strengthened by transmitting it directly to the general public.
- **HOWEVER, THE INTRODUCTION** of CBDCs could also be disruptive and create risks. In particular, CBDCs could have major consequences for financial intermediation. These risks would have to be evaluated by policymakers before any decisions are taken.
- **IF CBDCS ARE** introduced, central banks would have to carefully calibrate their properties to minimise these risks. But, eventually, if these risks – and in particular the risk of structural financial disintermediation – do materialise, central banks would have various instruments to counter them.

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1 Introduction

Under the Bretton Woods monetary arrangement put in place in 1947, the main global currencies were anchored to the US dollar (through a fixed exchange rate) and were, at least partially, convertible with gold. This system broke down in 1971 when US President Richard Nixon declared a temporary suspension of the dollar's convertibility into gold. Since then, monetary systems in most developed countries have been based on fiat currencies, in other words, currencies that are not backed by physical assets but that rely on the ability of monetary authorities to ensure the currency's stability. These currencies are issued by central banks in the form of physical cash (coins and banknotes) and reserves, combined with highly regulated bank deposits convertible at par with central bank money.

The fiat-based monetary system has functioned in this form since the demise of Bretton Woods, with only minor innovations. However, four major developments in the last decade have challenged the *status quo* and have re-opened the debate on the forms that money will take in the future:

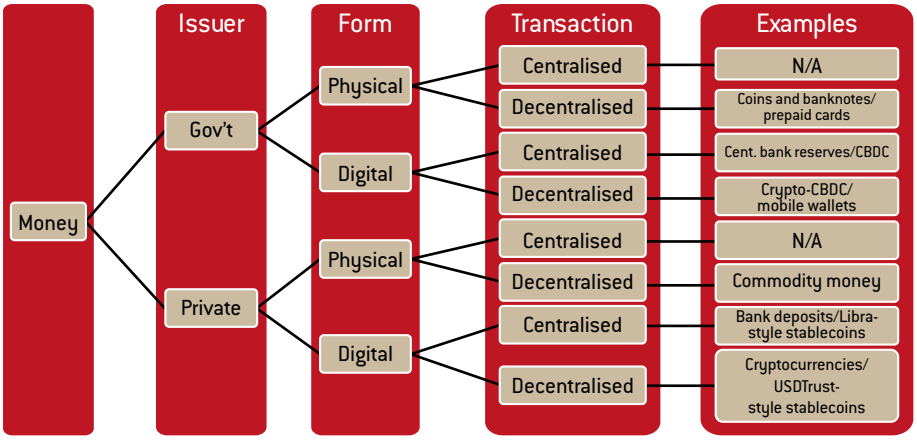
1. The share of transactions in cash in developed countries has fallen. In countries such as Sweden, coins and banknotes have become so marginalised as a means of payment that there is even talk of abandoning them completely. The Swedish Riksbank has opted against the total elimination of cash, but there is unequivocally a trend towards less cash usage.
2. The emergence of distributed-ledger technology, or blockchain (ie a decentralised, secure and unchangeable record of financial transactions), has enabled the appearance of thousands of cryptocurrencies, such as Bitcoin, which launched in 2009. This technology has since given rise to many private forms of digital money.
3. While the first generations of digital coins proved not to be stable means of payment and storing value, more recent versions have explicitly aimed to provide stability. A number of so-called 'stablecoins' have been issued in recent years, including Tether in 2014, which was intended (originally at least) to be fully backed by US dollar reserves, TrueUSD with a similar model in 2018, and Basis in 2017, which promised to create an algorithmic stablecoin[1]. The stablecoin idea has now become more prominent, with global tech giant Facebook announcing on 18 July 2019 its intention to issue its own fiat-currency-backed stablecoin: the Libra. Given its potential to reach millions, if not billions, of users across the world, authorities have taken a significant interest in how this might challenge official currencies.
4. As a result of these rapid and potentially significant developments, central banks are now contemplating the idea of creating central bank digital currencies (CBDCs). These could replace coins and banknotes and potentially make central banks' digital reserves available to all economic agents and not only to banks.

These potentially beneficial innovations in conveniently storing value and providing payments need to be carefully assessed against the costs they potentially entail for citizens. More broadly, important questions arise as their popularity increases, pertaining to the transmission of monetary policy, financial stability and the future of financial intermediation.

In Claeys *et al* (2018), we proposed a taxonomy for all forms of money, traditional and recent innovations, based on three criteria: 1) who the issuer is: government or private; 2) what form it takes: physical or digital; and 3) how transactions are settled: centralised or decentralised (Figure 1).

1 Despite an original and potentially promising model, Basis shut down its operations in December 2018.

Figure 1: A taxonomy of money



Source: Bruegel updated from Claeys *et al* (2018). Note: CBDC = central bank digital currency.

Claeys *et al* (2018) discussed the potential of cryptocurrencies (defined as private, digital, decentralised currencies in our taxonomy) to perform the main functions usually attributed to 'money' and the impact that they might have on monetary policy. This analysis showed that cryptocurrencies such as Bitcoin were not yet able to fulfil the three main functions of money (ie to serve as a unit of account, a medium of exchange and a store of value) and that they still looked more like speculative assets rather than money.

The main reason for this is that their inherent volatility, because of, among other things, their inelastic supply, limits their widespread adoption as a unit of account and as a medium of exchange. International currencies including the US dollar and the euro have established track records of providing price stability, which combined with their credible legal status and strong networks of users have given them the benefits of natural monopolies. As a result, Claeys *et al* (2018) did not expect any immediate risk that such cryptocurrencies would challenge central bank currencies, and certainly not the well-established international currencies. It would take a deep crisis of trust in official currencies for their widespread substitution by cryptocurrencies to materialise. In this context, Demertzis and Wolff (2018) considered at the time that there was no immediate need for new regulation, but rather there was an opportunity to learn about what these types of innovations imply in terms of financial risks.

In the meantime, as long as central bank currencies continue to provide the unit-of-account function, central banks' monetary policies should not lose their grip on their economy. Eventually, as a potential competitor to central-bank currencies, cryptocurrencies could even play a positive role by acting as a disciplining device to push central banks to take their price-stability mandates seriously, especially in countries with histories of bad monetary policy.

However, the emergence of a second generation of digital coins in the form stablecoins (ie private digital currencies, not necessarily decentralised, and possibly backed by fiat-currency reserves to ensure stability) issued by global tech giants, provides a different challenge. Through scale alone, these currencies might be more credible competitors to traditional forms of money. This, and in particular Facebook's Libra plan, has acted as a wake-up call for central banks and governments which, afraid of losing their monetary sovereignty, have renewed their interest in both the need for regulation and CBDCs as a potential solution.

In this Policy Contribution, we discuss two aspects of the debate on the future of money: the implications of the rise of global private stablecoins, and the role that public central bank digital currencies (CBDCs) could play in the future.

2 Should we fear the rise of global stablecoins?

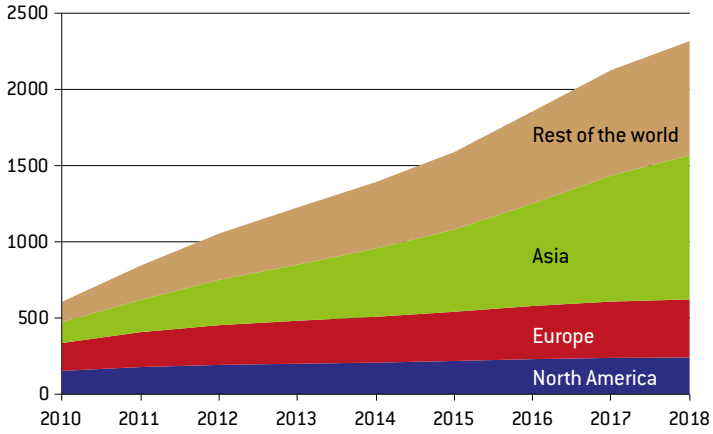
What makes recent stablecoin initiatives, such as Facebook's proposed Libra, more relevant for policymakers than the first-generation of cryptocurrencies is their scale. But beyond scale, there are two other aspects that are different to the first generation: the (more) centralised network and the attempt to reduce volatility in the coins' value – hence the label 'stablecoin'.

2.1 Network effects and global scale

While so far digital currencies have been small-scale (in terms of number of transactions or total market capitalisation[2]), when these initiatives come from tech giants that have access to very large networks of users, they become both systemically relevant and have the potential to exercise monopoly power.

This is in contrast to the first generation of cryptocurrencies, which faced high switching costs because of network effects. It is not obvious why consumers in the euro area would choose to use anything else than the euro, when paying in any other currency, including newly created ones, would be costly and inefficient. But as global tech giants already benefit from very large networks, a stablecoin issued by them will benefit immediately from scale and accessibility, two features that are pivotal for critical uptake of currencies. As Libra could be a stablecoin with the necessary scale to become a global currency contender, we discuss its main features as a way of understanding how global stablecoins in general might work.

Figure 2: Monthly active Facebook users (millions)



Source: Bruegel via Bloomberg.

Almost ten years after its creation, Bitcoin was estimated in 2017 to have 7.1 million owners worldwide[3]. By means of comparison, the active number of users of Facebook (and hence Libra's immediate network size) is, at around 2.5 billion, much larger than the number of people using international currencies such as the euro or even the dollar (Figure 2).

Authorities are thus legitimately concerned that Libra has the necessary scale to become a global currency contender without a clear understanding of what this would mean for

2 See Claeys *et al* (2018) for details

3 See Alex Lielacher (2019) 'How Many People Use Bitcoin in 2019?' *Bitcoin Market Journal*, 11 February, available at https://www.bitcoinmarketjournal.com/how-many-people-use-bitcoin/.

citizens. Bank of England Governor Mark Carney has pointed out[4] that Libra could become "*instantly systemic*" on launch day and should therefore be put under tight regulatory scrutiny. Similarly, Financial Stability Board Chair Randal K. Quarles has highlighted the need to contain the risks that arise from financial innovation and particularly the *"wider use of new types of crypto-assets for retail payment purposes would warrant close scrutiny by authorities to ensure that that they are subject to high standards of regulation"*[5].

The Bank for International Settlements (BIS, 2019) discussed the complex trade-offs that will arise "*between financial stability, competition and data protection*". One such complex case arises from Calibra, the digital wallet on which Libra will be stored. Currently, there are around 200 cryptocurrency wallets[6] via which more than 1 600 cryptocurrencies are exchanged and on which they are stored. Given that Calibra will be bundled with Facebook's ecosystem and made available to all its users, Facebook will potentially have the power to push its customers to use its own digital wallet, just like Amazon had the power to push their Kindle e-book reader to many of its customers that used its other services. The potential for a massive user base can lead to monopoly power for the issuer, which in turn can lead to severe financial vulnerabilities from system failures (either deliberate and fraudulent or simply erroneous).

Furthermore, the Libra Association (2019), the organisation that is planning to control Libra, argues that users that use Calibra to store their Libras will share no information about their financial transactions with other Facebook extensions. However, the most important concern voiced since the Libra announcement in mid-2019 has been distrust about the way Facebook operates, particularly in relation to data privacy and Facebook's global dominance. Wolf (2019), for instance, was very critical of Facebook's continuing failure to appreciate the way it is affecting modern democracies. Libra therefore starts with a sizable trust deficit that could hinder its promised popularity. There will therefore need to be clarity about how and where to regulate this digital wallet.

The European Council and Commission said in November 2019 that "*no global stablecoin arrangement should begin operation in the European Union until the legal, regulatory and oversight challenges and risks have been adequately identified and addressed*"[7]. There are still many unknowns about how digital currencies can challenge our commonly understood notion of money. And if strong network effects and scale amplify those risks, then policymakers need to be particularly cautious.

2.2 From decentralised permissionless, to centralised permissioned

As a first-generation technology, the Bitcoin blockchain was a fully decentralised, permissionless system, with a public ledger available to all network users. While this democratised the process of verification, it came at the expense of time and energy efficiency (Krause and Tolaymat, 2018). If Libra is going to exploit the vast scale that it promises, then these issues will become serious obstacles. That is why Libra will move back to operating in a more centralised system (permissioned blockchain), at least in the initial phase, in which the founding members will be in charge of the validator nodes. This will have the aim of ensuring

4 *Reuters* (2019) 'BoE's Carney says keeping open mind on Facebook's Libra', 18 June, available at https://www.reuters.com/article/us-facebook-crypto-carney/boes-carney-says-keeping-open-mind-on-facebooks-libra-idUSKCN1TJ26A.

5 See 'FSB Chair's letter to G20 Leaders meeting in Osaka', 25 June 2019, available at https://www.fsb.org/2019/06/fsb-chairs-letter-to-g20-leaders-meeting-in-osaka/.

6 A cryptocurrency wallet is a device, physical medium, programme or service that stores the public and/or private keys and can be used to track ownership, receive or spend cryptocurrencies. See for example https://en.wikipedia.org/wiki/Cryptocurrency_wallet and Sarah Hansen (2018) 'Guide To Top Cryptocurrency Exchanges', *Forbes*, 20 June, available at https://www.forbes.com/sites/sarahhansen/2018/06/20/forbes-guide-to-cryptocurrency-exchanges/.

7 *Information from the Presidency*, 6 November 2019, see https://data.consilium.europa.eu/doc/document/ST-13571-2019-INIT/en/pdf.

an optimal balance between effectiveness and security of the system.

Such a centralised system avoids the excess use of natural resources and will be fast to operate. However, centralised systems in the hands of a limited number of association members pose the risk of collusion (Abadi and Brunnermeier, 2019) to the detriment of users.

The Libra Association (2019) has been explicit about the fact that "*an important objective of the Libra Association is to move towards increasing decentralisation over time*". This will only be possible however once new technical solutions provide the power and stability to engage at the scale Libra aspires to. Until this is solved, the Libra Association will be the authority to trust to give permission for Libra transactions. Whether the association will be a trustworthy custodian of the ledger remains to be seen.

2.3 A provider of stable value?

Although popular, Bitcoin's high volatility has so far prevented the cryptocurrency from becoming a credible alternative to traditional money. The rationale behind Libra and other stablecoins is exactly to correct for that, by ensuring stable value.

An essential problem of the first generation of cryptocurrencies is that they are fiat currencies without the explicitly backing of a credible issuer, such as the state

One of the essential problems of the first generation of cryptocurrencies (such as Bitcoin) or even of previous attempts to build a stablecoin (such as Basis) is that they are fiat currencies without the explicitly backing of a credible issuer, such as the state. And just like any other fiat currency, they are inherently vulnerable to changes in beliefs and expectations that can lead to undesirable self-fulfilling inflationary episodes.

Libra, by contrast, will not be a fiat currency but will be backed by reserves composed of a basket of liquid and stable assets (themselves in official credible fiat currencies)[8]. Libra's issuance should work as follows: for any Libra minted, there needs to be a unit of a basket of assets. The Association controlling Libra will decide on the composition of this basket, with the intention to keep its value stable. Authorised resellers would purchase Libra coins from the Association in exchange for assets labelled in credible fiat currencies to fully back the new coins that are added to the reserves. Reserves are supposed to be fully invested in low-risk short-dated interest-bearing assets, the revenues from which will serve to cover operating costs and pay out dividends to the founding members of the Association. Users can request Libras from authorised resellers.

It has been argued that such a set up looks like a currency board. The custodian of the board aims to preserve the value of the basket. It should be compared more correctly to a simple investment fund guaranteeing redemption at par, which should at least in principle make it less vulnerable to self-fulfilling inflationary equilibrium. As long as the Libra Association backs each Libra coin with an identical pool of safe and liquid assets, its value should be stable.

However, at some point the Libra Association might be tempted to renege on its promise and to not back each coin fully, or to change the composition of the pool of assets in order to increase its own profits. For the moment, we can only assume that the Association's motive is profit maximisation, which is different to any monetary policy authority's objective.

The problem arises because there might be a conflict between maintaining a stable price for Libra (which implies the issuer honouring the initial pledge at any price) and profit maximisation (which gives the issuer the incentive to deviate from full collateralisation and a stable basket). As discussed by Chang and Velasco (2019), the incentives are wrong, and nothing currently would stop the Libra Association from changing the rules on redeemability and the degree of collateralisation. On the contrary, the Libra Association (2019) mentions that the portfolio backing Libra can be adjusted at will by the association[9]. Given that seigniorage profits go to the association and not the users, there is a clear incentive to maximise these

8 Although important details are not described in the Libra Association white paper (Libra Association, 2019).

9 The Libra Association white paper explicitly mentions that *"the association can change the reserve basket"* (Libra Association, 2019)

profits either by changing the weights, by investing in riskier and less liquid assets[10], or even by moving to partial backing. Eventually, the Libra Association could even drop the backing entirely and become a fiat currency to enjoy full seigniorage profits. But at that point, the Libra would become a regular fiat cryptocurrency (which means it will be subject to self-fulfilling crises) and would no longer be a stablecoin.

The value of Libra will depend crucially on the Libra Association's commitment to keep it stable. But unlike central banks that have a public function and are accountable to citizens to fulfil their stability mandate, the Association is not bound by a similar commitment, but pursues profit maximisation.

3 Should central banks issue their own digital currencies?

3.1 What are CBDCs?

There is no universally agreed definition of what constitutes a central bank digital currency (CBDC), but the term has become commonly used[11] to designate any form of central bank digital fiat liability that is accessible to all economic agents.

As our taxonomy shows (Figure 1), CBDCs could take various forms. First, a CBDC could be issued in a centralised fashion though accounts at the central banks. This actually already exists in the form of reserves held by commercial banks at the central bank. The novelty of a CBDC would be that it would allow the general public to maintain directly deposit accounts at central banks, as they do at commercial banks. Second, a CBDC could also be issued in a decentralised fashion as a crypto-CBDC based on distributed ledger technology (DLT), which, once issued by the central bank, could then be transferred from one individual to another independently from the central bank. Finally, a CBDC could also take a hybrid physical-digital form with pre-paid cards or mobile wallets containing digital currencies.

We consider the last two versions of CBDCs less relevant for different reasons: 1) for crypto-CBDCs, DLT is an immature technology that is currently less efficient, slower and much more energy-intensive than a centralised system. The only advantage it offers is anonymity (which is valuable for individuals, but would probably be considered highly undesirable by monetary authorities, as it could facilitate illegal activities); 2) cards/wallets meanwhile would have properties very similar to cash and are thus not worth analysing in more detail.

We therefore focus on the more promising version of CBDC: deposit accounts at the central bank available to all.

3.2 What would be the purpose of CBDCs?

Interest in CBDCs on the part of authorities is partly motivated by the popularity of private digital currencies that could challenge the role of official currencies. Providing digital currencies issued by the central bank could possibly make private digital currencies less attractive and slow down their adoption. Allowing households and companies to open accounts at the central bank would give them direct access to efficient and instantaneous retail payment systems – such as the Target Instant Payment Settlement service that European banks can already use to exchange reserves. This would remove one reason for switching to a private digital currency with a better payment system. But there are other reasons why introducing CBDCs could be useful.

10 This is particularly true in the current low rate environment in which safe assets might have negative yields in some countries.

11 See for instance Meaning *et al* (2018) for a detailed discussion on the definition of a CBDC.

One important reason for central banks to provide CBDCs to citizens is that if cash is scarce or even disappears, citizens will lose direct access to sovereign money, the ultimate safe asset (as long as the central bank implements the necessary policies to maintain the value of the currency, ie low inflation and stable foreign exchange rates). Should cash disappear, citizens would only have access to bank deposits, which are not as safe, to store value. Deposits above a certain threshold (€100,000 in the euro area) are uninsured, and even below this threshold, there is the possibility of losing access to savings even for a few days or weeks.

One important reason for central banks to provide digital currencies to citizens is that if cash is scarce or even disappears, citizens will lose direct access to sovereign money

In addition, the lack of direct access to the central bank currency could lead to a moral-hazard problem (Brunnermeier *et al*, 2019). If banks do not 'fear' convertibility of their deposits into central bank currency, they could lose some of the incentives (even though regulation would still be a major disciplining device) to manage well their solvency and liquidity risks. *In extremis*, if deposits do not have to be converted into a common currency, deposits from different commercial banks could at some point become imperfect substitutes for one another. In this case, there would be 'exchange rates' between them, depending on the trustworthiness of the particular issuer, as it was the case during the US free banking era in the nineteenth century. CBDCs would solve this problem by allowing households to access central bank currency in a new form, and thus restore the convertibility threat for banks.

The introduction of CBDCs could also strengthen monetary policy by transmitting it directly to the general public. Changes in policy rates would be transmitted directly to CBDC depositors, in contrast to today's situation, in which interest paid by commercial banks on deposits are relatively sticky[12]. This also means that CBDCs would make unconventional policies easier to implement.

First, as long as the CBDC is interest-bearing, it could help relax further the zero lower bound constraint because interest rates applied to the CBDC could be negative (unlike for banknotes). The abolition of cash would make this effect stronger. However, abolishing cash might be not desirable, because cash could still be useful at least as a back-up for a CBDC in case of a technical failure or cyberattack, and for privacy reasons. But even if cash continues to exist, as long as its use is inconvenient (which would be even more the case if CBDC were introduced) and its storage costly, implementing negative rates on CBDC holdings would be possible.

Second, CBDCs could reduce one of the potential side effects of quantitative easing (QE), especially when asset purchases are coupled with negative rates. Currently, central bank bond purchases from non-bank institutions create additional reserves that are inevitably held by the commercial banks that host the accounts of the non-bank sellers in the deposit facility of the central bank, because non-banks cannot hold reserves directly. On aggregate, this means that banks cannot control fully the quantity of reserves they want to hold. When rates are negative, as they are at time of writing, this becomes costly for banks and might result in potential side effects such as increased rates for lending to the real economy. If non-banks could hold CBDCs directly, QE would not affect the banking sector negatively.

Finally, provided the concept of helicopter money is an acceptable monetary policy tool, it would be easier to implement if all citizens had accounts at the central bank, because the central bank would be able to credit their accounts with CBDC units.

3.3 The potential risks of CBDCs

The introduction of CBDCs is sufficiently disruptive that it could pose a number of risks.

First, one the main fears of policymakers (see, for example, Coeuré, 2018) is that CBDCs will lead to cyclical bank runs. If households and companies have access to central-bank reserves, there is a risk of a flight-to-safety from commercial-bank deposits to CBDCs in each economic downturn. This type of run from banks to the central bank happened in the 1930s during the Great Depression in France, when it was possible for non-banks to maintain

12 In the euro area, before the crisis when policy rates were high, interest on bank deposits was significantly lower, while now the opposite is true, as shown by Bindseil (2019).

accounts at the Banque de France (Baubeau *et al*, 2018). Bank runs are already possible today by withdrawing cash or transferring deposits between banks[13], but the main concern is that digital bank runs towards CBDCs would be easier and happen more rapidly than traditional bank runs.

In addition to this cyclical financial stability risk, another serious, more structural, risk would be the reduction of financial intermediation. Banks would compete with the central bank to hold deposits. It is very difficult to predict what would happen, because it would depend on the particular properties of the CBDC introduced and on the behaviour of the central bank after its introduction, but this could lead to different outcomes (as explained, for instance, by Stevens, 2018).

A first possible outcome could be an evolution towards a financial system characterised by narrow(er) banks that are less reliant on deposits. Banks could either offer higher returns to depositors to try to retain their deposit base, or they could rely on other sources of financing. This would have profound implications, both potentially positive and negative. The extra competition from CBDCs would reduce the monopoly power of the banking sector and allow depositors to obtain higher returns from their deposits. For banks, by definition, the effect would be the opposite because they could be forced to rely on more expensive and potentially less stable sources of funding, such as the wholesale market[14]. This new banking model would make banks look more like investment funds, which could be less stable thus requiring an adjustment of the financial safety net. The need for traditional deposit insurance would be reduced because deposits could be kept safely in the form of CBDCs. However, if we consider that the maturity transformation provided by banks is a valuable service, then it needs to be protected from liquidity risk. Either insurance cover for banks' short-term liabilities would have to be broadened to include wholesale funding, with all the risks that this would entail (but the alternative would be frequent 'wholesale runs' such as those that happened during the last financial crisis), or regulation would have to be toughened significantly to avoid any maturity mismatch on banks' balance sheets, for example by forcing them to be financed mainly through equity and long-term debt.

Another possibility would be a tightening of credit conditions by banks if they are unable to retain depositors or attract new sources of funding. This tightening would lead to less lending and/or at a higher price, which would, all else being equal, result in a significant drag on investment and ultimately on economic activity.

3.4 How could central banks minimise these risks?

Policymakers have several tools at their disposal, should bank runs become more frequent as a result of the introduction of CBDCs. First, deposit insurance offsets the risk of runs when deposits are within the guaranteed amount. Second, the central bank should play its crucial role of lender of last resort by providing liquidity through loans to the banks that suffer runs, as long as they are solvent. The financial instability episodes in France in the 1930s discussed in Baubeau *et al* (2018) showed that the main problem was not the bank runs (towards the central bank or towards other saving institutions) *per se* but rather the strong "*gold standard mentality*" prevailing at the Banque de France at the time. This mentality prevented the central bank from playing its role lender of last resort and from replacing the shortfall in deposits held at commercial banks with central bank loans to avoid a strong credit crunch.

Central banks would also have various instruments to counter the risk of structural finan-

13 Actually, in France in the 1930s, the run from commercial banks towards safer savings institutions (*caisses d'épargne*) was even more significant than that towards central bank accounts. Similarly, Bindseil (2019) showed that during the European financial crisis (2008-12) transferring deposits from what were perceived as weak banks to stronger banks was a much more important form of run than conversion of bank deposits into cash.

14 This could also have the additional side effect of cutting banks off from their client base in terms of selling them other services generally bundled with deposit holding, including mortgages and overdraft facilities. Banks could also be stopped from acting as intermediaries between their clients and investment funds, insurance companies, etc, which would reduce the fees they receive on such activities and thus their overall profits.

cial disintermediation that could happen as a result of the introduction of CBDC, if it was considered an unfavourable evolution that could endanger price or financial stability. The central bank's reaction would thus vary depending on the magnitude of the problem.

In moderate cases, such as if the quantity of credit provided by banks is not significantly affected, but banks ask for higher lending interest rates (for example because they need to increase the returns paid to depositors to retain them), the central bank would have to lower its policy rates structurally to offset this effect and maintain financial conditions at the same (presumably adequate) level, all else being equal. In normal times this should not be a particular problem, but at a time when the effective lower bound is binding, it might be problematic, and might involve the increased use of unconventional monetary policies.

If disintermediation becomes a more significant issue and there is clear downward pressure on bank credit availability, the main way for the central bank to offset this trend would be to provide structurally more funding to the commercial banks to replace the lost deposits, so that they can maintain the same level of financing to the economy. This means the central bank balance sheet would have to become structurally much bigger[15] and also more exposed to the banking sector than has traditionally been the case.

The debate on the optimal size of central banks' balance sheets has not so far been settled[16]. However, the two main risks for central banks in increasing massively their refinancing operations would be:

- First, the central bank would take more risks onto its balance sheet because it would be more exposed to the risks faced by banks: in a way, the central bank would become itself a financial intermediary between depositors that would hold CBDCs and the commercial banks.
- Second, this means that the central bank would be involved more directly in the credit allocation process. In order to be able to provide a much greater amount of refinancing to the banks, the central bank might have to adjust significantly its collateral framework so that banks are able to access its operations at a sufficient scale. Central banks' decisions on collateral eligibility and haircuts are often perceived as purely technical decisions, but they are not always as neutral as they seem (Claeys and Goncalves Raposo, 2018). In particular, deciding to include new asset classes as eligible collateral (in order to increase the pool so that banks can obtain more refinancing) could have some powerful effects on credit allocation by the banks. The main advantage is that this would give the central bank greater control over the macroeconomic situation, but the drawback would be that it could potentially make the overall allocation of resources in the economy less efficient, and could also have some distributional effects (that should preferably be in the hands of citizens or elected officials).

To avoid the extreme situation in which deposit accounts held at the central bank would fully crowd out bank deposits, the central bank could also try to carefully calibrate the properties of CBDCs in order to reduce *ex ante* the incentive to use a CBDC as a main store of value. The simplest way to do this would be through its remuneration system. CBDC accounts should be remunerated at a rate below other policy rates (which could both reduce the structural disintermediation risk and the frequency of bank runs). However, the returns from CBDCs should not be so disadvantageous that their use as a medium of exchange becomes unattractive. In particular, when policy rates are negative, a portion of CBDC holdings could be exempted from the negative rates to avoid the negative impact on small savers (and also so that households are not given a reason to switch back to holding cash). Bindseil (2019)

15 Bindseil (2019) estimated that in the euro area, *in extremis*, if all bank deposits needed to be replaced by the European Central Bank, the increase of central bank credit to commercial banks would be €4 trillion, or a doubling of the size of the ECB's balance sheet.

16 See section 4.1 in Claeys and Demertzis (2017) for a summary of this debate.

proposed a very practical system to put that in place with a two-tier remuneration system for CBDCs: below a threshold of €3,500, CBDC holdings would be remunerated at the maximum level between the deposit rate and 0, and above that threshold CBDC holdings would be remunerated at the deposit rate minus 200 basis points. These numbers are indicative and the central bank would need to experiment to find the right balance, so that it incentivises the use of CBDCs as a medium of exchange, and gives access to everyone to the ultimate safe asset when necessary (especially if cash disappears), but disincentivises use of these accounts as a main store of value in normal times.

3.5 Who else could provide an equivalent to CBDCs?

Finally, an alternative solution to give the general public access to digital central bank liabilities would be not to provide it directly through a CBDC, but to do it indirectly through what could be considered 'full-reserve banks' (sometimes also referred to as 'narrow banks'[17]).

The idea, as described for example by Adrian and Mancini-Griffoli (2019), would be to allow new entities to hold reserve balances at the central bank, subject to some specific conditions. These entities would have a very particular balance sheet with only central bank reserves as assets (they would not give credit, nor buy any other type of asset) and only simple deposits as liabilities (they probably would not need to hold much capital, if any at all, given the absence of risk from their portfolios). The entity would pass the remuneration of central bank reserves to depositors and earn a small fee for the service provided.

This system would allow households and companies to hold indirectly the central bank currency and would have two additional advantages. First, it would allow central banks to focus on their mandates and not use their resources to provide direct services to their new customers (which could also have some negative reputational consequences for central banks if not handled properly). If all households and companies in the euro area opened CBDC accounts at the ECB, the number of accounts in the Eurosystem would grow from around 10,000 to more than 500 million (Bindseil, 2019). Second, as argued by Bordo and Levin (2019), this would help prevent a conflict of interest for the central bank. Competition from a CBDC could be considered unfair by banks given the crucial role central banks play in the organisation of the banking sector (for instance as a supervisor, among other functions). For all these reasons, privately-managed alternatives to CBDCs should not be discarded by central banks. Rather, they should be considered as one way to provide CBDCs (which would represent an acceptable form of stablecoin labelled in the central bank unit of account) to the general public.

REFERENCES

Abadi, J. and M. Brunnermeier (2019) 'Blockchain Economics', mimeo, 31 August, available at https://scholar.princeton.edu/sites/default/files/markus/files/blockchain_paper_v7a.pdf

Adrian, T. and T. Mancini-Griffoli (2019) 'The Rise of Digital Money', *IMF Fintech Notes* No. 19/001, International Monetary Fund, available at https://www.imf.org/en/Publications/fintech-notes/Issues/2019/07/12/The-Rise-of-Digital-Money-47097

Baubeau, P., E. Monnet, A. Riva and S. Ungaro (2018) 'Flight-to-Safety and the Credit Crunch: A New History of the Banking Crisis in France During the Great Depression', *Banque de France Working Paper* No. 698, available at: https://ssrn.com/abstract=3285119

17 This denomination can however be confusing given that the term 'narrow bank' is also used to describe banks that look more like investment funds, as described previously.

Bindseil, U. (2019) 'Central Bank Digital Currency – Financial System Implications and Control', mimeo, 30 July, available at: https://ssrn.com/abstract=3385283

BIS (2019) 'Big Tech in Finance: Opportunities and Risks', in *BIS Annual Economic Report*, Bank for International Settlements, available at https://www.bis.org/publ/arpdf/ar2019e3.htm

Bordo, M. and A. T. Levin (2019) 'Improving the monetary regime: The case for U.S. digital cash', *Cato Journal* 39(1): 383-405, available at https://www.cato.org/sites/cato.org/files/serials/files/cato-journal/2019/5/cj-v39n2-9.pdf

Brunnermeier, M.K., H. James and J.P. Landau (2019) 'The digitalization of money', *NBER Working Paper* No. 26300, National Bureau of Economic Research, available at https://www.nber.org/papers/w26300

Chang, R. and A. Velasco (2019) 'Will Facebook's Libra turn into a cancer?' *Project Syndicate*, 16 July, available at https://www.project-syndicate.org/commentary/facebook-libra-becomes-cancer-by-andres-velasco-and-roberto-chang-2019-07

Claeys, G. and M. Demertzis (2017) 'How should the European Central Bank 'normalise' its monetary policy?' *Policy Contribution* 2017/31, Bruegel, available at https://bruegel.org/2017/11/how-should-the-european-central-bank-normalise-its-monetary-policy/

Claeys, G., M. Demertzis and K. Efstathiou (2018) 'Cryptocurrencies and Monetary Policy', *Policy Contribution* 2018/10, Bruegel, available at https://bruegel.org/2018/06/cryptocurrencies-and-monetary-policy/

Claeys, G. and I. Goncalves Raposo (2018) 'Is the ECB collateral framework compromising the safe-asset status of euro-area sovereign bonds?' *Bruegel Blog*, 8 June, available at https://bruegel.org/2018/06/is-the-ecb-collateral-framework-compromising-the-safe-asset-status-of-euro-area-sovereign-bonds/

Cœuré, B. (2018) 'The future of central bank money', speech at the International Center for Monetary and Banking Studies, Geneva, 14 May, available at https://www.ecb.europa.eu/press/key/date/2018/html/ecb.sp180514_4.en.html

Demertzis, M. and G. Wolff (2018) 'The economic potential and risks of crypto-assets: is a regulatory framework needed?' *Policy Contribution* 2018/14, Bruegel, available at http://bruegel.org/wp-content/uploads/2018/09/PC-14_2018.pdf

Krause, M.J. and T. Tolaymat (2018) 'Quantification of energy and carbon costs for mining cryptocurrencies', *Nature Sustain* 1: 711–718, available at https://www.nature.com/articles/s41893-018-0152-7

Libra Association (2019) 'Official Libra White Paper', available at https://libra.org/en-US/white-paper

Meaning, J., B. Dyson, J. Barker and E. Clayton (2018) 'Broadening narrow money: monetary policy with a central bank digital currency', *Staff Working Paper* No. 724, Bank of England, available at https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2018/broadening-narrow-money-monetary-policy-with-a-central-bank-digital-currency.pdf

Stevens, A. (2017) 'Digital currencies: Threats and opportunities for monetary policy', *NBB Economic Review* 1 (June): 79-92, National Bank of Belgium, available at https://www.nbb.be/doc/ts/publications/economicreview/2017/ecorevi2017_h5.pdf

Wolf, M. (2019) 'Facebook enters dangerous waters with Libra cryptocurrency', *Financial Times*, 25 June, available at https://www.ft.com/content/07c05fba-b1c4-11e7-a398-73d59db9e399.