
Money We Trust

Designing Cash's Digital Counterpart



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Executive Summary

The fragility of the financial system, combined with technological innovation and the decline in cash use, is transforming the conversation around the future of money. Central banks and governments are starting to rethink the role they have in managing a country's currency. Fundamentally, our public institutions must protect people's trust in the monetary system by ensuring access to a public means of payment, which is especially important in times of crisis. A Central Bank Digital Currency (CBDC) offers a way to maintain this trust by averting the privatisation of money.

By introducing a digital counterpart to cash, central banks can protect two essential functions of money - as a medium of exchange and store of value - from commercial banks' reckless pursuit of profit.

The central barrier to implementing a CBDC is designing it so that it does not provoke bank runs or disintermediate the banking sector, and in doing so cause financial instability. In this paper we explore design features of a CBDC that would minimise disruption to the current system, whilst ensuring it constitutes a versatile tool which can be used to pursue socioeconomic objectives that are compatible with the existing monetary policy objectives of central banks. As well as ensuring a public means of payment, introducing a CBDC could increase financial inclusion, increase financial stability, and support the implementation of unconventional monetary policies such as helicopter money.

This paper is the first of two parts. In a follow up paper we will explore the more radical monetary actions CBDC could enable, in response to the intersecting challenges facing economies and democracies.

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1 Introduction

All of the world's major central banks have begun to examine the potential advantages and disadvantages of developing a new monetary instrument: central bank digital currency (CBDC). Although this new form of money has the capacity to significantly enhance monetary systems by maintaining an anchor of trust for the monetary system, improving financial inclusion, and making the private banking sector more competitive, it has also been heavily criticised for the risks it could pose to financial stability, specifically the risks of an unintended and disorderly disintermediation of the private banking sector and bank runs. However, this criticism has primarily been directed at CBDC in the abstract, rather than at specific design proposals. In this report, we propose a CBDC design that would minimise the potential risks to financial stability.

This report assesses both the benefits of CBDCs and the main implementation risks, and explores how such risks might be mitigated by enabling more precise central bank control over the CBDC's impact on the financial system. We conclude that it is paramount that this new monetary instrument is versatile and highly controllable if the private banking sector is not to face the risk of bank runs and unwarranted disintermediation of its current functions. Controllability should allow monetary authorities to determine the portion of the market share of monetary instruments that a CBDC would occupy, and therefore the degree on which it will infringe on commercial banks' functions, based on how competitive it is in relation to bank deposits. The CBDC design specified in this report would achieve the required degree of controllability by affecting the amount of CBDC that is desirable to hold through the application of an interest rate, and by creating separate tiers of remuneration.

The report is organised as follows: Section 2 goes over some of the potential benefits of a CBDC, highlighting that different economies have different priorities, needs and structures that determine the specific CBDC design to best meet their needs. Section 3 goes over the main components of a monetary system and examines the monetary instruments currently in circulation. This sets the foundation for our analysis of how introducing a CBDC could create risks for the current system, and what the determinants are for proposing specific CBDC design features. Section 4 narrows down the potential risks faced by the banking sector - bank runs and disintermediation - and identifies design features that would mitigate these risks. It is concluded that control over how competitive a CBDC is versus bank deposits in the provision of store-of-value and medium-of-exchange functions is critical, and the level of a CBDC's competitiveness is most clearly indicated by the market share the CBDC occupies. With that in mind, Section 5 goes over the design features and their implications, and proposes a specification. Section 6 presents our complete proposal for the design of a CBDC, which is roughly in line with that of Bindseil (2019). We then examine the basic mechanics of the proposed CBDC's controllability, and outline how a safe implementation of it could greatly benefit the monetary system and the economy as a whole. We identify the specific benefits that preventing further privatisation of the monetary system would provide, including increasing market discipline for commercial banks and increasing the capacity for monetary policy to be effective in times of crisis. Finally, we argue that protecting the payments system, ensuring competition in the provision of payment services (by ensuring the existence of both private and public means of payment), and promoting financial inclusion can all be achieved with this CBDC proposal.

2 Overview of the potential of CBDCs

In *'Digital Cash: Why Central Banks Should Start Issuing Electronic Money'* (Dyson and Hodgson, 2016), Positive Money highlighted the reasons for central banks to consider issuing digital currency, which included:

- Increasing the toolkit available for monetary policy by making policies such as helicopter money or 'QE for people'¹ easier to implement and potentially overcoming the 'zero lower bound' of conventional monetary policy.
- Increasing competition and promoting innovation in the payments system.
- Increasing financial stability by providing a risk-free alternative to bank deposits.
- Further increasing financial stability by reducing the concentration of liquidity risk and credit risk within the payment system.
- Allowing the state to recapture a portion of seigniorage.²
- Addressing the decline of physical cash.
- Increasing financial inclusion.

To the above we can also add:

- Increasing market discipline for the banking sector by reducing moral hazard and increasing competition for payments services.
- Address the national security and other risks posed by a fully privatised payment system.

Many of these reasons for a CBDC featured in a survey the Bank of International Settlements (BIS) conducted with 63 central banks around the world, representing 90% of global economic output (Barontini and Holden, 2019, p. 6), where they ranked potential motivations for issuing a general purpose or wholesale CBDC³ (ibid., p. 9):

Figure 1: Motivations for issuing CBDCs, ranked in order of importance by central banks

Score*

General-purpose CBDCs



Wholesale CBDCs



*The score is calculated as an average of the options: "Not so important" (1), "Somewhat important" (2), "Important" (3) and "Very important" (4).

Source: Central bank survey on CBDCs

¹ QE for People is a term used to describe a number of proposals that focus on central banks using money creation to get money more directly to households, including some proposals to finance governments directly (Van Lerven, 2016).

² Seigniorage is the profit made by creating new money. For the issuance of cash by the government, this is the difference between the face value of notes and coins and their production costs. For bank deposits, this is the net profit banks make from the issuance of loans.

³ Access to a CBDC can be limited based on the type of agent, sector or the purpose that it is used for, or it can be universally accessible (Meaning et. al., 2018, p. 4). In the literature, the terminology often used is that of 'general purpose' versus 'wholesale' CBDC. However, in this paper we will refer to access as 'general purpose' versus 'restricted'.

The ranking of motivations differs for central banks in developed⁴ economies which emphasise the potential to increase safety and financial stability. For emerging market economies, domestic payment efficiency and financial inclusion are seen as more important.

Individual countries have differences in the motivations for researching and potentially implementing CBDCs, along with their respective level of urgency to do so. For example, the use of cash in Sweden has declined dramatically over the last decade. This has led the Riksbank⁵ to question what its role would be in a cashless society and express grave concerns about the prospect of a fully private payments system:

“Firstly, the general public would no longer have access to what we call central bank money, which has lower credit and liquidity risk than private bank money. Historically, the possibility to convert money in a private bank to state issued banknotes has been considered fundamental to guaranteeing that confidence in private money is upheld. Secondly, the vulnerability of the payment system will increase if the use of cash falls so low that it no longer functions as a practically usable alternative in the event of serious and prolonged disruptions” (Bank of Sweden, 2018, pp.10-11).

Furthermore, the Riksbank outlines what inactivity on their part could mean for the general public which include (ibid., p.12):

1. That all their citizens will be forced to have an account with commercial banks.
2. That it will be easier for monopolies in the payment market to be formed, and give payment service providers the upper hand when deciding how much to charge for their services.⁶
3. The payment market and its development will predominantly fall into the hands of private agents who are primarily driven by the profit motive, whereas the state has wider socioeconomic considerations.
4. The fundamental security of being able to access cash, especially in crisis, will cease to exist.

The Central Bank of Uruguay on the other hand, successfully completed a CBDC test trial in 2018 as “part of a wider governmental financial inclusion programme... aiming for greater access, labour market formalization and payment system efficiency” (Barontini and Holden, 2019, p.4).

According to the UN, “one of virtual currency’s most promising uses for sustainable development is financial inclusion”. In India approximately 65% of people do not have bank accounts, whereas in many Central Asian countries that percentage rises to 95% (UN-ESCAP, 2017, pp.1-2).

These motivations echo a speech by Christine Lagarde - then IMF Managing Director and current President of the ECB - who listed financial inclusion, security, consumer protection, privacy and the potential to offer “a more level playing field for competition and a platform for innovation” (Lagarde, 2018, p. 7) as benefits of CBDCs.

It is evident that there are a number of possible benefits, priorities and reasons behind the potential introduction of CBDCs that vary depending on the needs, structure and realities in different economic areas. One of the clearest distinctions is that between developed and emerging markets, but even amongst developed economies there can be differences.

Nevertheless, all these potential benefits need to be weighed against the potential risks. The most frequently mentioned in the literature are those of disintermediation of the private banking sector and risks to financial stability, either due to CBDCs facilitating bank runs in times of crisis or leading to a decline in bank profitability (Carney, 2018, p.13, and CPMI, 2018, pp.15-16).

⁴The terms ‘developing’ and ‘developed’ are used in much of the data we reference, but we note that these terms generally lack formal definition and are increasingly considered problematic generalisations, as they fail to correlate with any specific differences between the countries they refer to.

⁵Riksbank is the central bank of Sweden, the oldest central bank in the world. More information is available at: <https://www.riksbank.se/en-gb/about-the-riksbank/history/>

⁶The existence of cash limits the rents payment services providers can levy on society for their services as a competitor with the lowest price/free service provider.

In 2019, the Official Monetary and Financial Institutions Forum (OMFIF) and IBM surveyed 23 central banks (10 in emerging market economies, and 13 in advanced economies) about the potential risks of introducing CBDCs. They found that 82% agreed that “their greatest financial stability concern from CBDC implementation was the risk of digital bank runs happening at a higher speed than ever before” (p.30). In addition, some do not see the added value a CBDC could bring, or believe that these risks outweigh the benefits (Bank of Denmark, 2017, p.1). These risks are fully addressed in section 4.

The implications of a CBDC will be determined by the design of this new money instrument. The features that are analysed as part of this report are (CPMI, 2018, pp.5-7):

1. Accessibility: how wide should access to this instrument be? A universal access or ‘general purpose’ CBDC would offer the widest access, allowing all members of society to hold it. A limited purpose or ‘wholesale’ version would see only certain economic agents able to hold and transact in CBDC.

2. The question of form: should the CBDC be token-based or account-based? How should the underlying settlement mechanism function?

3. Interest rate: should it have the capacity to bear interest or not?

4. Limits or caps: should limits or caps be placed on transfers and/or holding amounts?

5. Anonymity: what level of anonymity should be afforded to this new monetary instrument?

6. Convertibility to other monetary instruments and issuance: how does it enter and exit circulation?

The potential benefits and dangers of introducing a CBDC vary from economy to economy, as will the needs the CBDC should be optimised to meet. These considerations will shape the CBDC design choices made by different central banks and governments. Their decisions should also depend on the existing structures in each economy. In the words of Koning (2018, p.6): “There is no standard toolkit- every domestic economy could have separate motivations and design considerations.”

Throughout this report, when examples need to be considered in the context of a particular economy, we will assume that of a developed country (more specifically, the UK). References will be made to other economies as needed.

3 The monetary system

The monetary system is the foundation of any modern economy. Paramount to this foundation is trust in it (Borio, 2019, p. 18). One useful definition of the monetary system is “money plus the transfer mechanisms to execute payments” (Ibid., 2019, p.1). In addition to the above definition, we must consider the “system by which an economy is provided with money” (Black et al, 2013, Oxford dictionary of economics, p. 267). Thus there are three key components to a monetary system: the instruments which constitute money, the way these enter circulation, and the infrastructure which allows them to be transferred in order to settle transactions.

All these components, the parts that constitute them and their interactions could be affected by the introduction of a CBDC. If and how they are affected will be determined by how competitive the chosen CBDC is in relation to existing monetary instruments in circulation.

3.1 Monetary instruments: functions and designs

“...an economy has a number of different types of money: everyone can create money; the problem is to get it accepted.”

- Minsky (1986, p. 255)

Architecturally, monetary systems “have [traditionally] been organized around an anchor” (Brunnermeier and James, 2019, pp.3-4). Today, that anchor is the government and government-issued money in the form of physical cash⁷.

However, government issued money only constitutes a very small part of money in most economies. The majority of money takes the form of commercial bank deposits. Then there are central bank reserves (CBRs) to which the public does not have access. They are issued by the central bank, and used by banks to settle transactions that happen with bank deposits. In this way, CBRs act as an anchor for bank deposit transactions.

Functions of money and the main monetary instruments:

Money has 3 key functions⁸ (Ryan-Collins et. al., 2016, p.29):

- **Unit of account:** It is the unit on which goods and services are priced allowing us to understand their relative worth.⁹
- **Medium of exchange:** It allows us to transact through its transfer.
- **Store of value:** It allows for purchasing power to be retained and transferred to the future.

For the purposes of this report one more function which money performs will be made explicit and listed separately, which happens on a societal level: to generate trust. Although this function is implicit in the unit of account function, it will be referred to explicitly due to its fundamental importance. Money requires trust to perform all the functions above and it also creates the trust that is necessary for a monetary system to exist. This trust is critical for the conduct of exchange in goods and services which allows complex communities to operate on a daily basis.¹⁰

In the current monetary system there are three main types of money (Bjerg, 2017 pp.14-16): cash (which is accessible to everyone in an economy), bank deposits (which are accessible to those who have bank accounts), and CBRs (which are only available to certain financial institutions that can hold accounts at the central bank, such as commercial banks).

Cash

Cash is the most basic form of money and has a physical presence in either notes or coins. It functions as the anchor of the entire monetary system, and plays a vital role in establishing the trust such a system requires, as it is the most ‘liquid and risk-free asset in the economy’ that the public has access to (Rule, 2015, p.10). As a result, it functions as a ‘run to’ asset in times of crisis.¹¹ Its basic design features are:

- **Access:** the general public has access: anyone can hold cash. It is available either through the exchange of goods and services, or on demand from account holders to commercial banks (and demands from commercial banks to the central bank).
- **Form of monetary instrument:** It is token based, i.e. what matters is the validity of the instrument itself, with the identity of the transacting parties being irrelevant.

⁷In the past, gold has acted as the anchor.

⁸The authors cited mention four functions, including “means of making final payment or settlement”, but highlight that this function is not always mentioned as a separate function due to its close relation to that of unit of account.

⁹Arguably, “the unit of account is not a function of money: it is one of the characteristics of a monetary system; the other one is the existence of monetary instruments” (Tymoigne, 2014, p.12)

¹⁰Here it is worth quoting Borio’s (2019, p.5) footnote 12 in full: “...if trust was perfect, there would be no need for settlement: credit would do. Tellingly, the term ‘credit’ comes from the Latin credere, meaning ‘to believe’ or ‘to trust’. Perfect trust might conceivably exist in the smallest and most tightly knit of communities: members might have the assurance that all obligations will be honored. But in even slightly more complex societies, generating the necessary trust requires a more elaborate institutional technology.”

¹¹Other such assets could be bonds or gold, which can also function as a safe haven when trust in fiat money diminishes.

- **Transaction system:** decentralised - transactions happen through the physical transfer of funds between parties and are cleared amongst them. This leads to a high degree of anonymity.
- **Interest rate:** It does not bear interest and cannot have a negative interest rate applied to it.
- **Limits or caps:** There are no actual limits on the amount of cash one can hold but there are serious space and security considerations.
- **Issuance and seigniorage:** Reactively issued by the central bank¹² in response to public demand via commercial banks. The motivation behind the issuance of cash is to maintain trust in the monetary system and facilitate exchange.
- **Convertibility to other monetary instruments:** convertible to bank deposits, as cash is deposited in commercial bank accounts.

In terms of how it performs its functions as a monetary instrument, the usage of cash has been significantly challenged by technological innovation. More specifically:

- **Store of value:** due to its physical presence and the liabilities this creates in terms of security and space it cannot perform this function as competitively as bank deposits. Furthermore, the fact that it cannot bear interest makes it unattractive as an instrument for savings and more exposed to inflation. However, it does remain a useful way to store value for modest amounts or money obtained through any kind of illicit activity.
- **Medium of exchange:** This is perhaps where most recent technological innovations have taken the gravest toll in cash's competitiveness, due to the increasing ease with which bank deposits can be transacted. It is free to use, but there are costs associated with handling cash for businesses.
- **Unit of account:** Although the current anchor of the monetary system, it could in theory be completely replaced by private monetary instruments. The other form of state issued money, central bank reserves, would then provide a publicly maintained foundation for a privatised payments system.
- **Generation of trust:** This is a pivotal role which cannot, as things currently stand, be replaced by private monetary instruments or central bank reserves. CBRs are not accessible to the wider public, and commercial bank deposits would need even more state guarantees, with further implicit subsidies to the private banking sector to approach the degree of trust afforded to cash. Finally, the fact that it does not require technology or electricity to be exchanged makes it a critical backup transaction system for the economy.

Commercial Bank Deposits

Commercial bank deposits account for the vast majority of monetary instruments in circulation in any given modern economy. They are intangible as they are simply accounting entries in the ledgers of commercial banks. Their basic design features are:

- **Access:** Anyone who is eligible for and able to set up a bank account.
- **Form of monetary instrument:** It is an account-based monetary instrument, thus validation of account holders' identities is required for a transaction to take place. It therefore offers a smaller degree of anonymity compared to cash.
- **Transaction system:** It is a centralised system and transactions happen through trusted intermediaries: the banks where the accounts are held. When a transaction happens between account holders of the same bank, it can be cleared without the use of reserves. When transactions happen with account holders in different banks, they are summed, netted and the outstanding balances are cleared in central bank reserves (Bank of England Red book, 2015, p.4). Thus, central bank reserves serve as an anchor for this transaction system.
- **Interest rate:** Deposits held in commercial banks have traditionally been remunerated in order to attract depositors. This remuneration is different depending on the type of deposit, with interest rates negatively correlated with the ability to access the funds in the account. Sight deposits are accessible on demand, and have lower interest rates, whereas time deposits have some restrictions to access, and are more highly remunerated. Ever since the financial crisis, the whole spectrum of remuneration for deposits has significantly declined.¹³

¹² Coins are issued by the Royal Mint.

¹³ Bank of England Stat table G 1.4. Available at: <https://www.bankofengland.co.uk/statistics/tables>.

- **Limits or caps:** Overall, there is no limit on the amount of bank deposits that can be held, but there is a limit on the amount covered by deposit insurance. In the UK, the amount covered is £85,000 sterling and in the Euro Area €100,000. This constitutes the theoretically 'risk-free' amount, but in doing so banks become beneficiaries of implicit subsidies. These take the form of reduced risk premiums, as banks pay a lower interest rate on deposits than they would if deposit insurance was not in place. It also allows banks to hold less equity, freeing up capital for making more profits.
- **Issuance and seigniorage:** Deposits are created by private banks and building societies predominantly as part of the lending process. The primary motivation behind the issuance of bank deposits is the pursuit of profit by the banking sector, which is mainly derived from the spread between the interest rate on deposits and that on loans. The financing of the economy and provision of exchange medium are both secondary to that.
- **Convertibility to other monetary instruments:** Sight deposits can be converted into cash upon demand, whereas time deposits might have some time restrictions, notice periods or penalties that must be resolved or settled before cash can be withdrawn. The ability to convert bank deposits into cash plays a fundamental role in generating public trust in them.

In terms of function and performance, bank deposits have overall been offering an increasingly high level of utility to the general public:

- **Store of value:** They are a very convenient way to save for those able to have a bank account as they mitigate the safety and storage concerns of cash. The fact that deposits are remunerated provides a return, even if it is small, and thus some protection against inflation. In addition, the fact that commercial banks are protected by deposit insurance (as well as other explicit and implicit state guarantees) makes holding up to that amount effectively risk-free. In this respect, bank deposits are more competitive than cash.
- **Medium of exchange:** Due to technological innovation their use has increased significantly over recent years. Debit cards, online payment methods and contactless payments (in conjunction with the wide availability of terminals allowing such exchange) have led to a surge of monetary exchange using bank deposits. Nevertheless, this comes at a cost: the providers of transaction systems tend to charge for their services, usually burdening the traders.
- **Unit of account and generation of trust:** Their ability to function as a unit of account and the fact that people trust them enough to use them is rooted in their convertibility to cash, their relation to central bank reserves, and state assurances such as the deposit guarantees.
- **Key additional function:** Bank deposits play a pivotal role in the lending function of banks as they provide them with a cheap source of central bank deposits (in the form of cash), allowing them to achieve higher revenue from the spread between the interest paid to depositors and the interest they would need to pay in order to borrow reserves from the central bank. This means they play an instrumental role in the creation of new money in the economy via loans, and thus economic activity.

Central bank reserves (CBRs)

Central bank reserves, and the interest rate applied to them, are the primary monetary policy tools in most developed economies. They play a vital role in monetary authorities' efforts to manage inflation, and thus retain the value of any given currency.

- **Access:** Only "Commercial banks, building societies, designated investment firms... and central counterparties" (Bank of England Red Book, 2015, p.3) have access to CBRs - the general public does not have access to this form of government money.
- **Form of monetary instrument:** Account-based.
- **Transaction system:** The transaction system is centralised and administered by a single trusted party, the central bank.

¹⁴ Bank of England (2020). "Interest rates and Bank Rate". Available at: <https://www.bankofengland.co.uk/monetary-policy/the-interest-rate-bank-rate>

- **Interest rate:** The interest rate on CBRs usually referred to as the 'Bank Rate', and is generally considered to be the most important interest rate in the UK¹⁴ and one of the main tools for the conduct of monetary policy. This rate is used by the Bank of England to influence all other rates in the economy, including the rates on bank deposits and loans. Lower rates aim to boost economic activity by making borrowing cheaper and saving less remunerated, whereas a higher rate will aim to cool down economic activity by having the opposite impact.
- **Limits or caps:** Many countries and economic areas around the world compel commercial banks to hold a minimum amount of central bank reserves in relation to the overall size and riskiness of their balance sheets, but the UK does not.
- **Issuance and seigniorage:** In addition to the provision of central bank reserves to banks in exchange for eligible collateral (issued reactively upon the request of commercial banks), the issuance of reserves has been used as a monetary policy tool to combat the consequences of the 2008 financial crisis. When lowering the Bank Rate proved ineffective in stimulating the economy, the Bank of England (along with other central banks around the world) used the creation of CBRs to buy government and corporate bonds, a process commonly known as quantitative easing, in an effort to stimulate economic activity and mitigate falls in asset prices.
- **Convertibility to other monetary instruments:** Central bank reserves can only be converted to cash by commercial banks, which they do in order to meet the demand for cash by the public.

In terms of monetary function provision, CBRs cannot be analysed in the same way as the other forms of money we have examined. They are not directly comparable as they cannot be accessed by the public. It should suffice to say that they act as the anchor for transactions of commercial banks and a few other financial institutions.

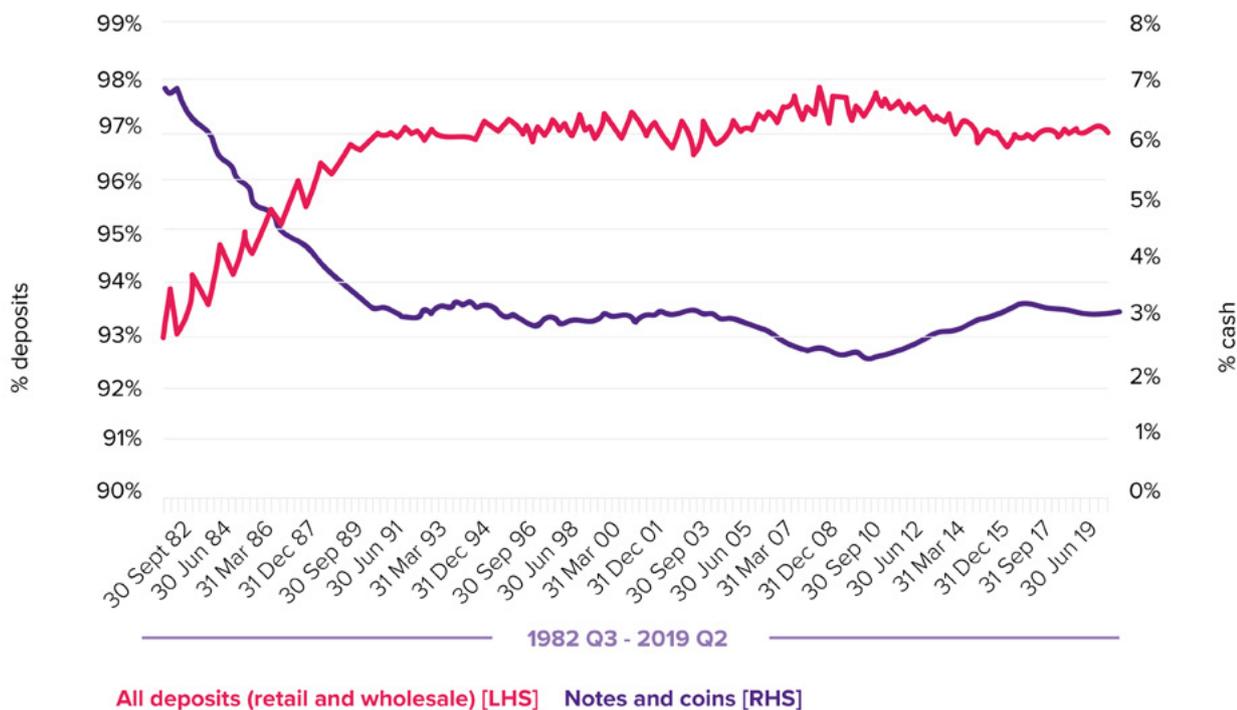
3.2 Competition between monies and market share

In order to empirically assess how effectively the different monetary instruments in circulation compete with each other, this section examines the market share they occupy in both the provision of store-of-value and medium-of-exchange functions. It should be noted that it is not possible¹⁵ to empirically assess the unit of account and trust functions as they are both foundational. Without their existence, we would not have a monetary system which would allow the store-of-value and exchange functions to be performed by the monetary instruments in circulation. Without trust fiat currency cannot exist, and lack of trust would render the entire monetary system critically unstable. Furthermore, these two functions cannot be decoupled for the two monetary instruments we are investigating: bank deposits and cash. CBRs are excluded from this analysis as they cannot be accessed by the public, and thus do not compete in the same market.

Overall provision of money functions and store of value

A determining factor of how successful bank deposits and cash are in competing with each other is market share. In most developed economies, bank deposits constitute the majority of money in which the public has access to, as measured through their amount in relation to the monetary aggregate measure for each economic area.

Figure 2: Publicly accessible monetary instruments in the UK: respective market shares and store-of-value function M4 universally available monetary instruments (bank deposits and cash, by percentage)



Source: Bankstats table A.2.2.1., author's calculations.

Since the early 1980s, the share of cash in relation to deposits has dropped significantly. More specifically, cash constituted around 7% of the monetary instruments available to the public in the early 1980s while bank deposits comprised the rest. The amount of cash then experienced a significant decline throughout that decade until it stabilised at 3% in the early 90s, a level it has remained ever since.

Since most money in the economy is not used to transact but to store value, it suffices to use the above chart as a good indicator for the market share of the store-of-value function, indicating bank deposits are far more competitive than cash in the provision of this function.

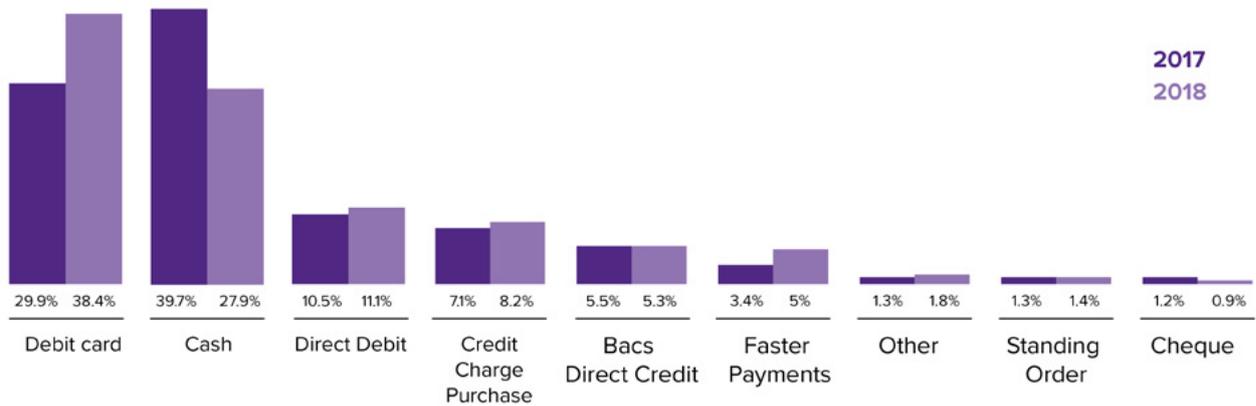
¹⁵ Within the limitations of this analysis.

Provision of money functions - medium of exchange

Figure 3 below shows the percentage share of different methods of payment to total number of payments made in the UK economy for 2017 and 2018. The usage of debit cards, which allow for the exchange of bank deposits, surpassed that of cash as the most-used payment method in 2018, with their usage increasing by 8.5% within the year and cash's declining by 11.8%. As a result, in 2018 cash was only used for 27.9% of all transactions, indicating a rapidly declining use of public means of payment versus private. This is "primarily due to the growing popularity of contactless payments and the increased speed of migration of payments away from cash" (UK Finance 2018, p.3).

Figure 3: Use of different payment methods in the UK

Total number of transactions using different payment methods in the UK for 2017 and 2018 (by percentage)

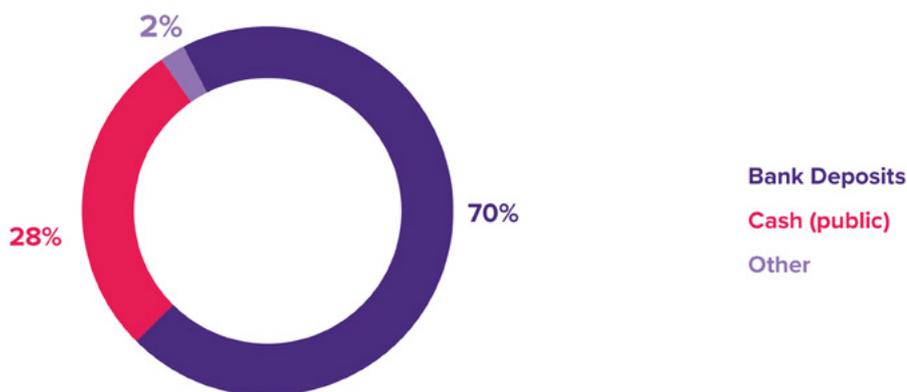


Source: UK Finance, *UK Payment Markets Summary* (2019, p.6 and 2018, p.9). Data excludes CHAPS.

All of these payment methods facilitate the exchange of bank deposits through private transaction systems. Reorganisation of this data (figure 4) reveals a clear picture of the market share of bank deposits versus cash for the provision of the medium-of-exchange function:

Figure 4: Share of the medium-of-exchange function for monetary instruments in the UK

Market share of bank deposits and cash in 2018



Source: (UK Finance , 2019 p.9, author's calculations)

In total, bank deposits account for 70% of the monetary instruments used as a medium of exchange. Again, private payment methods prove to be more competitive than the public option currently available.

3.3 Trust

This section highlights the function of trust which is implicit in the unit of account function. One large aspect of trust is the management of inflation. For good reason this is placed in the hands of public monetary authorities and not the private banking sector given its track record of inflating asset prices through credit creation and allocation.

Trust is critical for both the monetary system and for the existence of monetary instruments. As Borio (2019, pp.4-5) explains: “Fundamentally, a well functioning monetary system will enjoy the solid trust of participants. To be sure, trust that people will accept the corresponding instrument as a means of payment and that the transfer will be effective are absolutely necessary for the system to function at all.”

Even though bank deposits occupy by far the largest market share in the provision of money functions (in the UK and most modern economies), the whole structure of private monetary instruments is currently only possible because it is based on public monetary instruments. “Money today is a type of IOU, but one that is special because everyone in the economy trusts that it will be accepted by other people in exchange for goods and services” (McLeay et al, 2014, p.4).

The edifice of trust in the monetary system is currently based on the “two universal laws of credit and debt (which are the two sides of the IOU- it is a credit for the holder and a debit for the issuer). The first is that credits and debts are denominated in a unit of account –almost always a state money of account... The second is that the issuer of an IOU must accept her own IOU back in payment or what is called ‘redemption’” (Wray, 2011, p.3).

Cash, in conjunction with central bank reserves, directly enables and facilitates the public’s trust in commercial bank deposits. The government’s ability to levy taxes and issue generally accessible liabilities acts as the foundation for the monetary system and the wider economy. This creates a hierarchy of monetary instruments: at the top are government liabilities (cash and central bank reserves), followed by commercial bank liabilities (bank deposits), then the liabilities of other sectors (non-financial corporations), and finally those of households at the bottom (Wray, 2011, pp.2-6).

“Put differently, we can think of money as an especially trustworthy type of debt. In the case of bank deposits, trust is supported by central bank liquidity, including as a lender of last resort, by the regulatory and supervisory framework and varieties of deposit insurance; in that of central bank reserves and cash, by the sovereign’s power to tax; and in both cases, by legal arrangements, way beyond legal tender laws, and enshrined in market practice” (Borio, 2019, pp. 9-10)

Even though private monetary instruments do hold the vast majority of market share in the provision of store-of-value and medium-of-exchange functions, this is currently only possible due to the trust that their convertibility to state issued monetary instruments instills.¹⁶

As the market share for the provision of these services is increasingly occupied by private monetary means of storing and exchanging value, it is critical, in order to maintain trust, that the public continues to have access to state-issued monetary instruments.

Given the rapid decline in cash use, if trust in the monetary system as we know it today is to continue, a new form of accessible public monetary instrument will be needed. In this way, a CBDC could complement more than compete with private monetary instruments. A CBDC needs to be designed so that the monetary authorities can control these two opposing forces, that of competition and complementarity, so that this new instrument can positively contribute to the existing monetary order.

A carefully designed and implemented CBDC would likely become a new anchor of trust, allowing complex monetary systems to continue operating effectively in the face of increased demand for digital payments. However, in order to achieve that, CBDC must not inadvertently undermine the structures that allow for private monetary instruments - most importantly bank deposits - in order to maintain trust in all parts of the monetary system.

¹⁶ Wray (2011, p.9): “this ensures ‘par clearing’ – protected bank liabilities always trade one for one against government liabilities.

4 Risks involved in the introduction of a CBDC

The implementation of a CBDC will pose some risks to financial stability, which need to be effectively mitigated. In the previous section, it was concluded that CBDC would compete for market share with cash and bank deposits in the provision of both the store-of-value and medium-of-exchange functions. When it comes to the facilitation-of-trust function, a CBDC - just like cash - would have the upper hand due to its issuance by the central bank, and therefore if it were to compete rather than complement private monetary instruments, it could rapidly erode trust in bank deposits or significantly decrease their market share, generating new risks for the monetary system.

This information allows us to pinpoint the specific risks posed for the banking sector: the potential for faster bank runs conducted through online banking services, and a sudden unintended disintermediation of commercial banks. The first part of this section (4.1) reviews the concerns about CBDC facilitating digital bank runs. The second (4.2) assesses the risk of bank disintermediation by examining the liability side of the UK's aggregate bank sector and establishing how these banks are funded (4.2.1). Then part 4.2.2 looks at banks' aggregate assets to show their main functions and the corresponding aggregate income streams.

Our analysis concludes that if central banks can control the overall market share of CBDC, they can effectively mitigate the risk of excessive bank disintermediation.

4.1 Bank runs

The Committee on Payments and Market Infrastructures (CPMI) at the BIS highlights that “arguably the most significant and plausible financial stability risk of a universal access CBDC is that it can facilitate a flight away from private financial institutions and markets toward the central bank... a CBDC could allow for ‘digital runs’ toward the central bank with unprecedented speed and scale” (2018, p.16).

As noted in the introduction, bank runs are the greatest financial stability concern that central bankers have about the potential introduction of CBDC (OMFIF and IBM, 2019, p.30). “This is because depositors can more easily withdraw their money and transfer it to CBDC compared to cash withdrawals” (Wadsworth, 2018, p.16).

This rings especially true for “...depositors – especially wholesalers whose deposits are not covered by State guarantees – [who] might be tempted to withdraw their funds from banks to their accounts in CBDC, thereby fuelling potential bank panic and, therefore, exacerbating the financial crisis.” (Nuno, 2018, p.5)

Nevertheless, as Yanagawa and Yamoka of the Bank of Japan note (2019, p. 15), “digital bank run[s] may occur even now without having any CBDCs, since depositors can use internet banking for transferring their deposits to other banks”. Alternatively, they could use their deposits to buy assets considered to be safe, such as bonds or even gold.

In Chapter 5, we explore the design options for a CBDC that would best mitigate the risk of bank runs. We then analyse whether implementing a CBDC would increase the likelihood of bank runs, and discuss possible design features that would mitigate this risk, including tiered remuneration and the use of interest rates. Finally, we consider the privacy and security concerns of such a CBDC implementation, and identify the key questions they raise for the current monetary policy paradigm.

4.2 Banking sector disintermediation

Concerns have been raised that implementing a universally accessible CBDC would disintermediate the banking sector, by causing a dramatic reduction in the use of bank deposits, thereby impeding the ability of commercial banks to perform their core functions: creating and allocating credit while managing funding costs and constraints (including those that arise from the transactions that this process generates).

To accurately assess the risk posed to commercial banks, we will first go over the main ways in which banks fund themselves and then their main functions, by looking at the liability and asset sides of their aggregate balance sheet, and identify how CBDCs could potentially disrupt their operation.

4.2.1 Bank funding and its cost

The way any given bank funds itself can be seen through the liability side of its balance sheet. As noted by the ECB (2009, p.8), “Conceptually commercial banks fund their balance sheets in layers.” The first layer forms the capital base, containing equity and subordinated debt (and hybrids of the two). The second layer consists of deposits from customers. The third consists of short term liabilities: typically short term bonds, commercial paper, certificates of deposits, repurchase agreements and wholesale deposits.

Figure 5: UK banks' funding structure: Liabilities

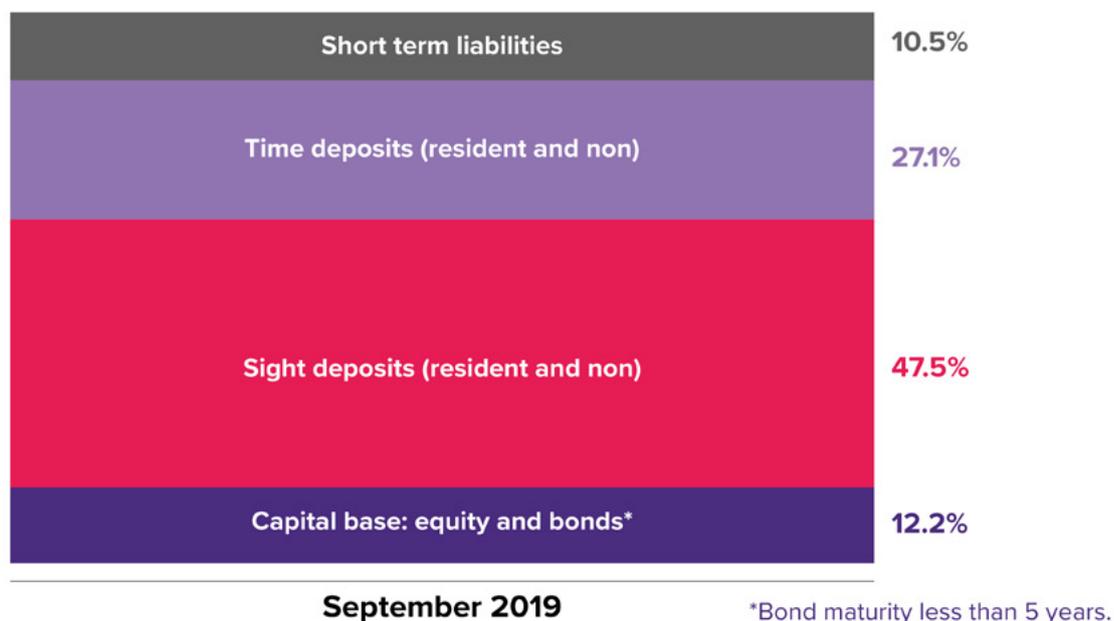


Figure 5 shows the consolidated balance sheet for all monetary financial institutions (banks) in the UK excluding the central bank.

The first layer, their capital base, accounts for around 12% of all their liabilities (11.3% Sterling capital and other internal funds, and bonds with maturity of over 5 years, which account for 0.9%). The second layer is composed of deposits that total 74.6% of all liabilities (47.5% sight deposits and 27.1% time deposits). Finally, the third layer accounts for 10.5% of banks' liabilities: 6.6% repos, 2.8% certificates of deposit and commercial paper, and 1.1% bonds with maturity up to and including 5 years.

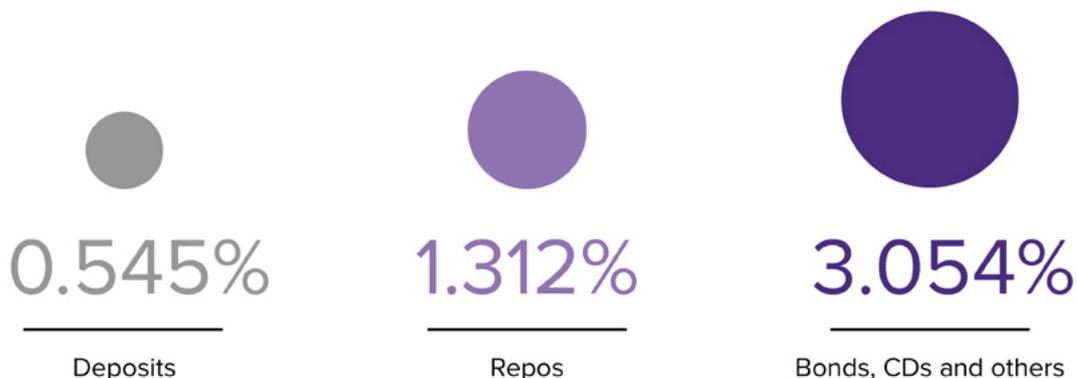
As highlighted in Section 3, a universal access CBDC would be a direct competitor of bank deposits.¹⁷ This could have significant implications as banks predominately fund themselves through deposits, which constitute 74.6% of their liabilities. Therefore, the degree to which it competes with bank deposits and the implications it has for their overall volume must be given special consideration.

The cost of this form of funding by banks is determined by the interest they pay on deposits. There has been a significant decline in interest rates overall since the 2008 financial crisis, when (in the pursuit of an expansionary monetary policy) central banks significantly lowered them. This had two opposing effects on banks: firstly, low interest rates on loans put downward pressure on bank income, and secondly rates paid on deposits used to fund this process of credit creation were also lowered, leading to a reduction of bank costs. This decline in the deposit rate has received a significant amount of publicity (Jones, 2019).

¹⁷ The introduction of a CBDC could potentially affect other items in banks' balance sheets depending on its design. Nevertheless, these effects would probably be indirect and for the purposes of this report focus will be placed on deposits which is where a CBDC could directly compete.

There are several different factors that affect the rate any bank pays its depositors, and it is said to be a competitive market.¹⁸ Paying interest on deposits is generally considered to be the primary means banks have of attracting deposits, which are the cheapest form of funding they have access to (see table 1 below).

Figure 6: Bank funding costs in the UK by source



A rough calculation¹⁹ of the average rate paid on deposits for the first two quarters of 2019 indicates that it was around 0.545%, which is 0.766% less than repos and 2.509% less than other debt securities.

If the introduction of a CBDC increases upward pressure on the deposit rate, the income of commercial banks would decline (assuming that lending rates and amounts, along with other income sources remain stable). If bank income from this source declined beyond a certain point, bank disintermediation could threaten financial stability.

Furthermore, increasing the rate that banks pay on deposits would likely provoke a corresponding increase in the rate banks charge on loans, as the spread between the two determines banks' profitability. The bank deposit rate is therefore another area in which CBDC could generate risk: both in the form of loss of revenue for banks and higher lending rates for borrowers. This last risk can also have implications for the rate of money creation: if demand for loans significantly diminishes, less money would be created by commercial bank loan issuance.

4.2.2 Bank functions

Commercial banks play a number of roles in modern economies. Having assessed the liability side of banks' balance sheets in order to determine the main ways in which the introduction of a CBDC might affect their ability to get funding, we now examine the asset side in order to determine what other areas of their functions might be affected by the introduction of a CBDC, and how this would impact banks' income.

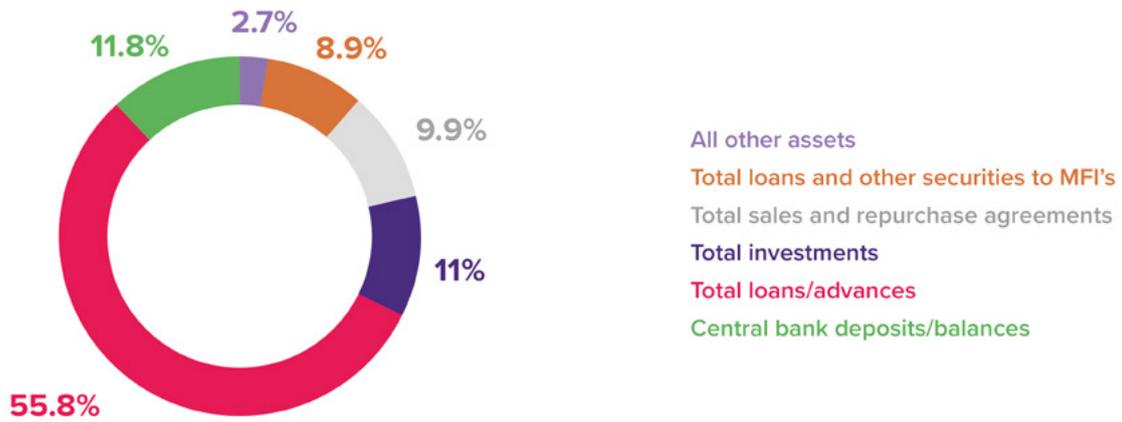
As seen in figure 7 below, in the UK "the average banking franchise continues to depend on traditional intermediation from depositors to borrowers" (De Young and Rice, 2004, p.40) through the credit creation process. Loans account for 55.8% of banks' balance sheets, by far the largest entry. In fact, if loans between banks are included, this raises the total amount of loans to 62.2% (and correspondingly decreases the total loans and other securities to MFIs entry to 2.5%). 11.8% of their assets are predominantly accounted for by deposits and balances they hold with the central bank. Of the rest, 11% are investments (3% are government bonds, 5% invested in other UK residents, 2% in non-residents, and 1.1% invested in other MFIs). Finally, 8.9% consists of other commercial banks' assets and intra-bank loans.²⁰

¹⁸ 'said to be' reflects the FCA's 2018 report, *Price discrimination in the cash savings market*, which expressed concern that "competition is not working well in the cash savings market, particularly for customers that stay with the same provider for a long time... we have seen evidence that providers' pricing strategies can take advantage of the high level of consumer inertia in the easy access cash savings market..... longstanding customers lose out through receiving lower interest rates than more active customers who shop around and switch" (FCA, 2018 b, p.3)

¹⁹ Data from the Bank of England's Bankstats tables B1.4 (Monetary financial institutions' ex. central bank's balance sheet) and B3.1 (Monetary financial institutions' quarterly income and expenditure) were used for these calculations. More specifically: for the calculation of the average cost of deposits, the average amount of interest payable on deposits for the first two quarters of 2019 (series TGEH) was divided by the sum of sight and time deposits for the first 6 months of 2019 (sight deposits=B3GL+B8ZC+B3MM+B3NM+3OMB)+ time deposits (B3HL+B8ZE+B3PM+B3QM+B3RM+B3SM+B3TM). The approach for repos was similar: the average of Q1 and Q2 of 2019 for series TGEI was divided by the average of series (B3IL + B3UM+B3VM+B3WM) and the same for the 'Bonds, CDs and other' series (TGEJ/B3YM)

²⁰ This % is raised to 10.1% making it the 4th largest class of assets, if the unclear 'investment to other MFIs' entry is added.

Figure 7: UK banks' functions: Assets



The main way that a CBDC could impede banks' arguably most important function, the creation of money through lending, is by affecting their sources of funding (analysed in 4.2.1). The other key function which is of particular interest when it comes to the introduction of a CBDC is the "supply [of] payment services that underpin the smooth operation of the economy" (Bolt and Humphrey, 2013, p.29). To account for a CBDC's impact on banks when it comes to this front, figure 8 below shows the main income streams for the aggregate UK banking sector. A risk to financial stability is that their income from the provision of these services is significantly diminished:

Figure 8: Aggregated income streams for the UK banking sector



Source: Bank of England Bankstats table B3.1 series in order of presentation from left to right: B68F, B69F, B74F, B5RF, B75F divided by B5RG (total income)

The revenue generated specifically by transactions comes under ‘net fees and commissions’ which constituted just under 16% of the sector’s aggregate revenue in 2018.²¹ The largest income stream for banks by far is that from interest received, primarily on loans, which was just under 60% of all revenues for the same year. This is followed by ‘other income’ at just over 19%, dividend income at around 11%, and trading income at 4.5%.

A key question for our analysis is how important the revenue from transaction services is for commercial banks. If the usage of cash continues to decline, the revenues generated by banks from the provision of transaction services are set to increase. Clearly, the existence of cash has not resulted in bank disintermediation (cash has less than 30% of the transaction market, as shown in section 3.2.) and banks were not disintermediated when cash usage was much higher. If access to cash proves difficult to secure and net demand for cash declines, this would allow for a CBDC to safely expand its market share.

If net demand for cash declines and access to cash proves difficult to secure, the overall market share for transactions services CBDC could safely occupy would correspondingly expand.²² However, the central bank should ensure it has the capacity to control how competitive a CBDC is in the provision of the medium-of-exchange function. The overall impact it has on the market share of bank deposits in the supply of this service can therefore be targeted to best protect financial stability and secure trust in the overall payments system.

4.3 Mitigating financial stability risks with CBDC controllability

We have established that implementing a CBDC introduces new risks for the banking sector. On the liability side, they are primarily exposed to the risk that bank deposits (their main and cheapest source of funding) could be displaced by CBDC if it is more competitive in the provision of the store of value function. In the words of Siciliani (2018, p.22): “retail banks’ mainstream business model, which is reliant on a stable supply of retail deposits, might come under threat as a result of the emergence of a new substitute for commercial banks’ personal and saving accounts that provides a safer money storage option thanks to access to a central bank’s balance sheet.” If a CBDC captures market share from bank deposits beyond a certain point, they would face funding issues impairing their ability to create credit.

This risk can also spill over to the asset side of banks causing profitability problems. We have established that if commercial banks, in the process of competing for deposits, are forced to significantly increase the rate they pay on deposits, this will have to be reflected on the rates they charge on loans. If this rate is too high and is met by a significant decline in demand from the public, their profitability could be reduced to the point at which they are disintermediated. This would have implications for the rate of money creation and thus consequences for economic activity.

The other key area where banks might face risk in generating revenues is in the provision of medium-of-exchange functions. In comparison to the size of their balance sheets and overall revenue, this source of revenue is rather small. However, the cost to the public using these services can be significant, leaving space for more competitive pricing to be beneficial.

In summary, a CBDC design which will allow the central bank to control how competitive it is versus bank deposits, and therefore the market share it occupies on both the store-of-value and medium-of-exchange functions, should alleviate the risks of both bank runs and bank disintermediation.

²¹ Unfortunately, the Bank of England does not provide a more detailed breakdown.

²² With access to a more specific data set, specific conclusions could be drawn about the effects CBDC would have on bank revenue from providing transactions services.

5 Designing CBDC to mitigate financial stability risks

This section provides an analysis of the main design features of a CBDC by assessing the different options of each design feature, and considering the implications these would have for the current monetary system. In sections 3 and 4, we identified the primary risks to the monetary system a CBDC could pose (more specifically, the potential impact on the banking sector) and how these could be effectively mitigated.

Our analysis will proceed by looking at the descriptions, different variations and the relation to existing forms of money of the various design features (covered in section 2). The implications for financial stability from a bank run and bank disintermediation perspective will be considered. Finally, a position on how each feature should be specified will be provided.

5.1 Access to CBDC: universal or restricted?

As discussed in section 2, in the current monetary system there are three main different types of money. The public has access to two of these: cash and bank deposits. Access to CBRs, the third type, is restricted to commercial banks. If CBDC is introduced alongside these, should access to it be restricted to specific agents or sectors?

Option 1: Restricted access CBDC

The arguments for introducing a restricted access CBDC usually focus on the benefits for efficiency, security, speed and cost of financial transactions and settlement systems. These grow if non-bank financial actors also have access to a CBDC (CPMI, 2018, p.8). However, a large part of these gains relate to the potential advances that a restricted CBDC would bring when used in conjunction with new underlying technologies, such as a distributed ledger (OMFIF and IBM, 2018, p.6). In many ways, a limited access CBDC would primarily compete with or complement central bank reserves, not cash or bank deposits. Although possible advances in financial markets would be welcome, and could potentially benefit the rest of the economy indirectly, limiting access to a CBDC would lack the additional benefits a universal access CBDC would likely provide.

Option 2: Universal access CBDC

If the CBDC is designed to be used by all members of an economy, it would compete directly with the other widely accessible monetary instruments: cash and bank deposits. How competitive it will be to these other monies in the provision of the store-of-value and medium-of-exchange functions ultimately depends on the specification of the rest of the design features.

Bank deposits, a liability of banks, are already in competition with cash, a liability of the central bank. However, due to issues relating to efficiency, practicality, security and remuneration, bank deposits have come to dominate the market as a form of money (as seen in section 3 above). A CBDC could also complement cash, modernising the central bank's means of payment (Riksbank, 2017, p.18).

An important issue here is the decline in the usage of cash which acts as an 'anchor of trust' for the entire monetary system (section 3). Sweden is at the forefront of this problem, as the use of cash has declined from around 40% in 2010 to approximately 15% in 2016 (Riksbank, 2017, p.4); some stores are already refusing to accept cash, and certain bank branches are no longer handling cash (Bech and Garratt, 2017, p.64). Concerns have been raised that the country's payment system could fall entirely into the hands of a small number of commercial banks, and that "in the long run, this concentration could restrain competitiveness in the market and make society vulnerable". In addition, the general population would lose the ability to store value and exchange with 'risk-free central bank money', reducing the resilience of their payment system (Riksbank, 2017, p.4).

Furthermore, a question that arises is whether or not the current bank dominated monetary system is as effective as it could potentially be in supporting economic activity versus a system where due to universal CBDC access, commercial bank liabilities would compete with central bank liabilities as means of storing value and conducting exchange. In general, healthy competition can lead to increases in efficiency and overall development. This does not necessarily mean that any CBDC design that would compete with bank deposits would lead to a better system, but if a CBDC was to be calibrated so as to foster healthy competition with bank deposits, while also providing a safety net for the rest of the economy, it could help improve the banking sector without impeding its core functions. In many ways, the potential introduction of a CBDC should be viewed as a complementary addition to the monetary and financial system, building the foundations for a more efficient and secure economy.

Economic benefits could also be gained by lowering the cost of transacting in the current monetary system, which for some parts of the population are significant. One example are "lower-income households which tend to rely heavily on cash, and for small businesses which incur substantial costs for handling cash or substantial interchange fees for taking payments via debit and credit cards" (Bordo and Levin, 2017, p. 3).

Other areas where a universally accessible CBDC could lead to a better monetary system were highlighted by Christine Lagarde, then Managing Director of the IMF. She highlighted financial inclusion, especially for marginalized communities, as one important reason for CBDCs to be introduced. As the use of cash declines and the use of digital money increases, and since banks are “not exactly rushing to serve poor and rural populations... .. If the majority of the people adopt digital forms of money, the infrastructure for cash would degrade, leaving those in the periphery behind”. Security and consumer protection is another benefit, according to Lagarde, as “without cash, too much power could fall into the hands of a small number of outsized private payment providers. Payments, after all, naturally lean toward monopolies” (2018, p.4).

The design features we specify in the next section allow a degree of control and variability on the competitive pressures the CBDC would place on bank deposits and cash (both as a medium of exchange and store of value). These policy decisions should depend on whether the market outcome for these services provided by other monetary instruments is sub-optimal, from a socioeconomic perspective.

5.1.1 Financial stability and monetary policy considerations for a universal access CBDC

Bank runs

Implementing a universal access CBDC would have significant implications for financial stability: it could increase the risk of bank runs and of bank disintermediation. The public’s newfound ability to store value in a digital form of money strictly safer than bank deposits could render bank deposits unsafe, as a run on banks in a crisis could be more practically feasible and happen at faster speeds than has previously been possible with physical cash withdrawals. However, the introduction of a CBDC would enable new forms of central bank intervention to respond to bank runs that threatened financial stability. One example of this would be the direct transfer of CBDC to commercial banks, as “the existence of a CBDC and the ease by which it can be transferred compared to transporting cash, could even facilitate the provision of liquidity from the central bank to banks in distress alleviating run pressures” (Mancini-Griffoli et al., 2018, p.24). The existence of deposit insurance could also help to mitigate these risks (ibid. p.25., Andolfatto, 2018, p.22).

Bank disintermediation

Just as with the risk of bank runs, allowing the public to have access to a new monetary instrument exposes banks to the risk of disintermediation by the central bank. The degree of risk predominately hinges on how competitive the CBDC will be as a store of value compared to bank deposits. If it is very competitive and starts to decrease the market share of bank deposits in the provision of this function, the degree of bank disintermediation should roughly correspond to the decrease in deposits. To mitigate these risks, design features should be implemented that ensure a CBDC is not competitive, or that it cannot be competitive beyond a certain point, such as applying an interest rate. This would directly influence the amount of CBDC that is attractive to hold.

Direct competition for the provision of digital payment services could affect commercial banks’ intermediation functions. The severity of this disruption would primarily depend on the amount of revenue banks receive from providing these services, and the degree to which that revenue would be lost (examined in section 4). These revenue sources tend to be less significant than others for banks, and given that they stand to increase if cash use declines, there is definitely space for a CBDC to compete in the market for payments services.

From a monetary policy perspective

Making CBDC universally accessible would enable new means of implementation and transmission for monetary policy. This, in conjunction with the extent to which holding CBDC is remunerated, determines how pronounced the implications for monetary policy will be (CPIMI, 2018, p.10).

Significantly, this form of CBDC would make unconventional monetary policies such as ‘helicopter money’ much more viable for the central bank to implement from a technical standpoint. Money creation by the state for direct transfer into the wider economy would likely be more effective than quantitative easing policies (Dyson and Hodgson, 2016, pp.7-8) for boosting effective demand and economic growth.

Conclusion

A central bank digital currency that is widely accessible to the public would be much more beneficial. Although universal access makes applying control to this monetary instrument more complex, it ensures the socioeconomic benefits of CBDC can be widely shared throughout the economy and society. There is a risk that ease of CBDC transfer could intensify the speed of bank runs, but a new and equally fast means of intervention to boost commercial bank liquidity in a crisis would also become available. Overall, we argue that the benefits of CBDC would be maximised by making it universally accessible.

The global financial crisis in 2008 clearly demonstrated the serious risk of a systemic failure of commercial banks and the implications for the payments system. That crisis required unprecedented interventions by both central banks and governments to prevent serious disruption to everyday economic activity. Implementing a universal access CBDC would increase the capacity of the central bank to combat crises and recessions while also providing the foundation for a back up payments system, greatly increasing the resilience of the monetary system.

5.2 Should CBDC be token-based or account-based?

Fundamentally, there are two main types of payment systems or transfer mechanisms: token-based and account-based systems (Kahn et al, 2018, pp.8-11). Both are record keeping arrangements, but they are distinguished by their identification requirements.

The primary example of a token-based payments system is cash, where what really matters is the identification of the payment instrument: making sure that the note or coin is not counterfeit. It also constitutes a decentralised payment system, as the clearing process occurs bilaterally when the money instrument is transferred between the transacting parties. In this case, the cash itself is the record, acting “as a device that summarizes past production, trade and consumption decisions” (Kocherlakota, 1998, in *ibid.* p. 8).

The most important account-based payment systems in most modern economies are commercial bank deposits and central bank reserves (CBRs). What is crucial for account-based systems is the identification of the accounts of the transacting parties so the transfer of funds can happen and the transaction to be cleared. This record keeping is done by a single trusted party (such as the central bank when banks transact using central bank reserves) or by third parties (for example, when transactions happen between two people who have accounts at different banks), usually for a fee.

An account-based CBDC requires a centralised payment system to clear transactions (controlled by a trusted party or trusted third parties), whereas a token based system could be decentralised, with clearing happening between those conducting any given exchange.

One important difference between the two systems is where liability lies if wrongdoing occurs. In a token-based system, the liability lies with whoever receives fraudulent token or the victim of theft, whereas in account-based systems, the liability (at least up to a point) lies with the manager of the account and not the holder (Khan et al., 2018, pp. 8-11).

The decision of whether to implement a token-based or account-based form of a CBDC will directly determine what other forms of money or financial instrument the CBDC would be in immediate competition with. This, along with the differences in regulation for token-based and account-based systems, has significant implications for the other possible design features. For example, a token-based CBDC cannot receive interest²³ but might have the capacity to offer a higher level of anonymity.

²³ Although more complicated than for account based but potentially technically feasible, there are laws regulating the interest bearing capacity of E-monies in various jurisdictions. In the EU, the Directive 2009/110/EC (recit 13) reads “Electronic money issuers should not, moreover, be allowed to grant interest or any other benefit unless those benefits are not related to the length of time during which the electronic money holder holds electronic money”. For the purposes of this exposition it will be assumed that when referring to a token or value based CBDC, the application of interest is not an option.

Nevertheless, both forms would be immune to credit or liquidity risk (just as cash is), as they would be issued by the central bank, and it would be possible for both forms to have an online and offline functionality (Riksbank, 2018, p.14-5). In addition, both forms have the potential to open the market of payment services to non-banks and foster private initiative, innovation and growth.

Option 1: Token-based CBDC

A token-based CBDC would have similar attributes to cash, but in a digital form. One example of such a system would be the central bank issuing unique codes that each correspond to individual tokens, in a similar manner to the serial numbers printed on banknotes (Bank of Israel, 2018, p. 15). A key benefit of this approach would be the simplicity and low cost of implementation, as the central bank would not need to create and administer accounts on a mass scale (Riksbank, 2018). This, along with other similarities, suggests a token-based CBDC might be a closer competitor to cash, as it would not give direct access to the central bank's balance sheet.

Just like with cash, there would be no option for a token-based CBDC to receive interest²⁴, and limiting the amounts that can be held by individuals would be more complex. This has important implications when it comes to the ability of the central bank to control the competitiveness of this monetary instrument vis-à-vis other monetary instruments, and for the feasibility of using CBDC to conduct monetary policy. This is because the controllability of a CBDC depends to a large extent on the ability to apply limits on the amounts that can be held or that are in circulation, and adjusting its attractiveness as a store of value and medium of exchange.

Monetary policy has traditionally been implemented through interest rate manipulation, so the introduction of a new interest-bearing medium of exchange could increase its efficacy, depending on how desirable such a CBDC would be as an asset (CPIM, 2018, p.10). Without an interest rate to manipulate, the only way through which monetary policy could be applied to this form of CBDC would be through policies which control the quantity of this instrument in circulation. Control over the quantity would be possible in aggregate, but targeted control over the quantity of a token-based CBDC would be a much greater challenge to implement.

Option 2: Account-based CBDC

An account-based CBDC would grant public access to the central bank's balance sheet, as it would constitute a deposit with the central bank. Although this has been possible for a while now, and in some instances the public did have access to central bank accounts, central banks "do not in general want to compete with commercial banks in providing banking services to the public" (CPSS, 2003, p.3) and therefore this access has been restricted or denied.

The provision of banking services is a rather wide term, encompassing a number of services (identified in section 4). These include offering store-of-value services, along with transaction services. We have determined that store-of-value services are most important for bank profitability, based on the volume of income banks generate and further reflected in the assets they tend to hold.

Although the central bank does not compete with commercial banks directly by lending to the public, it does offer the fundamental and universally accessible medium of exchange by supplying cash, as well as maintaining the value of currency. Cash can technically be used to save (though security and other concerns make it a less popular choice), so the central bank is already competing with the banking sector in the provision of a store of value and means of exchange.

Given that the central bank, on some level, competes with commercial banks by issuing cash, what would happen if cash were to disappear? This is happening in Sweden, and is projected to happen to a great extent in many advanced economies.

²⁴ Due to previously explained legal constraints.

An account-based CBDC would allow for the implementation of two key design features: applying a central bank controlled interest rate, and the capacity to introduce limits in the form of tiers on these accounts. For this reason, we argue that CBDC should be account-based.

The public could gain access to this asset on the central bank's balance sheet in different ways, subject to the degree of private sector involvement in the process. These accounts could be both provided and administered directly by the central bank, or the public could access the balance sheet of the central bank through an intermediary, such as FinTechs, other accounts providers or commercial banks if necessary.

As suggested by Christine Lagarde, then Managing Director of the IMF and current President of the European Central Bank (ECB), the optimal scenario would be that "the central bank focuses on its comparative advantage - back-end settlement - and financial institutions and start-ups are free to focus on what they do best: client interface and innovation" (2018, p.7).²⁵

5.2.1 Account-based CBDC: Financial stability and monetary policy considerations

Bank runs

As discussed in section 4, bank runs are possible if there is another asset to which the public can run to. Having one more monetary instrument does increase the capacity of the public to conduct a run but not the probability, which is determined by other factors.

Furthermore, an account-based CBDC allows for the central bank to increase its capacity to control movements to and from this monetary instrument, by opening the door for the application of features such as the interest rate or targeted limitations, disincentivising bank runs.

Bank disintermediation

An account-based CBDC gives the central bank the power to choose if and to what degree banks are disintermediated as it enables the implementation of design features that control how competitive a CBDC would be to bank deposits. Therefore, bank disintermediation would be under the control of the central bank.

Monetary policy

The mere introduction of a CBDC would increase the armoury of monetary policy tools available to the central bank, and an account-based CBDC could significantly increase the precision of the ways in which this new monetary instrument would interact with the monetary environment.

5.3 Applying an interest rate to CBDC

All monetary instruments currently in circulation except cash bear some level of interest. In the UK, the interest borne by central bank reserves is the main tool of monetary policy, at least conventionally.

Option 1: No capacity to bear interest

If an account-based CBDC were not to have the option of bearing interest, the monetary authorities would be deprived of a crucial lever of control over it.

An account-based CBDC enables the use of targeted limitations on holding amounts. However, the imposition of scarcity without the ability to influence the value of a CBDC, through the interest rate, would have unwarranted

²⁵ It must be noted that under Lagarde's proposition, the funds would be stored by the private sector (ibid., p.6) and not with the central bank as suggested here. Although in principle, that is not something that will be argued against here, the externalities of this scenario have not been accounted for and would require further research. Nevertheless, the implications for growth, innovation and market entry for the private sector remain similar.

consequences on its parity with other monetary instruments. Not only would it reduce control but it could even eliminate it, at least when it comes to the CBDC's value. As argued throughout this paper, the ability of the central bank to control the impact of a CBDC on the monetary system is paramount for its existence and appeal.

Option 2: Interest-bearing CBDC

A CBDC's desirability as an instrument to perform both the store-of-value and transaction functions could be controlled to a great extent through movements in its interest rate. The level of control which would be available here is better not only with respect to the degree but also timing, as it would allow a real-time dynamic response to economic or financial events. If the central bank was compelled to secure the deposit base of banks by instigating a substitution of CBDCs with banks' deposits, it could encourage the exchange of CBDC for bank deposits with forward guidance, announcing that it would decrease the interest rate on CBDC.²⁶ An announced increase in the rate would have the opposite effect.

5.3.2 Interest-bearing CBDC: financial stability and monetary policy implications

Bank runs

The capacity to bear interest, through forward guidance or its imposition, can be used to steer deposits between commercial banks' balance sheets and the central bank's balance sheet with or without cost being incurred by CBDC holders. Lowering the interest rate (the rate change could be applied across different time spans, or upon conversion) would mitigate against runs from bank deposits to CBDC. In addition, for banks facing a crisis, guarantees could be placed that allow the convertibility of bank deposits into CBDC which should instill the necessary confidence in the integrity of the bank deposits in question potentially mitigating the bank's collapse. Finally and as a last resort, if bank deposits from failing institutions are being converted into CBDC and the central bank wants to prop it up, it could proceed in redepositing them in the troubled institution while providing the necessary guarantees.

Although this scenario is not advocated for as it would exacerbate the moral hazard of too big to fail and subsidies in the form state deposit guarantees, its mention aims to illustrate how versatile the application of situational control by the central bank can be through an account-based interest bearing CBDC.

The risk of large-scale runs to CBDC could be further reduced if the central bank were to "artificially introduce some of the frictions that currently discourage large-scale runs to cash" (Meaning et. al., 2018, p.14). These could include requiring advance notice for large CBDC conversions, or withholding the payment of interest on balances held above a given limit. Stronger measures could include imposing fees on balances beyond a certain level or the application of a negative interest rate.

Bank disintermediation

As noted in section 4, bank disintermediation could come about if a CBDC were to be too competitive vis-à-vis bank deposits primarily in the store of value and to a lesser degree medium-of-exchange functions. Given that the central bank will be able to control the degree to which a CBDC is competitive on both functions versus bank deposits through the manipulation of its interest rate, the risk of unintentional bank disintermediation should be effectively mitigated.

Monetary policy

The efficacy of the traditional monetary policy tool - manipulating the policy interest rate - has been widely questioned due to its inability to counter the negative effects of the Great Recession. An interest bearing CBDC would introduce an entirely new monetary policy tool for the central bank, expanding the capacity of the central bank to enact monetary policy.

²⁶ Such forward guidance could be more effective if a negative interest rate was applied to a CBDC. In section 5.3.2, we discuss the option of implementing negative interest rates alongside tiered remuneration, and assess the advantages and disadvantages of such an approach.

A significant benefit of controlling the interest rate on a CBDC would be exerting competitive pressure on private banks. Specifically, if the spreads between lending and deposit rates were too large, an increase in the CBDC's deposit rate would instigate increases of bank deposit rates in order to compete, or banks would face losses from the net transfer of deposits from commercial bank accounts to CBDC accounts with the central bank. This enhancement of central banks' ability to apply competitive pressure to commercial banks could be instrumental in imposing greater levels of market discipline on the financial sector.

We conclude that a CBDC that is account-based and interest-bearing (in addition to being universally accessible) would make the operation of monetary policy more nuanced and effective, thereby maximising the CBDC's potential to provide socioeconomic benefits and safeguard financial stability.

5.4 Limits or caps

This design feature refers to “quantitative limits or caps on the use or holding of CBDC” (CPMI, 2018, p.6). It can primarily be used as means to control the use of CBDC vis-à-vis other monetary instruments. Limits could be placed on the holding amounts, or the amounts that can be transacted.

The main issue with the use of this design feature to control the usage of a CBDC is the fact that if any form of scarcity is imposed on it, due to its riskless and highly liquid nature, its parity with other monetary instruments might break down. As Fung and Halaburda (2016, p.14) note “...to have a national currency as the unit of account for the CBDC, the central bank would need to ensure at-par convertibility among its other liabilities and CBDC.” Especially important is at-par convertibility between CBDC and cash, as cash is a key anchor of trust for the monetary system.

Currently such limits are in place on bank deposits when it comes to the amounts that are insured as part of state guarantees or minimum reserve requirements that some central banks (such as the ECB) have for bank holdings of CBRs. There are also limits for the amounts that can be transacted in cash, often in order to combat tax evasion and illicit activity.

Option 1: No limits

If no limits were to be placed on amounts for holding or transacting with a CBDC, the main tool through which the central bank could exert control of this new monetary instrument would be through the manipulation of the interest rate as discussed above. Although this should be effective to a degree, given that it would be applied to all CBDC in circulation, it would not allow the authorities to separately determine the competitiveness of this monetary instrument in the provision of the store-of-value and medium-of-exchange functions.

Option 2: Limits

Imposing a hard limit in either transacting or holding amounts could potentially create a problem with maintaining parity between CBDCs and other monetary instruments. This is especially relevant in times of crisis, when the demand for risk-free monetary instruments such as a CBDC could significantly increase. If their supply is limited without the capacity to influence its value as an asset, it could break parity with other monetary instruments.

Option 3: Limits in the form of tiers

If limits in the form of tiers are implemented, the central bank can overcome the problem of fluctuating value due to the imposition of scarcity and a fluctuating demand, as the CBDC's value as an asset would also be influenced by the interest rate it receives.

Most interestingly, it would also allow for the decoupling of the competitiveness level at which a CBDC would provide the medium-of-exchange and store-of-value functions. In the words of Bindseil (2019, p.24) who argues for a CBDC with at least two tiers: “It allows assigning the payment function of money to tier one CBDC, while the store-of-value function would be assigned to tier two, and would essentially be dis-incentivized through an unattractive remuneration rate.”

Our proposal here is closely in line with that of Bindseil (2019, p.6) who convincingly argues that “the well-tested tool of tiered remuneration seems to be a way to ensure that the volume of CBDC will be well-controlled.” Tiered remuneration has been used extensively by major central banks, such as those of Japan, Switzerland and Sweden, as well as the ECB.

This version of a CBDC would allow the interest rate applied to it to be different for CBDC holdings beyond certain points. As a result, the use of the interest rate to control its level of competitiveness to other monetary instruments with regard to the main functions of money - store of value and medium of exchange - could be fine-tuned to a great degree.

For example, a CBDC where the interest rate is 0% for the first 2400 GBP²⁷ in an account and $-x\%$ ²⁸ for any subsequent amount would be rather similar to cash as a medium of exchange for small payments. However, the negative rate applied to amounts over 2400 GBP would ensure that it cannot be used as a store of value, limiting its competitive pressure to the banking sector only in the transactions front. This figure reflects the average monthly household expenditure in the UK, and should be appropriate as a starting point. A phased increase of this lower bound should be considered, to gradually increase the amount the public can hold safely with the central bank, provided this does not have adverse effects on financial stability.

5.4.1 Limits in the form of tiers: Financial stability and monetary policy considerations

A CBDC design which has limits in the form of different tiers in conjunction with the capacity to bear interest has important implications for the ability of the central bank to mitigate against both bank runs and banking disintermediation.

The arguments in section 5.3.2 on how the central bank can dis-incentivise CBDC holdings continue to apply, and thus safeguard against bank disintermediation and runs. Furthermore, the central bank’s capacity to control in what areas and to what degree a CBDC competes with bank deposits is greatly enhanced as the store-of-value and medium-of-exchange functions are decoupled.

Thus the degree to which a CBDC could impede banks’ funding - and by extension, the lending process - is separated from the degree it can compete from the revenues generated by transaction fees. This not only allows for the safe maintenance of a public payment option, but could even allow for the fine-tuning of market discipline imposed on banks, setting a ‘competition floor’ above which banks must compete.

5.5 Anonymity

The amount of anonymity or privacy that this new payment instrument should offer to transacting parties is an important design feature. If it were to be anonymous, it would bear close resemblance to cash and if not it would be more similar to bank deposits.

Currently, our payments information is in the hands of commercial banks, whereas with a CBDC it would reside with the state, which (at least for most democracies), is generally considered to be more trustworthy. Policymakers could effectively legislate to protect this data, and would provide it to the authorities only under the conditions that a bank would be obliged to do so under the current legal arrangements.

²⁷ ONS (2019). Family spending in the UK: April 2017 to March 2018. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/bulletins/familyspendingintheuk/financialyearending2018>. This figure is indicative and might need to be altered based on financial stability concerns.

²⁸ The level of interest rate here in the negative territory is not defined as for example a rate of -2% might suffice to guide the public in using bank deposits as a store of value in normal times, but in times of crisis this rate might need to be further into negative territory.

Christine Lagarde (2018, p.5) provides a colourful example of privacy concerns which might arise if all the means of transacting pass into private hands: “Imagine that people purchasing beer and frozen pizza have higher mortgage defaults than citizens purchasing organic broccoli and spring water. What can you do if you have a craving for beer and pizza but do not want your credit score to drop? Today, you pull out cash. And tomorrow? Would a privately-owned payment system push you to the broccoli aisle?”

Finally, the decision to proceed with a CBDC which has the option of bearing interest under a tiered system precludes the level of anonymity provided by cash (Koning, 2018, p.9). Nevertheless, given that all electronic transactions leave a digital footprint of some form, it is questionable whether approaching the anonymity of cash is even possible in the digital realm.

Furthermore, the primary objective for implementing this form of CBDC is to guarantee the continued existence of a public monetary instrument, along with the need to preserve financial stability. However, we will review the options for implementing anonymity in further detail:

Option 1: Anonymity

This option provides a level of anonymity akin to cash. Nevertheless, any digital transaction will leave some sort of digital footprint and therefore full anonymity will likely be difficult to achieve (Bank of Sweden, 2017, p.15, 25), unless value can be stored in cards similar to today’s prepaid cards. Then the exchange of these cards would allow hand-to-hand transactions just like cash (Bank of Sweden, 2018, p.36).

One important caveat of this option is that the liability for the transaction will lie with the parties partaking in the exchange. In the case of wrongdoing or loss, they would sustain the damages (Kahn, 2018). Furthermore, if the CBDC is fully anonymous, it could inadvertently facilitate financial crime. Striking the right balance between maintaining privacy and responding to such concerns could be a significant challenge for a central bank.

Option 2: Varying degrees of anonymity

There can be varying degrees of anonymity for CBDCs, as highlighted by the Bank of Israel (2018, p. 16), where the transacting parties may remain anonymous to each other but the clearing institution (a central bank, or a private sector provider) will know their identities. This could be for any amount, or only apply to transactions meeting specific criteria. In this case, the liability of wrongdoing could lie with the clearing institution, shielding the transacting parties.

Option 3: Anonymity level similar to that of bank deposits

This option would provide a level of anonymity similar to bank deposits. As noted above, there would be a greater sense of security and privacy associated with the CBDC if the party entrusted with the information was a central bank residing in a state with a democratic and accountable government. Again, the trusted party running the payment system and clearing the exchange could be liable for the security and any wrongdoing, insulating the transacting parties.

5.5.1 Anonymity: Financial stability and monetary policy considerations

The BIS' Committee on Payments and Market Infrastructures highlights that it is “a key decision for society... the degree of anonymity vis-à-vis the central bank, balancing among other things, concerns relating to money laundering, financing of terrorism and privacy” (CPIM, 2018, p. 6). Furthermore, as noted by Kahn et al, for payment systems, “record-keeping systems have tradeoffs in their level of access, privacy and security. For a given cost, there is a trilemma: no system can simultaneously have universal access, perfect security and complete privacy” (2018, p.9).

In order for a CBDC to be universally accessible, safe for financial stability, and compatible with monetary policy, the application of an interest rate, with differing rates of remuneration for separate tiers will be essential. On top of the substantial technical challenge of providing full anonymity for a CBDC, cash-like anonymity is incompatible with the account-based approach required by these design features.

Therefore, it is imperative that the central bank continues to support access to cash. As long as access to cash is protected, it can continue to fulfil the important function of a reasonably safe, secure and anonymous means of payment.²⁹

5.6 Convertibility

A final design consideration is the convertibility of a CBDC to other monetary instruments. It is likely that a CBDC needs to be on par with the creation-destruction that happens through its conversion to and from bank deposits.

Nevertheless, we suggest that central banks consider the option of using a CBDC as they have central bank reserves in the past for quantitative easing (QE).

This would allow the direct channeling of funds into the economy in order to boost aggregate demand, without using financial markets as an intermediary, which could potentially be more socially just and targeted.

How proactive issuance of a CBDC could affect the economy and the monetary system more specifically is an important area of further research.

Currently the only monetary instruments that can be converted to cash are bank deposits. If CBDCs were convertible with cash, this would create another outflow. This could generate financial instability risks which are not examined in this paper, but the possibility of direct convertibility of CBDC to cash definitely warrants further research. For example, it could be implemented as a second step to secure public access to cash if commercial banks continue to reduce their support for ATMs or reduce access to cash withdrawal services at bank branches. Simply announcing that policy makers are considering allowing direct conversion of CBDCs to cash would probably compel banks to conform with protecting access to cash.

²⁹ There is a risk that in the coming years, access to cash as a means of anonymous payment could become unavailable. In this scenario, one possibility worth investigating would be issuing a token-based CBDC with the capacity for anonymous transactions in parallel to the account-based CBDC specified here.

6 Design proposal and main benefits

This section will present a summary of the proposed CBDC design specification based on the analysis above. The aim of this report has been to provide a CBDC design which is safe enough for the monetary system so that it can be introduced, and versatile enough so that it can meet socio-economic objectives. The main parameter which ensures the safety and versatility of this CBDC design is the degree of control over the CBDC's competitiveness in the provision of money functions versus bank deposits, and therefore the authorities' capacity to adjust the respective market share of CBDC in relation to bank deposits. Thus "the choice over how attractive to make CBDC vis-à-vis deposits will depend on the extent to which the central bank is willing to encroach on the role that the banking sector has traditionally played in the provision of an electronic means of payment" (Meaning et. al., 2018, p.12)³⁰ for both the transaction and store-of-value functions, mitigating against both bank runs and bank disintermediation.

The first part of this section provides a summary of the CBDC design and describes the basic mechanics of CBDC controllability. The second section goes over some of the main benefits that this CBDC could provide, and areas for future research are explored.

³⁰ Arguably the degree of control that the central bank has "over the attractiveness of CBDC relative to deposits through its design" (ibid., p.12) is higher than suggested by the authors cited, given the ability to distinguish between the store-of-value and medium-of-exchange functions.

6.1 Proposed CBDC design

In section 3.1, we assessed cash, bank deposits and CBRs in terms of access, form, transaction system, interest rate, limits or caps, issuance and convertibility. We can now consolidate the conclusions drawn in section 5 and specify the full list of proposed design features for CBDC using the same framework:

- **Access:** a CBDC which is universally accessible, similar to cash. This is a prerequisite if the CBDC is to have an extended capacity to positively impact the monetary system and by extension the economy and society.
- **Form of monetary instrument:** account-based, similar to deposits in nature but similar to cash in liquidity and risk profile. This is a prerequisite if it is to have the capacity to bear interest³¹ and have limits in the form of remuneration tiers.
- **Transaction system:** initially centralised through a trusted intermediary (the central bank), similar to central bank reserves. Nevertheless, it could also be centralised through trusted intermediaries (as bank deposits are) or even decentralised (like cash). While we do not propose these transaction types be implemented in the short term, they should definitely be considered further down the line, especially the option of decentralised transactions.
- **Interest rate:** it should have the capacity to bear interest just like bank deposits and reserves do. Interest rate manipulation can provide a significant degree of control over a CBDC's competitiveness level versus other instruments, and therefore amounts in circulation to the central bank. The determination of how interest is charged (on the transaction as a fee, monthly, annually etc) can accentuate the degree of control.
- **Limits or caps:** in line with Bindseil (2019), it is argued that a CBDC should have a tiered remuneration system which would further increase the central bank's ability to control this new monetary instrument. The degree of control increases as tiering allows the competitiveness of the CBDC to be individually determined for both the store-of-value and medium-of-exchange functions.
- **Issuance and seigniorage:** its issuance should be reactive through commercial banks just as with cash, i.e. conversion of bank deposits to CBDC and vice-versa, albeit under greater control from the central bank. Regarding seigniorage, in both the case of conversion of bank deposits to CBDC or through the direct creation of CBDC by the central bank as part of an unconventional monetary policy, whatever the resulting seigniorage is should go to the central bank.
- **Convertibility to other monetary instruments:** convertible to and from bank deposits based on how appealing it is as a monetary instrument which is set by the central bank.³²

Mechanics of CBDC controllability

In terms of how a CBDC performs its function as a monetary instrument, it should be up to the central bank to determine how competitive it is against other monetary instruments, and thus the impact it has on the usage of cash and bank deposits, as well as the impact on the banking sector as a whole. The design can be used to increase or decrease its competitiveness versus other monetary instruments. More specifically:

- Store of value function: its degree of competitiveness in performing this function hinges on the joint use of the interest rate and tiers of remuneration. Together, the holding limits and the interest rate determine the amounts that are remunerated or penalised.
 - o The higher the level of interest offered in these tiers or tier (if there is only one tier) compared to that offered by the banking sector and the 0% on cash, the more competitive a CBDC will be as a store of value versus both bank deposits and cash.
Potential consequence: migration from bank deposits and/or cash to CBDC
 - o The lower the interest rate is in comparison to other monetary instruments, the less competitive the CBDC will be. In the case of bank deposits, there will be room to pay a higher or lower rate of return. For cash, which effectively has an interest rate of 0%, a negative rate would be needed to be less competitive.
Potential consequence: migration from CBDC to bank deposits and/or cash

³¹ According to the EU Parliament directive 2009/110/EC.

³² This refers to economies like the UK where the vast majority of people are banked. Nevertheless, there should be provisions for the unbanked. These provisions will need to be tailored to each country's specific needs and infrastructures.

o If the level of interest is around 0%³³ it should be just as competitive as cash in the provision of this function and less competitive than bank deposits.³⁴

Potential consequence: bank deposits unaffected, migration from cash to CBDC

o Overall, the degree and speed of migration between monetary instruments would most probably depend on the spread between the interest paid to them. This could also instigate movements of bank deposits rates to counter this effect.

- **Medium of Exchange:** The tiering of remuneration is critical in separating the functions of store of value and medium of exchange, in order to further fine-tune the competitiveness of CBDCs on these two fronts. Reference will be made at the rate of the first tier, which will be labeled the *transaction tier*. For any other tiers which would fall under the store-of-value function, the above applies.
 - o A CBDC interest rate at the same level of bank deposits should make it just as competitive as bank deposits and more competitive than cash.³⁵
 - o An interest rate at 0% would make it roughly just as competitive as cash and potentially less so than bank deposits
 - o An interest rate above that offered on bank deposits would make it more competitive than bank deposits and thus could potentially instigate a migration of deposits to CBDC tier 1 up to the level of the tier. The opposite applies and could instigate movements of commercial bank deposit rates.
 - o Finally, if transaction fees charged for making payments with the CBDC are lower than bank deposits, that should push bank deposit transaction fees lower or erode banks' revenues from this stream.
- **Unit of account:** Its function would be similar to cash, acting as an anchor for the monetary system, given that it would be state-issued money.
- **Generation of trust:** It would perform this role just as well as cash, with the caveat that since this electronic account-keeping and transaction system would require some form of energy, it could not act as a physical backup as cash does, but could still act as a backup for the private accounting and transaction systems. Furthermore, it would complement the monetary system, and by extension bank deposits, by ensuring that it has a credible anchor.

6.2 Use of a CBDC to achieve specific objectives

This section outlines the guiding principles for using this CBDC design, and discusses the specific socioeconomic objectives it would enable the central bank to pursue. We have argued in this paper for a CBDC design which makes it viable from a financial stability perspective. This has resulted in a design with additional benefits:

- Protecting the public's access to public means of payment, thus maintaining trust in the monetary system.
- Combating market concentration in the provision of banking services.
- Improving financial inclusion.
- Increasing market discipline in the private banking sector.

³³At this stage it is not within the scope of this paper to determine the rate at which the competitiveness of CBDC for the store of value function would emulate that of cash, however it is presumed to be slightly negative in order to compensate for the security and ease of storage it would offer versus cash.

³⁴Given that due to deposit guarantees they would have a similar risk and liquidity profile.

³⁵Assuming that the first tier is set below the amount covered by deposit insurance

6.2.1. Protecting the public's access to public means of payment

Issues faced

“Today, it is technically feasible for all payments in advanced economies to be made without cash. In a cashless society, the general public does not have access to public money. They instead hold deposits or digital currencies backed by the assets of private issuers. Even if those monetary instruments are convertible into each other, people would not have access to any monetary anchor into which bank deposits or digital currencies could be converted. In effect, private issuers would lose the discipline of public money, and their issuance would instead be shaped by other market forces. Indeed, if there were a broad loss of confidence in the banking system, people would have nowhere to run. The general availability of public currency disciplines the banking sector as a whole.”

(Brunnermeier and James, 2019, p.25)

Bank lending was a leading cause of the financial crisis of 2008, and the Great Recession that followed. Many commercial banks required public assistance to recover, and many economies are still trying to do so. Their tendency to generate financial crises, rooted in asset price inflation largely fueled by their lending, has shown that the commercial banks cannot be trusted to be the sole providers of money.³⁶

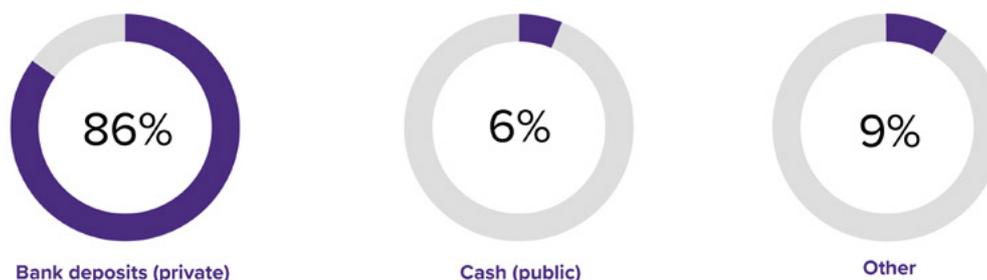
The issue above relates to the core of money functions, unit of account and creation of trust. If it cannot perform these two functions, it cannot act as a medium of exchange or a store of value. With the medium-of-exchange function in mind, the Swedish central bank, which faces the risk of a cashless society most imminently, states “If the state, via the central bank, does not offer any payment services on the strongly concentrated private payment market, it may lead to a decline in competitiveness and a less stable payment system, as well as make it difficult for certain groups to make payments. Ultimately, it may risk eroding basic trust in the Swedish monetary system.” (Bank of Sweden, 2018, p.12).

The fears above apply to the majority of central banks, as monetary systems and their payment service markets are usually ‘strongly concentrated’, tending towards ‘monopolies’ by nature, as highlighted by Lagarde (2018). Market concentration is not only a systemic risk, but can also result in rising rent extraction and reduced competition in that sector, with implications for the cost of transaction services. Last but not least, there are members in society who do not fit into any bank’s profit model and are left out from such a system, and may be forced to incur costs or pay a ‘poverty premium’ which they otherwise would not.

³⁶ Furthering this argument, even today, the areas in which commercial banks’ newly created money first enters circulation tend to be those most affected by asset price inflation, for example the housing market. To a large extent that can be attributed to the fact that their main consideration is profit and not more general supply and demand considerations which are accounted for by central banks.

The imminence of these risks on any given economic jurisdiction largely depend on the market share occupied by public monetary instruments and transaction systems versus private in the provision of money services. In the case of the UK, as noted in section 3.2 above, there has been a dramatic decline in cash usage in recent years. The projection of decline for the next decade, presented below (figure 9) is especially concerning, as is the possibility that this decline might happen even sooner than expected:³⁷

Figure 9: Projected decline of public monetary instruments used in transactions by 2028
Forecast for the market share of public and private monetary instruments in the UK



Source: UK Finance (2019, p.6), author's calculations.

To make matters worse, efforts from private interests to limit access to cash are already in motion. As Clarke (2018, p.5) explains: “the current arrangement [of cash access in the UK] is under threat from cost-cutting by banks and moves by card companies to make cash machines unprofitable. Some banks have pushed Link³⁸ for a reduction in the interchange fee on cash machine transactions. They have been able to do this because of the threat they will leave Link for alternative schemes operated by Visa and MasterCard, which are reported to set interchange rates up to 30% lower than Link, well below the true cost of facilitating the transaction.”

Given that ATMs are the main way in which the public accesses cash, a strong case can be made that commercial banks are actively trying to decrease the public's ability to transact using public means through predatory pricing, in order to increase their market share in the provision of money functions and transaction services.

How this CBDC design can help protect the public's access to public means of payment

Merely the introduction of the CBDC advocated for in this report could mitigate these risks. It would not jeopardise the functioning of the private banking sector, but it would ensure the continued trust in the monetary system by providing the public anchor which is foundational for its existence.

The aim is not to stop banks from performing their functions in the economy, but to make sure that there are sufficient checks and balances, ensuring that they will perform these functions well. A CBDC that is sufficiently competitive with bank deposits, perhaps to the degree that cash has been, would push toward that direction. It “has the potential to make the real economy more resilient to economic and technological shocks since [it] would facilitate continued access to a safe, generally accepted means of payment even when other means of payment became either economically or technologically unreliable.”³⁹ (Juks, 2018, p.40)

The CBDC design argued for in this report allows a high degree of central bank control over the CBDC's competitiveness in relation to bank deposits (in the main money functions that cash and bank deposits currently compete on). This ensures that expansion of the CBDC's market share will be conducted with financial stability as a primary concern.

³⁷ The initial forecast by UK Finance for the time by which debit cards would overtake cash as the most frequently used payment method was at a later time (UK Finance, 2018, p.3)

³⁸ The Link scheme “is currently the principal way in the UK that banks, building societies and providers of ATMs work together to allow customers widespread access to free to use ATMs.” (Nixon, 2017, p.1)

³⁹ Our addition in square brackets replaces “e-krona”.

In a time where cybersecurity threats are on the rise, a CBDC could even act as a back-up network for transacting, and would therefore make the entire economy more resilient.

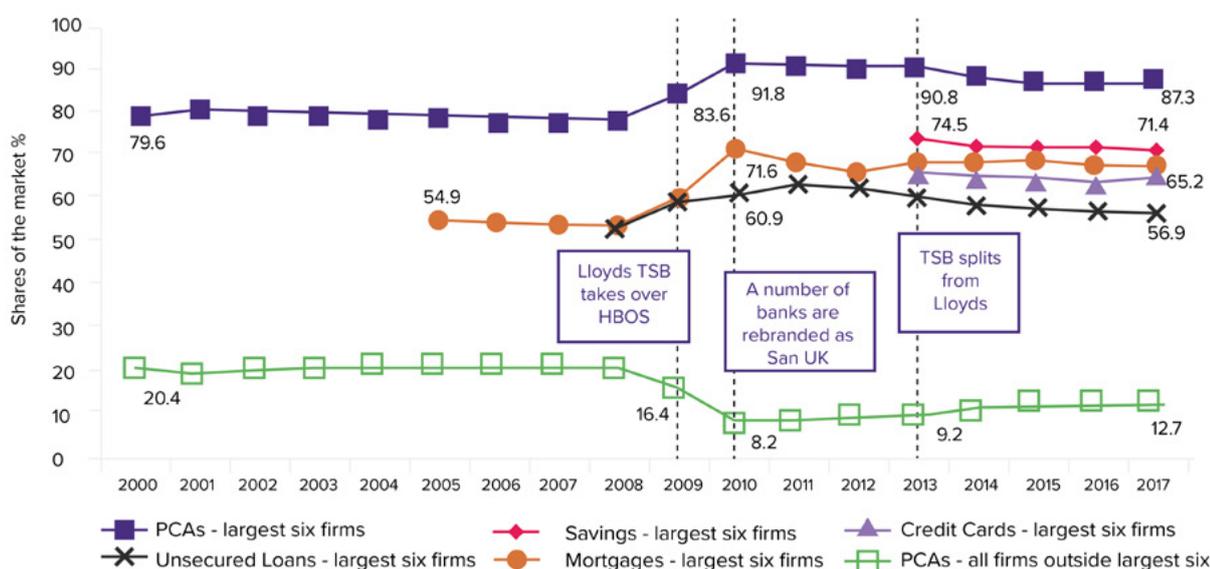
6.2.2 Decreasing concentration in the provision of banking services

Issue faced

“Policymakers had encouraged the new competition to the entrenched Lloyds, Royal Bank of Scotland, and Barclays. It does not seem to be working. In 2000 the top six firms accounted for 80 per cent of personal current accounts, according to the FCA. By 2017, the figure had risen to 87 per cent” (Megaw, 2019, p. 1-2/6).

The issue of a highly concentrated banking market is a problem faced in many economies and not limited to just personal current accounts (PCAs). The above percentages, which indicate the situation in the UK, are also depicted in the figure 10 below (FCA, 2018 a, p.4):

Figure 10: UK retail banking market concentration
Concentration levels in retail banking in GB measured using market shares of the largest six firms since 2000



Source: FCA analysis of GFK data

This data shows that the retail banking sector is highly concentrated. PCAs are of particular interest as they represent a type of account commonly used for the exchange and store-of-value functions. At one point, the 6 largest UK banks held over 90% (from 2010-2013) of the PCA market and by 2018 the same figure was 87.3%. For savings, we see a similar situation: the same banks held 71.4% of the market (along with roughly 66% of all credit cards and mortgages and 57% of unsecured loans).

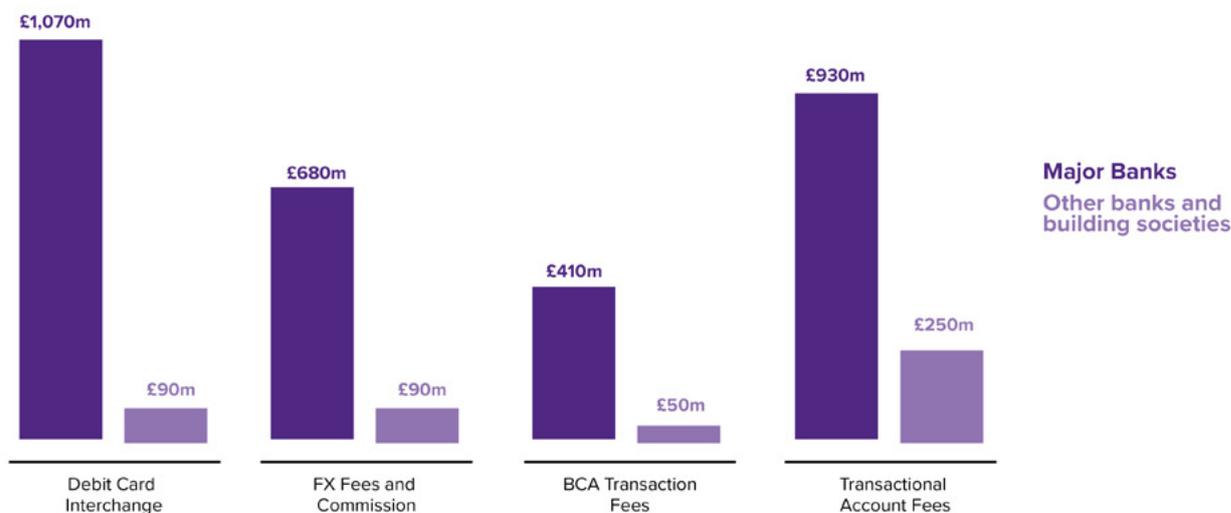
However, given that “the central bank probably does not want central bank money to become a large-scale store of value, i.e. investment vehicle as this would mean that the central bank would become a financial intermediary” (Bindseil, 2019, p. 14), our analysis will focus on how reducing the concentration of the market for transactions services would increase competition for the provision of money’s medium of exchange function.

Although steps were taken by the Bank of England in 2017 to remove the “...huge and unnecessary barriers to entry to this market”(Dyson and Hodgeson, 2014, p.1), not much has been achieved. The degree of concentration

in the provision of transaction services and how skewed it is toward the ‘big six’ is evident in figure 11 below, which depicts the revenues generated⁴⁰ from such services by firm category (FCA, 2018 c, p. 26):

Figure 11: UK transactional banking revenues

Revenue from transactional banking by type and firm category (2017)



Source - FCA analysis sample includes 6 major banks and 13 other banks and building societies that earned revenue from transactional banking. Interchange includes revenue from SME and Personal debit card transactions. FX includes fees and commission on foreign payments and transfers. SME transaction fees include charges for manual and electronic transactions through business current accounts. Transactional account fees include monthly charges for personal current accounts (e.g. packaged accounts) and business current accounts. Excludes: ATM interchange, negative revenue, revenue from overdrafts, and direct revenue from ancillary products such as insurance.

The total revenue received by these six banks is £3.1 billion, and for the 13 other banks and building societies it is merely £0.48 billion pounds.

The degree of market concentration, as indicated by the market share of accounts that offer these services and reflected by the revenues that they generate, shows that there is space for an increase in competition. Competition could not only lower prices but also increase the level of service provided to customers. As argued by the British Bankers Association “customers should have a wide variety of choice of both banks and banking products. We believe competition should be encouraged to provide this choice and drive innovation in the industry” (Barty and Ricketts, 2014, p. 70).

How this specification of CBDC design can help decrease concentration in the payments market:

The CBDC proposed here could help reduce market concentration in the payments market by increasing the degree of competition that banks face in the provision of the medium-of-exchange function of money. The tiered CBDC design feature would allow the central bank to specifically target the amounts of total deposits that can be used for this function.

The ability to specifically target these amounts would allow for them to be calibrated below the threshold that would create financial instability and uncontrolled bank disintermediation. Given that a central bank, in this case the Bank of England, may not want to administer accounts for citizens directly, the introduction of a CBDC would open a new market space for innovation and competition for both new and existing financial institutions, especially fintech companies.

⁴⁰ As noted by *ibid.*, this figure “shows the significant revenue pool that these fees and charges generate. Transactional banking also generates some negative revenue, such as the net interchange paid to ATM providers as a result of customers using ATMs, however this is not included in the analysis.”

Christine Lagarde (2018, pp. 6-7) has clearly articulated the benefits and opportunities of a CBDC, proposing a central bank–private sector partnership in which:

“banks and other financial firms, including startups, could manage the digital currency. Much like banks which currently distribute cash. Or individuals could hold regular deposits with financial firms but transactions would ultimately get settled in digital currency between firms. Similar to what happens today but in a split second. All nearly for free. And any time. The advantage is clear. Your payment would be immediate, safe, cheap, and potentially semi-anonymous. As you wanted. And central banks would retain a sure footing in payments. In addition, they would offer a more level playing field for competition and a platform for innovation.”

A note on CBDC as a store of value

The store-of-value function that bank deposits provide is the flip-side of the credit creation and allocation function banks perform, which is critical for any given economy. Providing a highly competitive option for this function through CBDCs sitting outside the private banking system would continue to necessitate that these funds are used as part of the creation and allocation of credit. In this case as noted above by Bisdail (2019), as well as the BIS' CMPI, amongst others, the latter of which states that this “could mean a greater role for central banks in allocating economic resources, which could entail overall economic losses should such entities be less efficient than the private sector in allocating resources” (2018, p. 2).

Given the continuing financial fallout of the 2008 financial crisis, we argue the private financial sector has failed to allocate credit effectively to optimise use of economic resources. The combined lack of market discipline and effective regulation has allowed commercial banks to lend speculatively rather than productively, accruing substantial profits while transferring the downside risks and losses to ordinary citizens, governments, and non-financial private sector firms. The potential use of a CBDC as a competitive store-of-value service to guide funding for credit creation towards more economically and socially useful projects is something that needs to be explored. As long as the overall rate of money creation does not decrease, and citizens generally support more ethical outcomes over purely financial gains, there could potentially be significant environmental, economic and social benefits. Furthermore, the government may be willing to subsidize these activities, as it currently does with the commercial banking sector, which could amplify these benefits. Ideas for the implementation of a CBDC as part of the credit creation process include:

- The potential for the creation of National Development Banks as an option of offering CBDC store-of-value services.
- The potential for the creation of Green Investment Banks.

It is important to keep in mind that a substantial amount of lending by banks currently goes to asset price inflation, whether that is in housing or financial sectors. As highlighted by Bezemer (2014, p.5) “ ‘credit is what credit does’ – [a] distinction made by Schumpeter, Keynes, Minsky, Tobin and Friedman.”

Another problem that could arise with a reduction in commercial bank funding due to the introduction of a CBDC, is that of an increase in the cost of bank lending. This could also be the case if banks increase the rate paid on deposits in order to compete with CBDC deposits.

This issue is highlighted by Juks (2018, pp.91-92): “A potentially higher cost of funding... raises the issue of who bears it: would it be banks, in the form of lower profitability or their customers? There are some good reasons to believe that the increased cost of funding due to a lower share of retail deposits would be at least partially absorbed by banks, and not entirely by the customers”. He then goes on to argue that “there are natural limits on how much banks can increase their lending rates to compensate for lost retail deposits. These limits are set by banks that use little or no deposit funding as well as other non-bank sources of funding that compete with deposit taking banks”.

These are areas for future research which could be conducted with this CBDC design in mind, as it provides a great level of controllability over the degree and area of impact on the private banking sector.

6.2.3 Improving financial inclusion

The unbanked in the UK account for about 3% of the population - approximately 1.3 million people (FCA, 2017, p.145). Although the percentage might seem small, the number of people is rather significant. This picture is starkly different when looking at the global level of the unbanked which is 21% or 1.7 billion adults of which “nearly half live in seven developing economies: Bangladesh, China India, Indonesia, Mexico, Nigeria and Pakistan” (Demirguc-Kunt et al., 2018, pp. 3-4). Based on this World Bank survey, the main reasons for not having a bank account were cost and distance (about 25% of unbanked) and lack of documentation along with distrust in the financial system (about 20% of unbanked) (ibid., p.5).

As noted in the World Bank report, the benefits of financial inclusion for development ‘can be wide ranging’ and include (ibid, pp.1-2):

- Reduction of poverty, by helping to improve people’s earning potential.
- Financial risk management, by allowing the long distance transfer of funds when faced with difficulties.
- Lowering the cost of making and receiving payments.⁴¹
- Aiding in the accumulation of savings and spending on necessities.
- Improvement of efficiency and reduction of corruption.

Nevertheless, and restated from above, “We know that banks are not exactly rushing to serve poor and rural populations”⁴² (Lagarde, 2018, p.4). It is also clear that a large portion of these populations - the 45% - do not trust the financial system or find it difficult or costly to access it.

How this specification of CBDC design can help improve financial inclusion:

The introduction of a CBDC as outlined here would allow for these parts of the populations in a number of developing countries to access the financial system in ways that are not currently possible due to the overriding profit motive of commercial banks.

By fine-tuning the interest applied in each tier of the CBDC, authorities could insulate their banking sectors from instability while servicing the very basic needs of the unbanked. The degree of trust would arguably be higher, and access could be wider through public-private partnerships and FinTech innovation.

As indicated by Dyson and Hodgson (2016), the access to these accounts could “be outsourced to companies who could provide the necessary communications services to provide digital cash holders with access to their electronic wallets and to the payment system.... these service companies could well be mobile phone operators but could equally be internet service providers or companies established primarily to manage Digital Cash Accounts on behalf of the account holders” (p.14).

6.2.4 Market discipline considerations and areas for future research

Commercial banks continue to enjoy numerous protections provided by the government, such as deposit insurance and ‘too-big-to-fail’ subsidies. As highlighted by Wolf (2018) when criticising the banking sector’s complaints on more extensive regulation and higher equity requirements as part of new Basel Accord:

“This amount of equity is far below levels markets would impose if investors did not continue to expect governments to bail out creditors in crisis... ..to the extent that taxpayers bear the risk, more equity offsets this implicit subsidy. The public at large has zero interest - in fact, a negative interest – in subsidizing risk-taking by

⁴¹ Cost here does not only refer to financial cost, but also time, travel and opportunity cost.

⁴² She also notes that “offering a digital currency is not necessarily the only answer. There may be scope for governments to encourage private sector solutions, by providing funding or improving infrastructure” (ibid., p.4).

banks, in general. For this reason, the subsidy it offers by providing free insurance must be offset by imposing higher capital requirements” (pp. 1-3 /4).

The problem of imposing market discipline on the banking sector has long been an issue that regulators have struggled to address. Before the Great Recession of 2008, when the boom that fuelled it was just beginning, the Basel Committee on Banking Supervision (2001, p.1) recognized that “Market discipline imposes strong incentives on banks to conduct their business in a safe, sound and efficient manner, including an incentive to maintain a strong capital base as a cushion against potential future losses arising from risk exposures”. Not long after, the Federal Reserve Bank of Chicago and the BIS cosponsored a conference at which the importance of market discipline for the banking and financial sector was highlighted: “long standing government discipline in the form of prudential regulation appears to be becoming less effective as financial institutions and financial markets become larger and more complex” (Borio et. al. eds., 2004, xi).

Until now, the degree to which this discipline could be imposed on the private banking sector has been rather limited, as commercial banks hold a monopoly (or at least an oligopoly) over the primary means of digital payment available to the public. A CBDC could open the door to numerous ways in which market discipline could be applied to the banking sector, making our economies safer and more efficient. As highlighted in section 6.2.1, just the existence of a CBDC would help safeguard the existing level of market discipline, which is otherwise disappearing with the decline of cash. Further discipline could be imposed by allowing entry of new and innovative private players in areas which so far have been dominated by a few commercial banks (as highlighted in section 6.2.2).

This paper has explored three key ways in which a CBDC could benefit our monetary system and our economy, but the introduction of this new monetary instrument could potentially lead to many more socially and economically efficient outcomes, and these should also be explored. Key areas for future research include:

- What level of loss of market share for both the store-of-value and medium-of-exchange functions of bank deposits would place the private banking sector in critical risk for any given economic area.
- Alternative ways to use CBDC created through conversion from bank deposits in order to create and allocate credit to specific socioeconomically beneficial purposes or industries.
- How proactive CBDC creation could lead to higher capacity utilisation in different economic areas and/or the achievement of socio-economic goals.
- How a CBDC could be used as part of unconventional monetary policy in order to combat the effects of financial and economic crises. Helicopter money could be instantly distributed to CBDC accounts to boost aggregate demand, and could potentially be more accurately targeted than other forms of monetary stimulus.
- How CBDC could contribute to the orderly dissolution of inefficient banking institutions and the transferring of their business to more capable organizations.
- How CBDC could mitigate the moral hazard created by ‘too-big-to-fail’ banking.
- How a CBDC can enable a more effective and efficient monetary system through public-private partnerships.
- The potential use of a CBDC to fund special purpose public-private banks, such as a green transformation bank or a national development bank.

7 Conclusion

The CBDC design outlined in this paper would minimise risks to the banking sector whilst still being a versatile tool that can be used to pursue socioeconomic benefits. We have concluded that control of how competitive CBDC is versus bank deposits is critical in order to protect financial stability, by safeguarding against unwarranted bank disintermediation and bank runs. If cash use continues to decline, safely implementing CBDC would avert the complete privatisation of money, and should constitute an effective channel for the transmission of unconventional monetary policies. This form of CBDC would provide a solid platform for the central bank to bring about positive change and help ensure that benefits of future monetary stimulus are more equitably shared than those of the past.

In summary, the CBDC design proposed in this paper:

- Reduces the risks to the monetary system posed by the decline of cash.
- Complements cash and bank deposits by accurately controlling how competitive a CBDC is versus these monetary instruments and thus its market share.
- Expands the central bank's monetary policy toolkit, unlocking new options for responding to financial and economic crises and realising socioeconomic benefits (alongside a traditional monetary policy).
- Builds a foundation for protecting the digital payments system in times of crisis.
- Provides a basis for future research into the potential interactions of CBDCs with central banks' unconventional monetary policy approaches.

The suggested CBDC design allows for the central bank to separately determine how competitive it is in performing the store-of-value and medium-of-exchange functions versus other monetary instruments.

This is possible as the proposed CBDC is account-based, allowing for limits in the form of tiers to be implemented and for an interest rate to be applied. This ensures the central bank has the required level of control over how attractive a CBDC is for savers, and how competitive it is for making transactions. The degree of competitiveness can be measured by tracking the market share occupied by different monetary instruments in the provision of monetary functions.

To achieve the above, a CBDC needs to be fully accessible to the public. If the rapid decline in cash usage continues, the need for a new digital form of public money to act as the anchor of trust for our monetary system will increase.

Along with securing access to cash, CBDC would provide the potential to increase financial inclusion, an issue of critical importance for billions of people across the world.

Preserving access to cash alongside the implementation of a CBDC is critically important: cash provides an irreplaceable anchor of trust for the monetary system, and ensures that the payments system is still able to function at a basic level if digital payments technology is disrupted. Cash is also unique in its ability to provide a highly anonymous means of payment. While an acceptable level of anonymity can be achieved for digital payments with technical and legislative measures, it will always fall short of the anonymity provided by cash (regardless of the apparent sophistication of such proposals). Such measures should therefore be seen as complementary to cash, and never as a substitute for this core function that cash provides.

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