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How can CBDCs improve financial inclusion?

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ABSTRACT

This research paper focuses on central bank digital currencies (CBDCs), a new type of currencies developed by central banks around the world that will only be available in a digitalised way and which rely on the blockchain technology. Indeed, with the growing rate of digitalisation in the economies, and the emergence of cryptocurrencies, which are extremely volatile and not controlled by any central authorities, central banks are facing a threat to their monetary authority and are resorting to digital alternatives to provide for new options that are also appealing to the participants in the economy. For this reason, CBDCs are becoming more and more important in monetary debates, but few research has been done about them and even fewer practical cases are existent nowadays, despite their large potential. In particular, CBDCs could have a critical impact in developing economies to make the payment system more efficient and improving financial inclusion. Therefore, this paper aims at analysing the different CBDC projects that are currently ongoing within the aforementioned countries and what their potential is to be better solutions for financial inclusion with respect to the existing alternatives, such as mobile money.

Through an analysis of the existing literature, this thesis synthetizes the information that is currently existing about CBDCs, from the origin of money and central bank roles which then led to the different motivations behind these projects. After that an analysis of the three main existing projects, namely the Sand Dollar in the Bahamas, the ECash in the Eastern Caribbean Currency Union and the eNaira in Nigeria, is carried out, with interviews from different experts to better understand their state and how they can help with financial inclusion.

What emerges from the paper is that CBDCs have a large potential to increase financial inclusion, which is actually a main rationale behind their development, due to different features that make them better than the alternatives, in particular lower transaction costs, offline access, greater trust in emitting institution and greater potential direct access. However, according to some experts, the current projects may have gone too fast without considering the actual need for the population for digital payment alternatives and could thus be a source of increased complexity for users.

ACKNOWLEDGMENTS

This master thesis is written as a part of my master's degree specialization in Finance at HEC Paris. Due to the rapid development of the blockchain technology and to my interest in emerging economies, I decided to pursue the topic of CBDCs and how they can represent a tool to improve financial inclusion with a focus on the aforementioned markets. I found this a complex topic with many challenges yet to overcome, due to its novelty and lack of reliable data, but also extremely interesting as it represents an innovation that could have a large beneficial impact on people and society.

I would like to express my gratitude to my supervisor Prof. Guillaume Vuillemey for his critical and rapid feedback from choosing the subject to finishing the thesis. Furthermore, I wish to thank the people that helped me in the completion of this report, notably Karina Johnson from the Eastern Caribbean Central Bank, Ozili Peterson from the Central Bank of Nigeria and Antonia Esser and Michaella Allen from the CENFRI for their invaluable help in providing expert opinion and very interesting insights by accepting to be interviewed.

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Chapter 1. INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

Since the aftermath of the global financial crisis in 2008, when the pseudonym Satoshi Nakamoto published a report called "Bitcoin: A Peer-to-Peer Electronic Cash System.", cryptocurrencies and the blockchain technology rose to fame as a potential alternative and decentralized monetary system in protest of the current one, blamed of being too favourable towards large banks and corporations, rather than individuals. The greater and greater attention towards this technology and the lack of regulation often led to speculative and very volatile cryptocurrencies, adding up on the uncertainty. Despite these issues, it is clear that the blockchain technology has a large potential to make the financial system more efficient and faster thanks to its automatization, security and decentralization.

For this reason, and in order to pose the technology under an authority for greater scrutiny, central banks around the world started to evaluate the possibility to implement the blockchain technology in their system with the launch of central bank digital currencies (CBDCs). These new type currencies works as a digital version of conventional cash, thus answering to the need of an ever-growing cashless society and offering people the opportunity to participate in faster and more efficient transactions, while at the same time not being exposed to the risks that are common of cryptocurrencies, in particular the high volatility and the lack of regulation.

The need to react to an alternative system that could hinder central banks' ability to conduct monetary policy and the effort to make fiat currency relevant in a cash-less society are not the only points of interest behind CBDCs. Indeed, the blockchain technology has clear advantages in making transaction faster, more efficient and in providing an easy access to a distributed ledger for everybody. Therefore, it could offer new opportunities in helping people accessing financial services. For this reason, central banks, especially in developing economies, are considering CBDCs as a way to increase financial inclusion, by allowing people to have digital

wallets to make/receive payments without the burden of accessing physical services, which are often a too great barrier to overcome.

As these projects are very recent and few research has been done on their utility, the motivations behind this paper are those of analysing the current available sources to understand whether financial inclusion really is a critical reason for central banks when designing a CBDC. Moreover, another reason for this research is that of observing whether CBDCs, according to experts' opinions, can really represent a valuable tool in fighting financial inclusion and be a better alternative than existing digital finance services, with a focus on mobile money, a technology that helped millions of people be included in the financial world.

1.1 RESEARCH QUESTION

The purpose of this paper is to study the potential of CBDCs for improving financial inclusion, especially in emerging economies, where this problem is more pressing. The thesis presents an analysis of the ongoing CBDC projects to understand if financial inclusion does represent a rationale behind them and how well they have been working so far to reach that goal.

Therefore, the thesis question is:

How can CBDCs represent a valuable tool in improving financial inclusion with respect to current digital finance alternatives?

1.2 OUTLINE

Chapter 1 contains a presentation of the background, research question, and outline of the thesis. Chapter 2 includes a review of the existing literature to better understand what the origins of central banking are and which factors led to the development of CBDCs. In order to understand this, the review begins from the very origins of money, from its definition, to the theories about its creation to finally the different types of money existing today. From there, an analysis on the history of central banks and their role in the economy is carried out. Then, so as to grasp why the blockchain has become so important, the origins of the technology and

cryptocurrencies, with their benefits and limits, are studied, moving onwards to their evolution in less volatile instruments, the so-called stable coins.

CBDCs are considered as an institutional evolution of the latter, therefore, Chapter 3 analyses them, considering their origins, the main motivations and technologies behind them. The chapter also describes the main focus on the impact of CBDCs for this thesis, financial inclusion, and studies the impact of other digital finance solutions to improve, in particular mobile money, with a focus on emerging economies.

Chapter 4 provides with an analysis of the ongoing CBDC projects that are already implemented, namely the Sand Dollar in the Bahamas, the ECash in the Eastern Caribbean Currency Union and the eNaira in Nigeria, studying their origins, motivations and adoption. The chapter further provides with interviews with experts to better understand the success and issues that these projects are facing. Moreover, the final part of the chapter analyses more in depth the role of CBDCs and financial inclusion, trying to understand whether they can be a complete solution to the problem, a complementary one within the current financial ecosystem, or an unnecessary complexity for users, strengthening the analysis with opinions from experts. Finally, chapter 5 delivers the final thoughts on this topic and areas for further research.

Chapter 2. LITERATURE REVIEW

2.1 MONEY

2.1.1 Functions of Money

The concept of money has been studied, defined, and explained by many scholars. According to the theory, money has 4 main functions: 1) medium of exchange; 2) store of value; 3) means of unilateral payment or settlement; and 4) measure of value. Even considering these different functions, the main importance of money relies in its role as a solution to the issues caused by barter. For example, Smith (1776), explains how the division of labour drive people to start bartering by exchanging their surplus with their wants. Money, as a medium of exchange, takes place to overcome the double coincidence of wants. Thus, he emphasizes the two functions of money: "that wealth consists in money, or and silver, is a popular notion which naturally arises from the double function of money, as the instrument of commerce and as the measure of value" (p. 398). Similarly, Mill (1865) emphasizes that "the inconveniences of barter are so great, that without some more commodious means of effecting exchanges, the division of employments could hardly have been carried to any considerable extend" (p. 4). In his view, money should just be precious commodities, such as gold and silver, that serve as the medium of exchange. Thus, money serves two critical functions: as a medium of exchange and a common measure of value . Also, Milnes (1919) defines money as "a third commodity, chosen by common consent to be a medium of exchange and a measure of value, between any and every other two commodities" (p. 54). As an alternative method, Smith (1776) argues that "labour is the real measure of the exchangeable value of all commodities" (p. 30). However, as "labour is difficult to measure" (Smith, 1776, p. 31), he explains that money can be used to estimate value, although "the nominal prices themselves are adjusted on the basis of the labor expended in both the production of money and other commodities" (Henry, 2000, p .4). Moreover, he indicates that money serves as a standard of value and a store of value. The aforementioned studies mention several commodities that were used as money (mainly as a

medium of exchange and a measure of value), like precious metals (gold and silver), cattle, sugar, and iron. However, not all commodities can be used as money. Hill (2018) explains that in order to perform the function as a medium of exchange, a commodity should have wide acceptance, should not be extremely volatile, should establish confidence, have right denomination, be portable, be durable, and be secure. In addition, in order to carry out the function as a measure of value, a commodity should be applicable widely and reduce costs that are required to discover and compare relative value and prices between goods and services (Hill, 2018). The classical literature then states that the main function of money is being a medium of exchange, however, some more recent theories do not consider that as the main rationale behind it. Instead, the primary function would be money as a measure of value. Ingham (2004), states that "money is uniquely specified as a measure of abstract value (money of account); and as a means of storing and transporting this abstract value (for means of final payment or settlement of debt)" (p. 70). This view emphasizes that money is not tangible. This abstraction denotes a conditional 'promise' to pay that is used to cancel "any debt incurred by the issuer" (p. 12). And it also represents the purchasing power that is possessed by money, which "exists independently of the goods it can buy" (Ingham, 2004, p. 70). This argument is based on other studies such as Keynes (1930), which opened by an emphasize on the primary function of money as unit of account: "Money-of-account, namely that in which Debts and Prices and General Purchasing Power are expressed, is the primary concept of a Theory of Money" (p. 3). Other theories, such as Lawson (2016), stress that the primary function of money is as a general means of payment. In this context, money serves to terminate obligations or debts. In addition to these functions, Jevons (1896) and Milnes (1919) mention that money acts also as a standard of value and a store of value. As a standard of value, money enables all economic agents to set or agree on standard or uniform prices for transacted goods and services, thus being a universal language for all economic agents in determining values or prices of goods and services. As a store of value money should be able to store and retain its value over a reasonable period of time, so it can be used for delayed spending (Hill, 2018). Related to this function, Ingham (2004) states that "money is able to store abstract value, as pure purchasing power, for longer periods than is necessary for any particular exchanges" (p. 3). In this regard, money should be able to provide enough liquidity to be used without in the future for "multiple purposes without having to first be transformed" (Hill, 2018, p. 43) and provide confidence that its value will not degrade rapidly (as what happens in hyperinflation).

2.1.2 Emergence of Money

When examining the literature on the functions of money, it also critical to study how money originated to understand where the need for it came from. The following sub-sections describe different theories that try to explain how money was developed. From these theories there are two main groups, based on the main function of money that they stress. Barter theory emphasizes money's function as a medium of exchange, while both the Credit Theory of Money and the State Theory of Money emphasize money's function as a unit of account and a means of payment. Goodhart (1998) classifies the theories into two groups: the Metallists, which argue that "money evolved as a private sector, market-oriented, response to overcome the transactions costs inherent in barter" (Goodhart, 1998, p. 408); and the Cartalists, which argue that "the State has generally played a central role in the evolution and use of money" (Goodhart, 1998, p. 408).

2.1.2.1 Barter

Barter theory is mainly used by classical and neoclassical economists. According to this, before using money, humans used barter in trading goods and services to fulfil their needs or wants, and money appeared to overcome the impracticalities in barter. In this regard, money is a 'neutral veil', a highly liquid commodity (Ingham, 2004) that only emerges in the society to remedy the double coincidence of wants of barter, thus becoming just a type of common commodity that acts as the medium of exchange to facilitate transactions. Because the advocates of this theory argue that mostly the coins made of precious metals (gold, silver, and copper) are the money, they are called the Metallists. Smith (1776) states that when the division of labour is established, people start living by exchanging and society grows to be a commercial society. In his view, barter is then a mechanism of "… exchanging that surplus part of the produce of his own labour, which is over and above his own consumption, for such parts of the produce of other men's labour as he has occasion for." (p. 22). So, this mechanism allows two participants to trade goods based on their deficits and on surpluses. However, this system may become impractical and have different disadvantages and issues. Humans then moved to the use of money as money can remedy these problems. As written by Smith (1776) "In order to avoid the inconveniency of such situations, every prudent man in every period of society, after the first establishment of the division of labour, must naturally have endeavoured to manage his affairs in such a manner, as to have at all times by him, besides the peculiar produce of his own industry, a certain quantity of some commodity or other, such as he imagined that few

people would be likely to refuse in exchange for the produce of their industry." (p. 22–23). In the book, Money and the Mechanism of Exchange, Jevons (1896) highlights three difficulties in bartering that led to the 'creation of money. First, barter requires two participants to have disposable goods that immediately suit each other's wants. Jevons calls this event as 'double coincidence of wants' which does not have a high probability of happening. The time and efforts used to make double coincidence take place could be used for more productive activities. The solution for this is utilising common commodities "which all are willing to receive for a time, so that what is obtained by sale in one case, may be used in purchase in another" (Jevons, 1896, p. 4), so that they act as a medium of exchange, which is an intermediary instrument that has standardized value and is accepted by both parties. Second, in barter, it is difficult to measure the adequate amount or quantity of exchanged goods. The answer to this issue is using a kind of commodity that acts as a common measure of value, "in terms of which we estimate the values of all other goods, so that their values become capable of the most easy comparison" (Jevons, 1896, p. 5–6). For example, it is more direct to determine how much rice can be exchanged for one ounce of gold and how much sugar can be obtained for the same amount of the commodity. In this example, gold acts as a common denominator commodity that makes it easier to measure the value of the goods. Third, in barter, it is difficult to divide the exchanged goods to reach a requested value in the transaction, as certain goods are not easily divided without a decrease in their valuation. For example, if a carpenter produces a precious table for bartering and he wants a shirt from a tailor and a some bread from a baker. The value the table is much higher and partitioning would destroy that value.

2.1.2.2 Credit Theory of Money and State Theory of Money

Barter theory explains how money emerged to eliminate the double coincidence of wants, so as to make it easier to conduct commercial transactions. According to this theory, the history of the monetary system began from barter, then money was created, and this led to a credit system in the end. However, as argued by Graeber (2011), the process of the development of the monetary system began in the opposite way. In addition, the barter economy did not actually happen; it was "a purely imaginary exercise" (p. 23) that could be found in textbooks. Graeber (2011) explains that several Mesopotamian tablets were found "recording credits and debits, rations issued by temples, money owed for rent of temple lands, the value of each precisely specified in grain and silver" (p. 21). He shows how the Temple bureaucrats in the Sumerian

society developed “a single, uniform system of accountancy, …, to calculate debts (rents, fees, loans ...) in silver” (p. 39). At that time, silver was used as money, but it was not used as a medium of exchange as it did not circulate in a large amount; most of them stayed guarded in treasuries. But, it was utilised to compute the prices and debts that were issued by the Temple or Palace. Therefore, even ancient societies set up commercial mechanisms by giving and settling debts/credits (Innes, 1913), not by exchanging commodities. So this theory for the creation of money is named the Credit Theory of Money. Innes (1913) describes that money comes up as debts and credits come up, and it should disappear when the debts are paid off, as he explains “money, then, is credit and nothing but credit. A's money is B's debt to him, and when B pays his debt, A's money disappears” (p. 402). Therefore, commercial operations merely mean exchanging debts and credits. Innes (1914) additionally defines his theory “Shortly, The Credit Theory is this: that a sale and purchase is the exchange of a commodity for credit. From this main theory springs the sub-theory that the value of credit or money does not depend on the value of any metal or metals, but on the right which the creditor acquires to “payment,” that is to say, to satisfaction for the credit, and on the obligation of the debtor to “pay” his debt and conversely on the right of the debtor to release himself from his debt by the tender of an equivalent debt owed by the creditor, and the obligation of the creditor to accept this tender in satisfaction of his credit.” (p. 152). He emphasizes the function of money as an abstract unit of account that is only utilised to measure debt. So, money is just a representation of a promise to pay. This promise includes purchasing power that can be transferred or can circulate. The process of the emergence of money from credit can be described as follows (Graeber (2011)).

• A gives a coat to B, and B promises something to A with an equivalent value to pay for that. In this context, B awards a promise to pay to A.

• After obtaining that, A could pass this promise to other parties, like C. At this point, B owes C the same value that B previously promised to A.

• C could use this promise to buy other things, based on needs/wants, from D.

In this context, as long as A can guarantee to C that B will pay the promised value (also, C can assure D, and so on), the process will continue for years. This is what generates money. Graeber (2011) states, “in this sense, the value of a unit of currency is not the measure of the value of an object, but the measure of one's trust in other human beings” (p. 47). Similarly to this, the State Theory of Money emphasizes the function of money as a unit of account and as a general

means of payment. State Theory of Money was introduced by Georg Friedrich Knapp. In his view, the emergence of money cannot be separated from the sovereignty of the state. He asserts that money is developed by the state as a uniform nominal unit of account that is used to measure and settle debts, tax debts in particular. What the state determines as acceptable to pay tax at public pay offices will become legal currency (Graeber, 2011); as noted by Ingham (2004): "by declaring what it will accept for the discharge of tax debt, assessed in the unit of account at the public pay offices, the state creates money" (p. 47).

2.1.3 Classifications of Money

Money can thus be classified into various types based on its characteristics. This sub-section provides a review of the existing literature which provides for a categorization of money into different categories. Kahn & Roberds (2009) classify money based on the payment systems. They classify payment systems into 'store-of-value systems' and 'account-based systems'. In store-of-value payment systems, money is a payment object (e.g., commodity money, coins, or bank notes) that is perfectly liquid and owned by the payer. In this regard, when the payment takes place, money, which is the payment object, is transferred from the payer to the receiver and consequently its ownership is changed. In the account-based system, money is a "claim on a payment object" (He et al., 2017) that is registered in the payer's account and when the payment occurs, the claim is transferred to the receiver's account. In another theory, Graeber (2009) separates money into 'commodity' money, which act as a medium of exchange for transacting other commodities, and 'debt' money, which is created for the purpose of debt, so, contrary to 'commodity' money, 'debt' money does not emerge from an exchange. Graeber (2009) argues that in this regard: "money arose not as a medium of exchange but as a unit of account (and secondarily, means of payment), specifically, as a way of assessing and levying tax payments. Money here is a way of managing debt, starting with the debt that subjects or citizens were assumed to have to their sovereign. In order to do so, the state must establish the nominal units of account, and fix the conversion rates between commodities." (p. 110). Michael Kumhof (2015) states that, as a medium of exchange, money can be classified based on two key characteristics, the first based on which technology represents money and how trust is generated in money. As for the technology, money can be distinguished into token-based and credit-based. Token-based is money that denotes greater value than its intrinsic value, so, for example, the banknotes and coins that are commonly used. Token money can be described both

as a medium of exchange, but also as a store of value that symbolizes money itself. Alternatively, credit money does not signifies the ownership of money as money does not store value, but it only measures value. Graeber (2011) argues that in this regard, money is used to measure debt. Therefore, credit-based money is an ultimate representation of debt (Kumhof, 2015). Bonds and money market account are the examples of credit money. Looking at how trust is generated, Kumhof (2015) argues that money is distinguished into sovereign-power money and private-arrangements money. This distinction looks at who controls the issuance of money, whether it is government-based(sovereign-power money) or privately issued (private-arrangements money). As stated by Benes & Kumhof (2012), privately-issued money is based on debt and this kind of money has led to major financial crises "due to usury associated with private debts" (p. 13), while government-issued money is debt-free. Sometimes, government-issued money is also called outside money, as it is generated by the government out of the commercial and private banking system, privately-issued money is instead called inside money as it is created within the that system. Cash, central bank reserves, CBDC, and public digital cash system are the examples of outside money, while bank deposits are examples of inside money.

2.2 CENTRAL BANK ROLE

A Central Bank is defined as the authority responsible for policies that affect the supply of money and credit in a given country or jurisdiction. This function is normally accomplished through different tools, such as open-market operations, discount window lending or changes in reserve requirements for banks. The history of these institutions goes back to the Middle Ages, when the emergence of modern financial systems in merchant city-states prompted authorities to regulate liquidity in the economy.

2.2.1 Central Bank History

According to Ugolini (2018), the history of Central Banks starts in Venice in the late middle age, as Venetians were the first to experience the issues that central banking can solve: bank transfers were authorized in the city to pay relatively small sums and discharge debt. This pervasive role of dematerialized payments made Venice the first place in the West to set up a modern payment system, but also caused violent liquidity crisis throughout its history. As a result, economic activity could be seriously damaged and even the state had troubles in

smoothing irregular cash flows. Therefore, in 1282, the authorities centralized many financial activities in the "Casa del Frumento" (Grain Office), which had the role of buying grain and reselling flour, but also of issuing debt and collecting deposits from the public on the security of future tax revenues, becoming a "state bank". Throughout the 14th century, these tasks were gradually moved to private chartered banks, which were affected by a long series of liquidity crisis until the 16th century. So, authorities were forced to intervene by establishing restrictions on bank operations, disclosure requirements or lending of last resort. At the beginning of the 17th century a further evolution took place, with the establishment of the Banco del Giro, which provided for monetization of public debt through the issue of inconvertible money. Deposits in this bank became the standard mean of payment and made the Banco del Giro the "central bank" of Venice until the end of the Republic. This evolution followed a similar path in other cities that were at the forefront of economic and trade activities and had an established financial infrastructure, such as Genoa, Amsterdam or Hamburg.

When national states began to emerge, also central banking assumed national connotations. The first institution recognized as a central bank was the Swedish Riksbank, which was set up in 1668 as a joint stock back that lent funds to the government and acted as a clearing house. In 1694, the Bank of England was created, with the main purpose of purchasing government debt and issuing private notes. At this stage, central banks were mostly involved in funding governments and facilitating transactions among banks, by becoming the repository in the system. This allowed them to provide emergency cash to other institutions in times of distress, becoming lender of last resort. A further evolution took place at the beginning of the 20th century, when another wave of central banks was set up, among which the Fed. In this context, their main purpose was to consolidate the different instruments used by people as currency and to manage the gold standard adherence, by holding a large amount of reserve to ensure convertibility. After the 1st World War, central banks started to be concerned with the more modern goals of employment and price stability, maintaining the function of lender of last resort, especially in a time of widespread banking crisis as the 1920s and 1930s, which led to the adoption of interest rate ceilings and deposit insurance. This brought a period of relative stability until the 1970s, when the so-called "Great Inflation" and innovations in the industry led to deregulation and increased competition. (Bordo, 2007) In order to fight these issues, the most advanced economies adopted the idea of central bank independence with the following understandings: clear legal mandate on price stability, employment and exchange rate setting and market neutrality with interest rate as main tool. The 2008 crisis brought a novel concept

on central bank function with many of them taking unprecedented actions, such as emergency lending to bank and non-bank financial institutions, the purchase of distressed assets and the large-scale purchase of bonds, with quantitative easing. This final evolution brought to a large increase in their balance sheet and a consequent critical role in financial markets. Therefore, it is just a natural step for them to explore the new technologies and be a front-runner in new trends that arise in the sector, such as the rising importance of blockchain technology.

2.2.3 Central Banks in the Digital Era

In the course of their history, central banks have evolved with the available technology, especially in the payment realm with the institution of real-time gross settlement systems (RTGS) or with the introduction of retail fast payment systems (FPS), that allow for the instant settlement of payments among business and consumers. The current technological evolution with the blockchain technology and the growing demand for digital payment alternatives (graph 1) pushed these institutions to evaluate and explore digital currencies to serve the public interest (BIS Annual Economic Report, 2021).

2.3 BLOCKCHAIN

Starting from a definition of the technology, blockchain is a distributed digital ledger that can store data of any kind, thus recording information about transactions in cryptocurrencies or smart contracts. This information can be recorded in any conventional database, the real difference of blockchain is that it is totally decentralized, so, instead of being held in one location, the copies of a blockchain database are held on multiple computers, called nodes. A majority of these nodes that make up the network are then needed to validate and confirm the legitimacy of a new block of data. The blocks, once verified, are then added to the digital ledger, which is basically a chain of data blocks. This ensures that the technology is much more secure than a conventional database, where information can be changed without oversight.

Regarding the validation process, blockchain can be divided in two systems:

- Permissionless: network is unrestricted and every node can take part in the verification
- Permissioned: the nodes that participate in the verification process are chosen by central authorities, thus partly losing the decentralized character

This process can have two main mechanisms, the first one is called “proof of work”, where the nodes engage in intensive computing activity, called mining, to solve complex mathematical equations and complete the validation. The other alternative is the “proof of stake”, in which participants may verify block transactions based on the amount of coins held: the miners place a certain quantity of cryptocurrency, for example, in a pool and the protocol chooses which nodes can be given the ability to validate looking at the stake involved.

Moreover, always in terms of security, blockchain can be further divided into two categories based on who can access and read the ledger:

- Private: only authorized participants have access
- Public: anyone can get access

Therefore, based on these categories, the technology can be regulated by a central authorities for validation or not and at the same time decide on which entities can get access to the information.

It is worth noting that blockchain is a type of distributed ledger technology (DLT), which comprehend all types of technologies that can store data in a ledger distributed among a peer-to-peer network of nodes, giving users transparent information on transactions and efficient registration. The main differentiation factor of blockchain is the greater security provided thanks to the aforementioned validation mechanisms, while giving the possibility to quickly retrieve information on transactions, thus being particularly useful for the financial sector, as testified by the rise of cryptocurrencies relying on it.

If we examine the main advantages of the technology, with a focus on how they can fit with financial transactions, we can find the following:

1. Security

   As data is constantly tracked and stored in a secure way, the benefits of this are quite clear as they represent a way to retrieve information in a fast way, reducing the need for bureaucratic and time-consuming processes, while ensuring a high level of confidentiality.

2. Decentralization

   The fact that there is not a central entity controlling transactions and their validity, ensures that everyone follows the same set of rules for the functioning of the system.

Moreover, the fact that there is no central core, makes the system more difficult to attack.

3. Tamper-resistance
   Changing or modifying validated transactions is extremely hard and generally requires the consensus of the participants. Therefore, it is easy to find a unique version of the data that is resistant to changes or possible sabotaging.

4. Transparency
   All transactions are transparent and can be viewed by participants in the network. In case of a public blockchain, everyone can see them, but also in case of private network, all the authorized participants can easily have access to all registered transactions, thus bringing a high level of trust.

Despite these advantages, there are still some characteristics that can pose challenges to the large scale deployment and utilisation of the blockchain technology:

1. The large amount of energy consumption may limit its scalability and performance
2. In case of a consensus-based blockchain, participants may collude to overrun the network and cancel/breach certain data, still posing a security threat
3. Transparent data on a blockchain might be a problem when specific data sets are not meant to be publicly available, or need to be changed due to errors, inaccuracies or other problems in the original data entry (European Commission, July 2019)

2.3.1 Cryptocurrencies

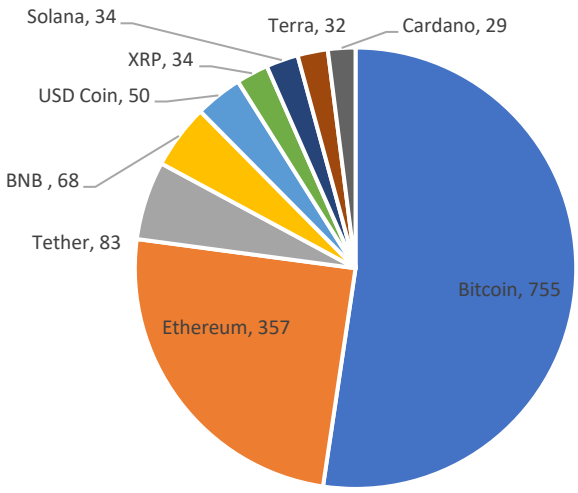
Maybe the most famous application of blockchain technology in the finance realm is that of cryptocurrencies. These instruments are defined as a medium of exchange that is digital, encrypted and decentralized, with no central authority to manage and maintain their value, which is a task attributed to users in the internet.

The origin of this asset dates back to 2008, when Satoshi Nakamoto published the paper “Bitcoin: A Peer-to-Peer Electronic Cash System”, where the characteristics of the Bitcoin, which became the most famous of the cryptocurrencies, were outlined. The author described

the Bitcoin project as “an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party.” This shows how cryptocurrencies developed in pairs with DLT technologies, due to their digital and decentralized nature.

Cryptocurrencies have quickly gained popularity among investors, attracted by the potential gains that such an investment can grant and by the previously described future opportunities in digital payments offered by the technology, with many of them reaching multiple billions of valuation. **Figure 1** shows the main cryptocurrencies with the corresponding valuations.

Figure 1 - Top 10 Cryptocurrencies by Market Cap (in $billion)



Source: coinmarketcap.com, April 2022

Given the importance in size and history for the technology of the Bitcoin, the first cryptocurrency to be created, it is worth analysing its functioning more in depth.

2.3.2 Bitcoin

As mentioned, the Bitcoin technology supports a cryptocurrency created by Satoshi Nakamoto, the pseudonym for a person or group of people, as a protest to the global financial crisis and the financial systems, where banks were bailed out by governments using taxpayers’ money. In this technology, no central entity is responsible for creating the coins or validating the transactions, but the users in the network are granted this role and responsibility, by solving

complex cryptographic questions to validate new blocks of data and receiving newly minted bitcoin as a reward.

2.3.2.1 Characteristics

Bitcoin is a ledger that keeps a historical book of all transactions, storing information in exchange for a digital proxy of value, where the coins are an accounting item and whose value is solely determined by the trust that holders have on the underlying technology.

As common for a DLT technology, the Bitcoin does not need a central authority and transactions are authorized by the nodes in the network through a consensus mechanism. The currency serves three main functions (Aziz, 2019):

- Medium of exchange: the use of the bitcoin in exchange for goods and services is still limited due to the preponderance of paper currency for this function, which is favoured by the backing of central authorities, but also this usage is gaining traction.
- Unit of account: this function is best served when the consumer can compare prices in currency terms. The high fluctuation of the bitcoin partially impair this possibility, but the more recent stabilization in its value can favour this function for the future.
- Store of value: the bitcoin, due to its volatility, is immune to inflation but also varying too much. As mentioned, a stabilisation in its price can make it a better store of value than paper currency thanks to immunity to inflation.

2.3.2.2 Advantages & Disadvantages

Thanks to the aforementioned characteristics of the technology, bitcoin can have a number of advantages, such as reducing the cost of transactions and improving their efficiency and speed due to the fact that no central authority is needed and users can participate in exchanging it simply by creating an account. Moreover transactions can be verified in a very short time span, almost instantaneous, differently from credit-card payments that may require a few days for it. The security of transactions is also very high.

As for the limitations and existing challenges, the main one is represented by the large volatility of the currency, making it exposed to speculative based value. In addition, the bitcoin use may be limited by regulators due to concerns regarding money laundering and illegal transactions.

It is clear that these issues increase the risk of cryptocurrencies and limit greatly their usage, even for the most popular of them, making it hard to satisfy the traditional functions of money and to be a credible alternative to official currencies. For this reason, over the recent years some alternative cryptocurrencies, called "stable-coin" have arisen with the aim to solve these problems.

2.4 STABLECOIN

A stablecoin can be defined as a cryptocurrency that aims to maintain a stable value relative to a specified asset, or a pool or basket of assets (FSB, 2020). This is done by anchoring them to an underlying asset or by ensuring that an adequate supply can match consumers' demand and thus avoiding the large volatility created by the demand-driven cryptocurrencies. Therefore, stablecoins can do so under two mechanisms: they are called asset-linked stablecoins when issuers purport to back them with fiat currency, assets or other cryptocurrencies. Otherwise, algorithm-based stablecoins seek to use algorithms to increase or decrease the supply of stablecoins in response to changes in demand (FSB, 2020). In this way, these assets provide for a more stable form of currency which can still benefit from the advantages of DLT technology, thus being a bridge between cryptocurrencies and fiat currency.

The aforementioned mechanisms give rise to three different types of stablecoins:

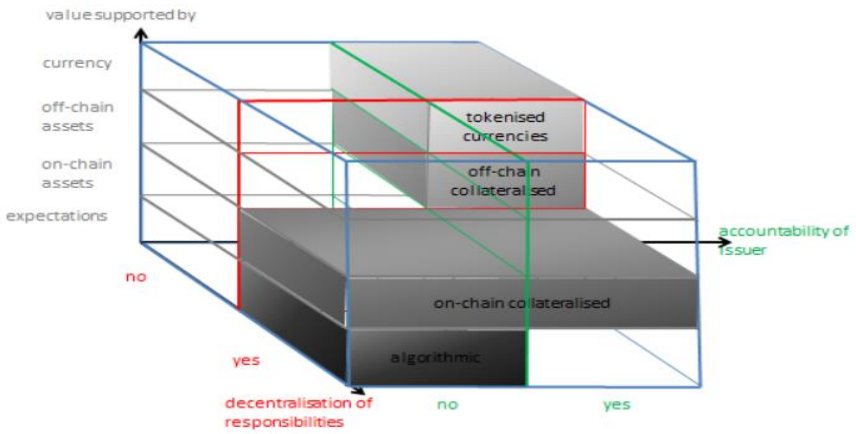
1. Stablecoin fiat/ asset-collateralized (off-chain collateralized): these are supported on a one-to-one basis with real assets such as dollar, gold or oil. Therefore, the users of the technology still have the need to trust a third party that guarantees it, much like traditional currencies.
2. Crypto-collateralized stablecoins (on-chain collateralized) : in this case cryptographic resources are used as a guarantee of stability. Risks are mitigated by using different currencies with to cover volatility price with usually a ratio 1:1.5. The need to trust a

third party is eliminated but requires overcollateralization with other currencies, which is economically ineffective, as it utilizes a large amount of cryptographic resources.

3. Uncollateralized stablecoins (algorithmic) : stability here is given by the right combination of supply and demand. Instead to support the currencies with resources, it creates "algorithmic central bank", which manages supply and demand according to rules coded in a Smart Contract. If price increases, more coins are minted, if price decreases, some of the existing tokens are repurchased and burned. In this case, it might be decided to not peg a currency to the US dollar but rather to some economic measures of life stability (e.g. index of consumer prices). In this way, they avoid not only crypto-volatility but also the collapse of traditional currencies. In this sense, uncollateralized stablecoins could radically change the world, becoming more reliable than current legal currencies.

Based on these criteria, the ECB classifies stablecoin through a "crypto-cube" (**Figure 2**) where one measure (the right horizontal axis) is the existence or absence of an issuer responsible for the attached claim, one (left horizontal axis) is the level of centralisation of responsibilities for the stablecoin and the last (vertical axis) is what determines the underlying value of the currency.

Figure 2 – Crypto Cube



Source: ECB Occasional Paper Series No 230 / August 2019

As an example, the main stablecoins are the Tether, the USD Coin and the Binance USD, which have a combined market capitalisation of about $120 billion and are all pegged 1:1 with the US Dollar, therefore they need to have a supply limited by dollar reserves and are regularly audited to ensure that they have enough reserves to maintain the peg.

2.4.1 Advantages & Disadvantages

Thanks to their greater stability stablecoins can drive further innovation in payments, in particular for cross-border transactions and remittances, making them faster, more efficient and cheaper (Panetta, 2020).

At the same time, however, they also pose a number of risks: in particular, in case of wide acceptance, they could make payments dependent on technologies that are not governed by political authorities, bringing issues in traceability of payments and increasing the risk of cyberattack. Moreover, a system based on stablecoins would be vulnerable to runs, as they would not be protected by schemes such as deposit insurance, based on users' belief on loss-absorption capacity and possible value decrease in the redemption price. The widespread usage of stablecoins could also create problems in monetary policy transmission, as a large shift from conventional deposits to the latter may influence the transmission of monetary policy and banking operations (Panetta, 2020).

For this reason, despite the benefits offered by stablecoins compared to cryptocurrencies, the risks that may pose pushed Central Banks to study a safer alternative that can still combine efficiency and affordability in payments without jeopardizing the stability of the financial system.

Chapter 3. CENTRAL BANK DIGITAL CURRENCIES

The rapid rise in interest and the discussed issues with cryptocurrencies and stablecoins, prompted central banks to explore digital forms of payment, being further encouraged by the increasing digitalisation in the economy and the great opportunities that this brings. This brought to the development of the so-called Central Bank Digital Currencies (CBDCs).

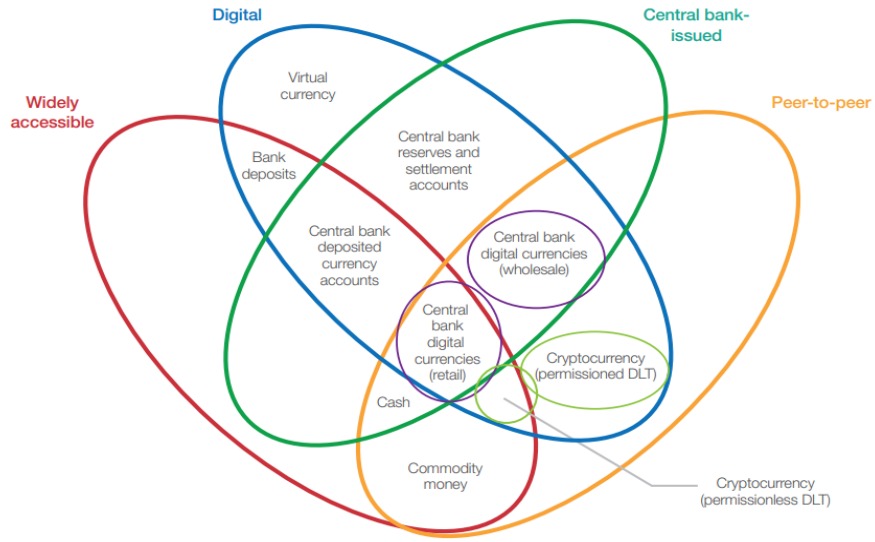
To give a definition to this concept, the Bank of England gave the following in 2018: "*Central bank digital currency is any electronic, fiat liability of a central bank that can be used to settle payments, or as a store of value. As such, CBDC can be viewed as electronic narrow money and in some senses already exists in the form of central reserves*". (Meaning et al.).

Other definitions, consider this type of digital currency as electronic base money (EBM), digital base money (DMB) or e-money, it is thus difficult to give a clear denomination, but it is important to keep in mind that it is the digital form of fiat currency.

In order to understand better what the characteristics that make a CBDC are, the BIS developed the "money flower"(**figure 3**), which classifies money based on accessibility, digitalisation, type of issuer and degree of peer-to-peer transactions.

This shows how CBDCs are quite unique in the sense that they can fill every dimension of the graph, as they represent a digital way of payment that can be widely accessible to the general public as much as cash, and that can be easily used for peer-to-peer transactions. Therefore, they would guarantee the most complete service to users.

Figure 3 – the Money Flower



Source: BIS - CPMI-MC (2018)

3.1 RETAIL VS WHOLESALE CBDCs

A very important characteristic to notice following this graph, is the existence of two main kinds of CBDCs:

- Retail CBDCs: retail CBDCs can be directly held by citizens and businesses
- Wholesale CBDCs: wholesale CBDCs are restricted to financial institutions and wholesale entities alone for interbank payments and financial settlement processes.

Central bank digital currencies should be viewed in the context of these functions of the central bank in the monetary system. Wholesale CBDCs are for use by regulated financial institutions. They build on the current two-tier structure, which places the central bank at the foundation of the payment system while assigning customer-facing activities to PSPs. The central bank grants

accounts to commercial banks and other PSPs, and domestic payments are settled on the central bank's balance sheet. Wholesale CBDCs are intended for the settlement of interbank transfers and related wholesale transactions, for example to settle payments between financial institutions. They could encompass digital assets or cross-border payments. Wholesale CBDCs and central bank reserves operate in a very similar way. Settlement is made by debiting the account of the bank that has net obligations to the rest of the system and crediting the account of the bank that has a net claim on the system. An additional benefit of settlement in wholesale CBDCs is to allow for new forms of the conditionality of payments, requiring that a payment only settles on condition of delivery of another payment or delivery of an asset.

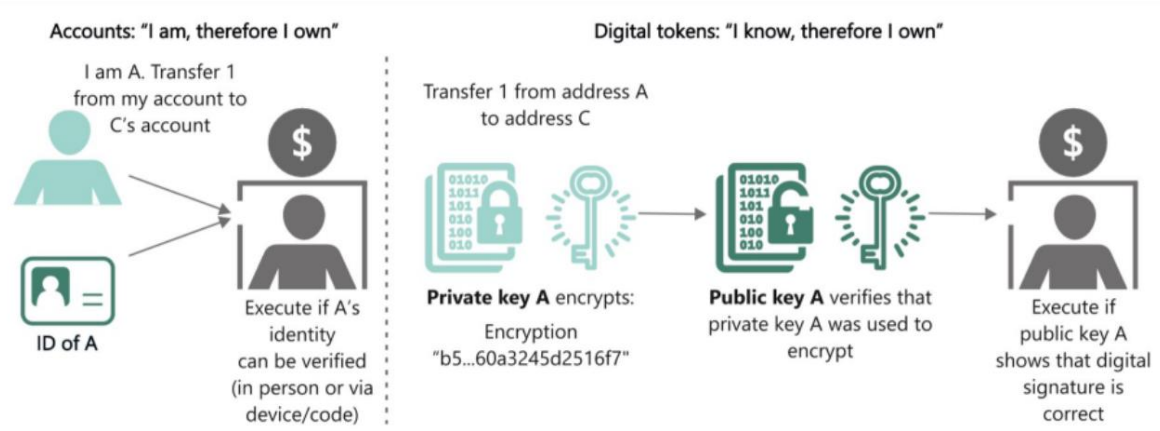
Retail CBDCs represent a much greater innovation as they make the general public possess a direct claim on central banks' assets, eliminating credit risk for participants in the payment system and reducing the risk of liquidity problems for any intermediary. Moreover, they represent the main choice by central banks when implementing a CBDC, due to the greater distribution, especially in emerging economies, where one of the main goals of such projects is increasing financial inclusion. Retail CBDCs can come in two variants, based on how users can access them:

-Token-based: this method involves the transfer of an object of value from one wallet into another and the tokens would use some form of distributed ledger technology for verifying the chain of ownership of each token and validating payment transactions, without requiring the direct involvement of the central bank, as the payments take place based on demonstrated knowledge of a public/private key. However, the central bank would determine the supply of CBDC tokens, which would be fixed in nominal terms and serve as legal tender. This method would ensure anonymity, as the central bank does not know who transferred the token, but only about the object transfer.

-Account-based: this alternative method involves the transfer of a claim recorded on one account to another and in this case the focus is on the identity of the holder of the account. In this case, the central bank would process each payment transaction by simply debiting the payer's CBDC account and crediting the recipient's CBDC account, similarly to current payment method using traditional money. The accounts would be accessed through verification of users' identity. In this case, the absence of anonymity would make it easier for central bank to monitor potential illicit payments.

The following graph (**Figure 4**) can give a clearer outline of the two alternative methods for retail CBDCs:

Figure 4 – Account-based compared with token-based access



Source: BIS Quarterly Review, March 2020

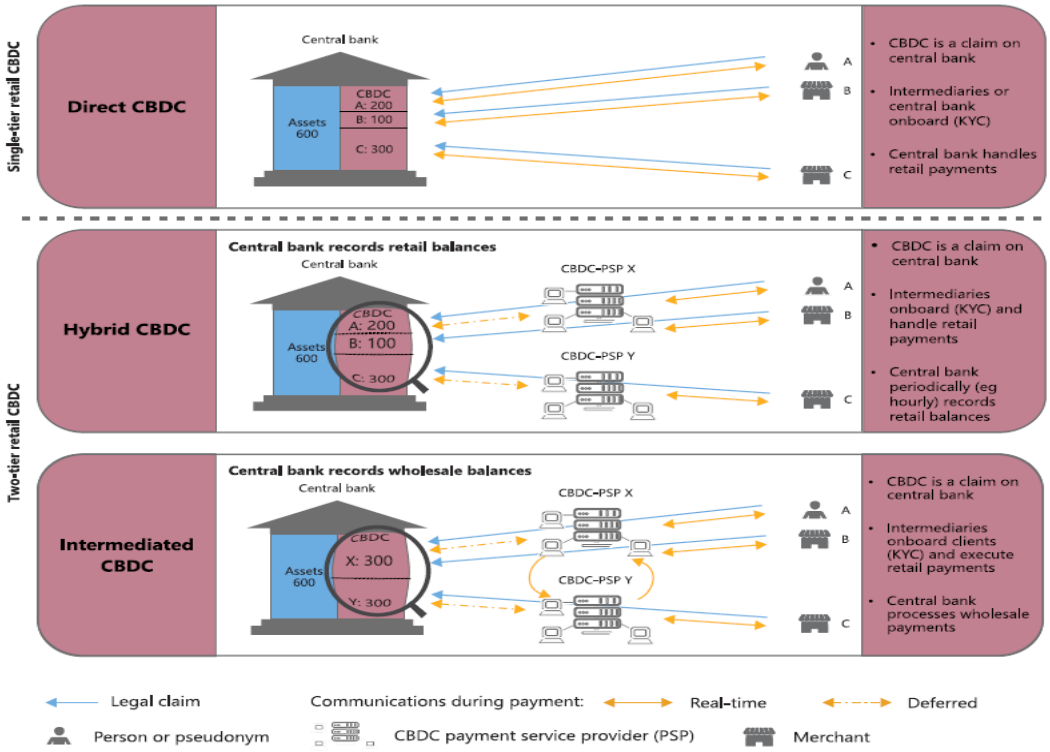
3.1.1 Design

One of the most important characteristics of CBDCs is to figure how consumers will adopt them in practice and thus creating them in a way that they can be useful to consumers compared to cash and digital payments, while clearly defining the role of the central bank and private sector players. Almost all central banks envisage the strong participation of private players, commercial banks and non-bank payment service providers (PSPs) in the mechanism, so that users can easily transfer funds from their bank account or from other payment services to their CBDC wallets (Auer et al., 2021). This could be a more integrated and direct alternative than the so-called "Direct CBDCs", where the system is fully operated by central banks in a one-tier system, implying a large shift in operational tasks from the private to the public sector. As this would imply large costs, the system is not the one choice, as central banks do not aspire and may not even be able to replace the private sector in these consumer-facing activities (Carstens, 2019).

Another potential design could be that of a "Hybrid" infrastructure, where private sector actors conduct all retail payments, while the central bank provides for the backing of the infrastructure. This would ensure that the claims would be directly on the central bank, which would not be directly involved in the transactions, but ready to intervene in case a PSP failed.

These different alternatives are shown in **Figure 5**:

Figure 5 – CBDC Architecture



Source: BIS Quarterly Review, March 2020

As visible here, in the direct model, the central bank handles all payments, keeping a record of all holdings, while a two-tier structure the participation of PSPs intermediaries would eliminate such burden. In the hybrid model, payments are handled by PSPs, with holdings that would be periodically checked by the central bank, while in an intermediated model, the PSPs keep the holdings and communicate them to the central bank, thus being constantly monitored.

3.1.2 Technology

Another important issue that central banks need to analyse when designing a CBDC is the optimal technology that underpins the aforementioned design. Indeed, CBDCs could be run on

a permissionless scheme as the Bitcoin, thus a system where validators offer their "proof of work". This method however, would be inefficient, both because overcoming a central authority goes against the principle underlying the creation of CBDCs, and because it would require very costly computing abilities and would create multiple equilibria, providing for negative externalities on miners and society (Biais et al., 2019), thus going against the social purpose of central banks.

Decentralisation, however, can also be obtained through "permissioned" DLT (Auer et al., 2021), which involves a network of known validators that can validate ledger transactions and who trust each other, thus taking less time when accepting transactions. This method, by being more controlled and more efficient is more commonly chosen by central banks, but it can also bring some costs. As shown by Auer, Monnet and Shin (2021), the chosen validators verify transactions and update the ledger at a cost that is derived from a supermajority voting rule. Without giving proper incentives to validators, however, their records cannot be trusted because they cannot commit to verifying trades – thus giving rise to a public good provision game – and they can accept bribes to incorrectly validate histories. For this reason, while the permissioned scheme is generally superior, it requires a strong rule of law and enforcement.

Related to this and the technology used, it is important to consider the implications that CBDCs can have regarding data protection: sure enough, as privacy in digital payments is currently limited, payment providers can price discriminate against future consumers, thus leading to a sub-optimally low social welfare (Garratt and van Oordt, 2021). Introducing CBDCs can protect consumers' welfare by providing for a new option with more privacy protection. Indeed, central banks, as they are non-commercial entities, can credibly protect users' data without sharing it or using for private benefit. The degree of data protection and anonymousness should always consider the trade-off between consumers' benefits and the integrity of the payment system, because a fully anonymous CBDC, as previously discussed, could lead to serious issues, such as illicit transactions, money laundering, etc. At the same time, a greater request of data could lead to the concern that public authorities may utilize data to track users and control their resources and spending on CBDC transactions, thus bringing the need for additional oversight and safeguard over authorities' actions.

The question on data protection can also involve the choice of the technology supplier to develop the necessary technological solutions. There are two main approaches for this, the first

involves choosing a main contractor that supplies the technology and works together with the central bank to implement the solution. This approach has been chosen by the Bahamas with NZIA or by the Eastern Caribbean Central Bank with Bitt. In the second method, the central bank develops the CBDC with internal resources and may rely on different contractors for smaller parts of the project depending on the areas where additional help is needed, for example the People's Bank of China partnered with certain intermediaries just for the creation of particular payment solutions and functions to add to the e-CNY ecosystem. It is clear how the second approach requires much more internal resources and research for the central bank, thus involving higher costs, but allowing for a greater control over the process and on transaction data.

3.1.3 Interest-bearing Capacity

Another important characteristics of CBDCs is whether they should pay interest or not. On a technical level, both token-based and account-based CBDCs could pay interest, as they are both direct claims on central banks' assets.

The decision to pay interest could entail a number of benefits, as examined by Nelson (2021):

- Breaking through the zero-lower bound: the largest potential advantage, with the assumption that paper currency was eliminated, regards the possibility of central banks to set a negative interest rate on CBDCs to stimulate the economy as needed. This could help avoid a deflationary spiral as no one could avoid the negative rates by switching to paper currency.
- Strengthening the policy floor: when the central bank implements monetary policy by driving market rates down with greater money supply, the fact that only commercial banks and other depository institutions earn interest on deposits held at central banks, may render market rates lower than the one paid on reserves balances, which should be the floor. Since everyone would have access to interest-paying CBDCs, monetary policy floor would be strengthened.

However, deciding to pay interest on CBDCs could also lead to certain disadvantages, for example, Nelson (2021) notes how interest-paying CBDCs would make it less costly for the public to engage in a flight to quality in times of uncertainty, as they would be more attractive than cash as a safe asset. Therefore, central banks' balance sheets would need to be much larger to manage this potential instability in their reserve amount. Moreover, an interest-bearing

CBDC could pose a threat to the current financial system by affecting the intermediation role of banks as people may perceive the central bank-guaranteed assets as safer and prefer holding accounts in the new digital currencies.

For this reason, certain studies, such as one made by the IMF (Agur, Itai, Anil and Dell'Ariccia, 2020), argue that the optimal CBDC design would provide for a negative interest rate. This would increase deposits and financial intermediation activity, thus creating welfare, and would prevent the disappear of cash payments, which would impact negatively households that have a preference for cash transactions.

In general, most CBDC projects are considering no interest payment, both to avoid the aforementioned risks and to limit the competition of digital currencies with the current financial system based on interest-paying deposits held at financial institutions.

3.2 MOTIVATIONS FOR CBDCs

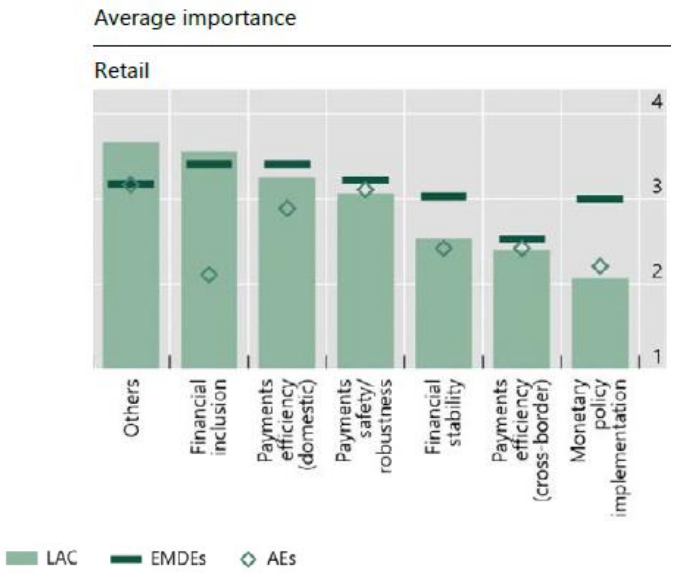
For the purpose of this research, the current chapter analyses the main motivations behind the implementation of a CBDC project, with a focus on the retail type, so as to understand what the main challenges that central banks are trying to solve are and how CBDCs could help fill the gaps that are present in the current financial context.

The main motivations for implementing can be varied and depend on the state of the economy of the issuing country, the characteristics of the payment system and any existing domestic challenge at an economic and social level. In general, however, certain goals are considered crucial by most of the authorities behind any existing project.

- **Financial inclusion**: this is one of the main policy goals when implementing a CBDC. Indeed, especially in emerging and developing economies, large parts of the population are still lacking access to financial services and CBDC could increase access to digital payments and thus increase a general access to financial services. This motivation is particularly pressing in countries where banking services are difficult to access due to geographical and connectivity difficulties. Indeed, as shown in **Figure 6**, in a survey made by the BIS in South and Central American jurisdictions, financial inclusion is the principal motivation both for the Latin American (LAC) area and other emerging

markets (EMDEs). As expected, this is not so important for advanced economies (AEs), where the large majority of people already has access to financial services.

Figure 6 – Survey on Motivations for CBDCs



Source: BIS Papers - Ready, steady, go? – Results of the third BIS survey on central bank digital currency, 2021

- **Access to Payments**: similar to financial inclusion, access to payments is an important objective for central banks. In this case, even countries with a high level of financial inclusion may face challenges in payment access due to shortage of cash availability, firms' refusal to accept cash and technical issues in the digital payment infrastructure (Soderberg et al., 2022). For example, the Riksbank, the Swedish Central Bank, is designing a potential CBDC, the e-krona, with the intention to include in the digitalisation of payments certain categories that are still much reliant on cash payments, such as elderly people or groups with disabilities. CBDCs, could be designed to develop a universal access to payments by being more easily trusted, as they are emitted from a recognised authority, and by being available offline, thus with the opportunity to be used in remote areas.

- **Payment efficiency**: where the use of cash or check payments is relatively high the operational costs may be quite high and the transaction could be slowed down by the necessary controls on identity and fund availability. In many developing economies, even digital payments are expensive, due to the difficulties in ensuring internet access and the recent state of the technology. Therefore, CBDCs could increase the efficiency of payments by reducing the needed controls on transactions, which would be immediate on the blockchain technology, and by reducing costs. Indeed, the non-for-profit nature of central banks should lead them to offer low-cost payments to the public as a way to increase social welfare.

- **Resilience of payments**: making sure that citizens and business can pay or that they can receive government transfers under difficult circumstances is important for many countries, but the urgency of this is particularly high in disaster-prone nations. For example, in the Bahamas and the Eastern Caribbean, resilience is considered a key policy goal. Both areas are mostly made up of islands and are very vulnerable to natural disasters, so the destruction of physical, financial infrastructure and the difficulty in accessing cash are serious concerns. In the Bahamas, a hurricane in 2019 precipitated the start of the Sand Dollar pilot in the same year to facilitate assistance payments to and within afflicted areas.

  Similarly, the Eastern Caribbean Central Bank (ECCB) accelerated the expansion of its DCash pilot to areas affected by a volcano eruption in St. Vincent and the Grenadines in 2021.

  Moreover, countries with a highly digitalized payment sector are concerned about disruption to digital services and concentration risks where there are only a few large operators. In China, for instance, the digital payment market is dominated by two companies, AliPay and WeChat Pay. The local central bank has thus shown concern that, in case those firms failed, there could be serious consequences to the payments system. Therefore, a CBDC could serve as an alternative and backup option in the current payment environment.

- **Fighting illicit use of money**: the fact that cash is an anonymous payment method, makes it very hard to audit and track payments, making it the perfect way to pay for

illicit transactions, such as money laundering, tax evasion or financing terrorist organisations. The implementation of account-based retail CBDCs could lead to a reduction of this problem as payments would be instantaneously tracked by the authorities, with the assumption that most transactions would switch from cash to CBDCs.

- **Monetary policy implementation**: as discussed previously, the fact that CBDCs are a direct claim on central banks' assets, make them a possible instrument to help central banks in the implementation of their monetary policy, especially when they include an interest-bearing character. Moreover, if new payment methods, such as a foreign digital currency or a global stablecoin had to be adopted by the mass population, central bank functions could be seriously impaired. Therefore, developing a local CBDC could eliminate this risk and ensure monetary sovereignty.

- **Competition**: CBDCs could increase competition in a country's payment scenario, both in a direct way, by simply offering an alternative method to conduct transactions, and in an indirect way. In the latter case, if CBDCs were to follow a two-tier structure open to PSPs, they could lower the barrier to entry in the payment service sector, thus increasing the number of firms and reducing costs (Soderberg et al., 2022). Sure enough, the payment market tends to be dominated by a limited number of providers in many countries, and this could lead to high fees and less innovation incentive. Therefore CBDCs could ensure more competition, limiting costs and increasing efficiency and research for innovation.

As shown here, the motivations can be quite varied and can differ also based on the type of CBDC, whether retail of wholesale, with objectives for the latter more related to payment efficiency, payment safety and monetary policy implementation (Alfonso, Kamin and Zampolli, 2022). While retail CBDCs may be able to have a more direct impact on people's lives and on how they interact with the financial ecosystem.

For the purpose of this research, the analysis will go more in depth in how CBDCs can increase financial inclusion and access to payments for the users, with a focus on the projects that are currently deployed and have financial inclusion as one of the main stated goals, namely the

Bahamian Sand Dollar, the eCash of the Eastern Caribbean Central Bank and the eNaira in Nigeria. These projects are taking place in emerging economies, where people are financially underserved and access to non-cash payments is still limited, both for geographic and social reasons. Therefore, CBDCs have the potential to have a large and direct impact on citizens and improve their living conditions.

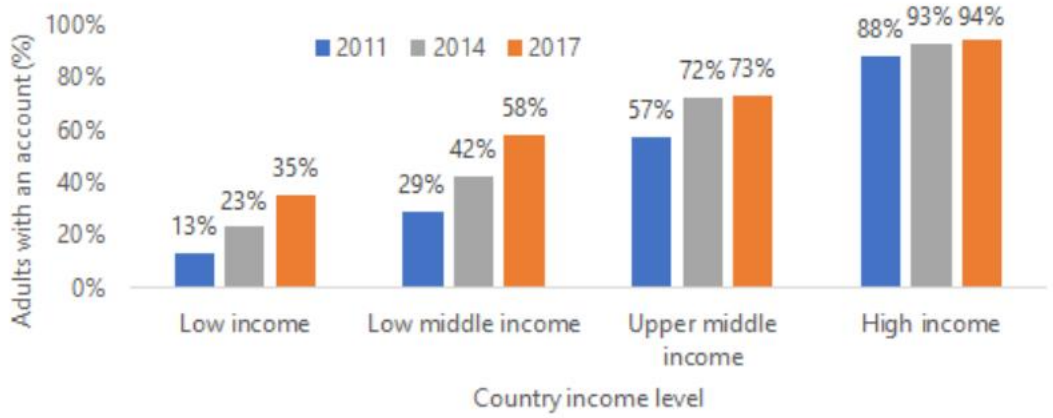
3.3 FINANCIAL INCLUSION

Financial inclusion is defined by the World Bank as the possibility that "individuals and businesses have access to useful and affordable financial products and services that meet their needs—transactions, payments, savings, credit and insurance —delivered in a responsible and sustainable way". This access can facilitate the daily life of people, help families and businesses in their long-term objectives and being a safety net in case of emergency. Due to its large impact and importance for global development, financial inclusion has also been deemed as a key enabler for 7 of the 17 "Sustainable Development Goals" of the World Bank, in particular no poverty; zero hunger; good health and well-being; gender equality and women's empowerment; decent work; economic growth and full and productive employment; industry, innovation, and infrastructure; reduced inequalities; and partnerships for the goals. Financial inclusion can indeed alleviate poverty and increase prosperity for the most vulnerable categories, by transforming unpredictable income flows into a regular resource that can help them meet their daily needs, through the access to remittances, credit and savings services and by providing a margin of safety in case of emergencies or unexpected expenses. According to the latest data by the World Bank, in 2017 almost one-third of adults in the world, 1.7 billion, were unbanked, with a prevalence for women, poor and rural households.

Financial exclusion can be voluntary or involuntary. Voluntary exclusion occurs when individuals report that they have no need of the financial system, for example in case that a relative already has an account. Involuntary exclusion arises when households are unable to use the financial system because of external barriers, such as cost or documentation (Beck et al., 2007; Allen, 2016). Other barriers include low income and levels of education. Allen (2016) conclude that to encourage households to engage with the financial system, policy should provide an enabling environment, such as lower-cost products, proximity of financial services and use of financial institutions for government payments to individuals as a way of incentivizing a habit to banking.

It is therefore clear how increasing financial inclusion is a priority for international institutions and many governments worldwide and, since 2010, more than 55 countries have made commitments to increase financial inclusion, while more than 60 have created an actual national strategy to do so. For this reason, much progress has been made on this front. For example, the share of people holding a bank account rose from 51% in 2011 to 69% in 2017 on a global level, as proven by the data collected by the World Bank shown in **Figure 7**

Figure 7 - Account Ownership by Country Income Category



Source: The Drive for Financial Inclusion: Lessons of World Bank Group Experience, 2021

The increase in financial inclusion has been particularly pronounced for low and low middle income countries, but the level is still quite low, especially to some disproportionally excluded groups, such as women and poorer households, for instance the gap between rich and poor did not improve in low- and middle-income countries between 2014 and 2017 (2017 Global Findex), or in rural areas in Africa the access gap compared to urban areas remained quite high (Bull, 2018).

According to the World Bank strategies, institutions can help and support countries attain higher levels of financial inclusion through 9 intertwined areas:

• Use of national financial inclusion strategies (NFIS);
• Modernization of retail payment systems and government payments;
• Reform of national payment systems, including remittance markets;
• Diversification of financial services for individuals;
• Leveraging of technology for financial inclusion (“fintech”);

• Enhancement of competition and expansion of access points;
• Strengthening of financial consumer protection;
• Improvement of financial capability, including through national financial education strategies and diagnostics;
• Gathering of financial inclusion data through global and country-level surveys and other resources.

Also the IFC, the International Finance Corporation, identified certain strategic areas where to concentrate in its IFC 3.0 strategy to improve financial inclusion at a global level, with a focus on strengthening the banking sector, increasing lending to SMEs and supporting digital finance initiatives, considered as a more cost-effective way for people to access financial services.

It is therefore clear how digital financial services are seen as a critical and key enabler for a greater financial inclusion and to improve access for under-served communities. One big hope to increase financial inclusion has been the rapid development of mobile money, seen as a way to increase access to digital finance due to the high penetration of mobile connections even in emerging economies. Consequently to its importance, the following section analyses the historical growth of mobile money and its role in reducing financial exclusion.

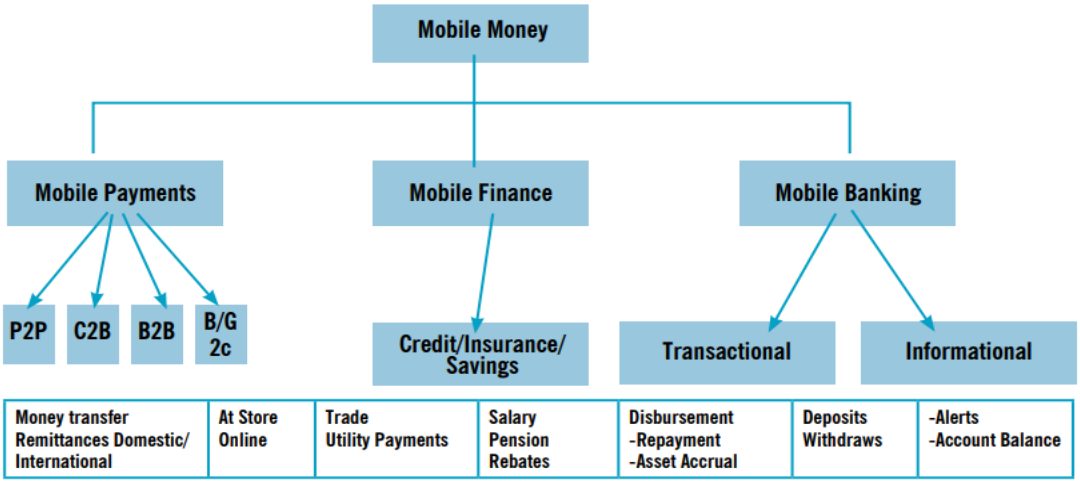
3.4 MOBILE MONEY

Mobile money refers to the use of mobile phones to perform financial and banking functions (IFC Mobile Money report 2011). This definition regards a varied plethora of services, including payments (e.g., person-to-person transfers, utility payments), finance (e.g., insurance products), and mobile banking (e.g., account balance inquiries). At a global level, the growth of mobile money has been quite impressive, particularly in developing and emerging economies where a large proportion of the population are excluded from more formal traditional financial services (GSMA 2014). According to the IMF's Financial Access Survey, "*mobile money is a pay-as-you-go digital medium of exchange and store of value using mobile money accounts, facilitated by a network of mobile money agents. It is a financial service offered to its clients by a mobile network operator or another entity that partners with mobile network operators, independent of the traditional banking network".* Mobile money therefore does not require a bank account, but just the access to a generic mobile phone, making it easier

to reach people compare to mobile banking services, which are connected to a certain bank account.

Figure 8 gives a clearer picture of the different services that are encompassed by mobile money, which can include mobile payments, for peer-to-peer transactions (P2P), payments for retail goods purchased by private customers (C2B), business-to-business (B2B) payments and business-to-government or government-to-customer (BIG2C) payments, thus the payment of salary, taxes and social pensions. Another main function is that of mobile finance, where customers can access credit, insurance, savings and other financial products. Finally, mobile banking operations, such as paying for transactions or checking the amount remaining in an account are other services that can be included in mobile money.

Figure 8 – Different uses of mobile money



Source: Gencer 2011

As shown in this figure, mobile money can help customers satisfy a large number of financial services, going to purely informational ones, to others that can be essential for them, such as receiving remittances, both at a domestic and international level, and to receive government aid.

As for the technical aspect, mobile money is run by mobile network operators (MNOs) and consists of transactions conducted using mobile phone networks which can access customers' funds held by the MNOs. These funds can be purchased as airtime or deposited directly into the customer's mobile wallet for future use in transactions. For this reason, also the regulatory

framework is made by telecom regulatory authorities and subject to the singular companies' policies.

3.4.1 Historical evolution

Mobile money has known a rapid growth on a global level, but the area where it represented a real major breakthrough is Sub-Saharan Africa, therefore, analysing the development of the technology forcefully means looking at its evolution there. Indeed, the first mobile money license was issued in South Africa in 2004, but it is in 2007, with the introduction of M-PESA in Kenya that it achieved large-scale success and importance, with the latter still representing to date the most successful platform for the technology. M-PESA was initially created as a mobile-based micro-financing application to extend financial access to under-served users in the country, but it was changed into a mobile money platform when developers noticed how people were using it more for general money transfers than for microloans. M-PESA provided users with an electronic payment and storage system that could be accessed through mobile telephones. Customers had to register at an authorized M-PESA outlet where they were given an account number linked to their phone number, and a SIM card application on the mobile phone permitted the access to the money account. Users generally deposited and withdrew cash from their accounts by exchanging cash for electronic credit with a special mobile money agent, who received a fee. The money could be then sent and received to other M-PESA accounts as well as to non-registered users through their phones, in addition to using M-PESA to pay bills and purchase air-time. All transactions were registered through secure SMS.

This facility in the use brought financial services to the poor and middle classes for the first time. Today, M-PESA is used by over 17 million Kenyans (over two-thirds of the adult population) and approximately 31% of the country's GDP flows through it. Before M-PESA, in 2006, only 20% of Kenyan adults had access to financial services. By 2010 this number had risen to 75%. A World Bank report similarly found that M-PESA users are approximately 33% more likely to have savings than their peers.

Apart from this success story, mobile money played a crucial role in the financial inclusion of African, but also global population, with more than one billion accounts registered in 2019, of

which 471 million are based in the African continent (GSMA, 2020). The importance and the large size of the African market for the technology is shown in **Figure 9**. This has had a huge impact on the local economies both in financial terms but also socially, for example in the same year, digital transactions in Africa made up the majority of mobile money compared to a historical prevalence of cash-based transactions, showing how the technology is changing people's attitude towards digital payments. This surge has been driven by customers becoming more sophisticated in their mobile money transactions and in increased interoperability of this service with banks, governments and business (GSMA, 2020). Also at a global level this technology has rapidly expanded and in 2020, 136 million new accounts were added, with a 12.7% growth, coming both from a continuing consumer interest and from easier regulatory practices, such as more flexible know-your-customer (KYC) processes (GSMA, 2020). Apart from the discussed dominance of the Sub-Saharan market, East Asian and Pacific countries were other important contributors to this increase. The success of mobile money can also be measured by the constant increase in transaction value, which went up by 22% in 2020 so as to reach a total of $767 billion worth of transactions during the year, with a large prevalence of cash-based transactions both for deposits (68% of total incoming transactions) and for withdrawals (60% of total outgoing transactions) (GSMA, 2020).

Figure 9: **Mobile money accounts by region in 2020 (in millions)**

Source: GSMA 2021 State of the Industry Report on Mobile Money

The success of mobile money is made possible by the high penetration rate of mobile phones in emerging markets, by regulatory ease, the facility in its use, but also by some critical players in the ecosystem: mobile money agents. These agents can easily reach rural areas and remote

places, in a much more effective and cheaper way than bank branches, and thus continue to play a pivotal role in the digitisation of cash in many markets. They collect cash from users or distribute in case of withdrawals while registering the transactions in the mobile money platform, providing for a direct and human interface that people can understand more easily than a digital one. As of December 2019, the continent had 3.4 million agents of which 1.9 million were active on a 30-day basis. In terms of reach, this translates to approximately 340 agent outlets per 100,000 African adults compared to only 6 bank branches and 13 ATMs per 100,000 African adults, while at a global level 5.2 million agents are estimated (GSMA, 2020).

3.4.2 Advantages of mobile money

The rapid and impressive growth of mobile money services has been fuelled by a number of advantages that make the technology easier to use for people living in remote areas, often cut out by communication routes and services and who are not economically viable customers for banks, due to the limited number of transactions and amount deposited and the high cost of establishing bank branches in such areas. Among the advantages and benefits of such technology, the most important ones are:

- Convenience: mobile money offers the possibility for subscribers to enjoy an instant access to their money any day of the week and at any time, without the need to spend a long time queuing at bank branches, that are often underrepresented for the number of customers they need to serve (Oluniyi, 2009). The use of mobile phones to pay for financial transactions is a further element of flexibility and accessibility, as the use of mobile phones is quite widespread, for example reaching an average of 76% in Sub-Saharan Africa, the world's poorest area (World Bank, 2020). The possibility to rely on mobile money agents is a further factor of convenience, since they represented an easily accessible interface to deposit and withdraw money, even in remote areas.

- Low transaction costs: mobile money represents a low cost alternative for transferring money, especially in the case of cross-border payments and remittances. For example, the average cost of sending $200 abroad using the technology is 2.7%, while using conventional money transfer operators is 6%, thus representing a much cheaper way for payments, and the savings are larger for smaller transactions (GSMA, 2016).

Therefore, mobile money can be a valuable resource for low-income people that rely on remittances and that are more likely to engage in smaller transactions.

- Security: the mobile wallets offer a secure place to save as funds are stored virtually. And both the mobile money platform and the mobile phone can be password-protected, representing a safe way to store money. Moreover, the technology eliminates the need to travel with the needed amount of cash in hands, reducing the risk of theft or loss.

- Transparency: mobile money technology allows for tracking of transactions and does not require for any middlemen, therefore users can directly check where their money flows go and have a much greater control over transactions.

- Risk-sharing: several studies show how users of mobile money are more resistant to exogenous shocks and can maintain their consumption level in times of crisis. This can happen because mobile money users are less reliant on a closer network of financial help, which would be the case for cash-based transactions, thus being in a network that is affected in the same way by natural disasters for example. Indeed mobile money users are more likely to receive remittances from abroad (Riley, 2018).

3.4.3 Disadvantages of mobile money

Despite these clear and large benefits offered by the technology, mobile money still presents certain hurdles that limit its use and its uptake:

- Regulatory environment: the regulations of mobile money applies to mobile operators, which need to receive approval by local central banks. The needed licence, however, can very difficult to obtain, lengthy and quite expensive, thus reducing the potential to innovate and improve the service, due to regulatory uncertainty and high costs (Cooper et al., 2018). On a customer level, compliance requirements cans also be very burdensome, with a large amount of needed KYC documentation, which is often not adapted to different risk profiles, thus increasing the regulatory burden on agents and leading to high rejection rates (Cooper et al., 2018).

- Low interoperability: mobile money services are still not completely integrated in the different payment systems and networks. Therefore, processing payments from other banks and PSPs can be very complex and lead to high costs for mobile money companies, increasing their costs, which can be passed on to consumers.

- Liquidity constraints: agents may face liquidity issues and may not be able to provide for cash withdrawals or transfers to customers, exposing them to counterparty risk and creating reputational risk for providers. Sure enough, studies show that in some cases, agents without liquidity actively deny the business of customers when they are unable to provide mobile-money transfers or cash-out services (Kiarie, et al., 2018). Moreover, despite the greater reach compared to banks, agents may still face consistent difficulties in reaching population in remote areas, so users may face high costs and time to travel to agents.

- Low digital literacy: research shows that a common challenge to become active mobile money users regards a low understanding on mobile money use and its benefits (IFC, 2018). Therefore, the lack of awareness can generate mistrust and resistance to digital payment services, making people more prone to using cash. Furthermore, low financial and digital literacy can increase the likelihood of fraud and consumers' manipulation by agents.

Therefore, as shown in this section, mobile money can be a key instrument to reach financial inclusion, but, at the same it provides for certain structural flaws in its functioning that may limit its efficacy as a universal mean to reach financial inclusion. The issues are mainly related to connectivity impairments, which may still be present in many emerging economies, to the presence of intermediaries that may lack the necessary liquidity for a correct functioning of the market and that may act as an authority that limits access to certain customers, and to the regulatory hurdles that arise with respect to MNOs, which do not present a clear advantage in terms of time and costs over that of conventional financial institutions, as commercial banks.

Chapter 4. ANALYSIS OF EXISTING CBDCs

This chapter examines certain pilot CBDC projects that are currently existing, in particular, those deployed by the Central bank of the Bahamas, the Eastern Caribbean Central Bank and the Central Bank of Nigeria, to verify their usefulness to increase financial inclusion and to compare them as an alternative or a complement of mobile money.

4.1 SAND DOLLAR

The first CBDC project is the Sand Dollar, deployed by the Central Bank of the Bahamas, which is also the one in the most advanced state, by being actually implemented at a full scale in the country at the moment.

4.1.1 Project History

The Central Bank of the Bahamas began to think about a way to increase access to financial services in the country when several studies showed consistent gaps in financial inclusion. Indeed, the dispersed geography, with sparse populations and many rural communities makes it such that they have limited access to physical delivery of banking services, as operating bank branches in this conditions is not profitable. In addition, up until 2018, existing regulations made it quite difficult for customers to open bank accounts as commercial banks responded to more demanding terms on correspondent banking relationships (CBRs). These issues are testified by a survey made by the Central Bank which shows how 80% and 70% of the inhabitants commonly used savings and checking accounts respectively, and how only 48% of individuals could access credit card facilities. Therefore, due to these difficulties, the Central Bank realised how important establishing a digital payment service could be for the population and started a pilot phase of its CBDC in Exuma in December 2019.

Exuma was chosen because it had levels of access to financial services compared to those of the national average and a high mobile phone usage rate (96% mobile phone ownership). Indeed, a survey conducted in the area by the central bank showed that half of the owners did not use their mobile devices to perform any transactions during the last 6 months, while 40% used their devices to pay bills and 39% used them to make purchases, thus indicating a low acceptance and utilisation of such a commonly present technology for financial usage. However, the survey showed that this limit was mostly due to high costs, difficulty of usage and cybersecurity concerns. Once those issues were addressed, respondents said that they would be willing to engage in digital finance, with close to two-thirds of respondents disclosing a willingness to use mobile devices for payments or commercial transactions in the future.

Once the technological infrastructure and availability to citizens in Exuma was ensured, in October 2020, the central bank exited the pilot phase and deployed a national roll-out of the Sand Dollar, which was made available to the general public.

4.1.2 Analysis

Unfortunately, the Central Bank of the Bahamas has not yet disclosed information and data on the utilisation of the Sand Dollar by the population and on how it increased access to digital finance and services such as digital payments or credit facilities.

What is clear from the available data however is how a CBDC technology is seen by the central bank as an opportunity to increase the population's participation to finance and how financial inclusion is actually the main policy goal of this project. Indeed, as declared by the central bank, financial inclusion is the first issue that was considered with the Sand Dollar, due to the presence of remote and underserved communities, which could be reached by digital infrastructure. This benefit would be paired with others, such as reducing cash usage, which would ensure a greater control on financial transactions against money laundering, reducing transaction costs and strengthening economic surveillance by reducing the amount of informal transactions and increasing the amount of information for tax collection.

These stated policy goals are in line with what is generally found in the literature about the benefits of CBDCs, especially showing how these can be critical to ensure a greater financial inclusion in emerging economies. The limited use of mobile finance highlighted by the

aforementioned survey shows how problems related to security, high costs and ease of use represent an obstacle for the widespread usage of current digital finance solutions. CBDCs, therefore, can be a valid alternative due to their higher legitimacy, by being backed directly by a trusted public institution, and to the lower costs that a non-profit provider, as the domestic central bank is, could guarantee over private sector providers of technologies such as mobile money.

4.2 DCASH

The DCash is a CBDC deployed by the Eastern Caribbean Central Bank, the central banking authority that oversees a currency union of different countries in the Caribbeans (Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, St Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines), starting from a pilot project in 2019 and with an expected complete rollout in 2021. Unfortunately, the pandemic and technical difficulties delayed the project, which is still in the pilot phase. As in the case of the Bahamas, also the countries in this currency union suffer from issues related to the difficult geography and remoteness for certain segments of the population, to limited access to financial services among the population and limited usage of digital technologies. Indeed, in the Latin America and Caribbean region, on average only 51% of adults had an account at a financial institution, and only 11% of adults were given access to formal borrowing, compared to an OECD average of 18.4% (BBVA Research, 2016). It is thus clear how, also for the ECCB, financial inclusion and making financial services more accessible for the population are a critical rationale behind the deployment of the DCash project. In order to better understand why the central bank decided to implement it and to analyse how useful it can be for the stated goals, an interview with Karina Johnson, a project manager at the ECCB in charge of the DCash pilot, is provided in this paper.

4.2.1 Interview n°1

Interviewer: what is the main rationale that your central bank had when launching the DCash?

Ms Johnson: So, the idea which underpins our move towards the CBDC is especially financially inclusion for the unbanked and the underbanked. The banking systems here, it is somewhat fragmented, and it is characterized by significant barriers to entry depending on your

income levels, whether it be the signup requirements and being able to meet them, whether it be being able to maintain the minimum balances, or else the transaction fees just in terms of maintaining an account. So a number of reasons may please access to banks and banking accounts outside the region. Have a significant portion of our population in addition to this population or the CBDC was also brought in to help effect payment system modernization or payment system as it stands is very much tied to traditional payment methods with a great deal of dependence on cheques and obviously on cash. And so for this reason, the CBDC is seen as worthwhile solution, not only for end users retail customers, but also for the banks in terms of the transportation insurance and custody costs associated with the usage of cash or key targets is the reduction in cash in circulation by 50% by the year 2025 ambitious words. In addition to this and in support of the currency union, and the wider Caribbean community and our drive to create a single economic union. The CBDC is also designed to encourage greater competitiveness for businesses, SMEs and larger businesses within the wider Caribbean with a CBDC which allows for easier transactions and this will be a significant boost to businesses, especially the SMEs. In really improving the competitiveness. Aside from this, it is also envisage that it will work to support the flow of money throughout the region, not just business or merchant transactions, but P2P. As you know, we have a fairly mobile population without within the ECCU, which is also on the pin by freedom of movement of our citizens. And so, at ease in the initial pilot, it merely allows for the payments to flow within the region among the member states. We anticipate that with maturity of the CBDC that additional financial services which are built upon them, and which take account of these freedoms of movement of capital of persons, etc. That services tailored to this may also be developed on the CBDC.

Interviewer: So, based on this, let's say it is a CBDC that then also involves the participation of financial intermediaries like banks, so it's not a retail only currency.

Ms Johnson: Yeah, we are very much still utilizing financial institutions as one of the main conduits. So the cash is minted and distributed solely by the ECCB and it is issued to financial institutions at their request. At this stage of the pilot, participation by the banks is entirely voluntary. From the financial institutions, people may access the cash through their bank accounts. They can download a wallet from either of the Play Store, app stores, and through their bank account may find their wallets with DCash. Alternatively, and again in pursuit of that financial inclusion objective. It is open to persons who do not have bank accounts to download at the cash wallet and to fund their accounts using agencies These agencies, one will

review and approve an application conducting the requisite KYC due diligence checks, right. So, these agencies will not necessarily be financial institutions. Although I think in a few cases, we have credit union serving as these agent agencies. So the agencies allow for onboarding of customers who do not have bank accounts without compromising on the due diligence that DCash is expected to maintain. So the financial institutions can, on their own, utilize their own KYC due diligence checks, because they have customers, they make them approve, and inactivate in a wallet. So that's one way. Or alternatively, if people may wish to activate a wallet without being a customer of any particular institution, the agencies would perform that function. When you access or open a wallet through an agency, this is a value based wallet, that's what we refer to it as. And value based wallets can be funded by on ramp in or plain fee fiat currency to a merchant teller, which will then be added to your digital wallet. Alternatively, you can if you have a bank account, authorize your bank to transfer funds from your account into your digital wallet. And then your wallet is funded. The same means of exiting the DCash platform would be either through your merchant teller, where you'd ask to withdraw cash into physical currency, or else through your bank where you'd ask that the funds that need cash be converted to your bank account to, I guess, easy currency.

Interviewer: And going back to the, to the part that you mentioned about people without the bank accounts, deciding to open the DCash account. So in that case, the regulatory framework and the needed KYC to open it are different from the ones opening a bank account, maybe less stringent?

Ms Johnson: Compared to most banking requirements for the opening of value based wallet through an agency, what a person is required to do and the onboarding is entirely remote. You will submit one piece of picture ID from issued by any government of the ECCU. It must be ID-issued by any of our member governments. And then in addition to what we can call a selfie photo. These are the signup requirements.

Interviewer: And let's say talking about the adoption rate of the technology, when you implemented the pilot, what was your target? Were you able to reach this target, or did you encounter some issues in reaching it?

Ms Johnson: We are still pursuing our targets as the pilot is still ongoing. In fact, the pilot in its proper sense, will commence once we have on boarded the last of our eight territories. So,

so far, we have gone live in seven with the final territory coming on board, which is Anguilla, then the pilot, in essence, commences for 12 months, at which time we then will be pursuing our targets.

Interviewer: And in the territories where you have actually implemented it, did you encounter some issues in having the population adopt the technology?

Ms Johnson: There are certain issues. First, this is the first time that perhaps the majority of our populations are interacting with a FinTech proper service, in which it is envisaged, from inception to completion to be entirely online. To the other aspect is what is referred to as internet or broadband penetration throughout the region, which varies across the islands. I think the most recent statistic from our Eastern Caribbean communication regulator is that mobile broadband penetration for the entire ECCU is less than 75%. This is also coupled with the fact that not just being a full time FinTech product, but at a more general level digital trust is something that has to be built up in the population. Yes, I think that one of the advantages, however, with a CBDC, and especially with our CBDC is that we are a trusted, and we have been a trusted regulator for the region, we've steered the region through a number of significant challenges, including the global financial crisis, and we've maintained a high degree of stability. So this goes some way, but it does not completely address the need to build digital trust in our population. And this aspect, obviously has to be enhanced by legislative protections, which provide, you know, a further degree of, you know, clear standards for the handling of data, not only by the ECCB, but in relation to any other third party service providers, which utilize the payment network. So digital trust definitely, in addition to this significant challenges will arise again, because of the variation in financial literacy, as well, among the population. And I think, you know, many of us are discussing CBDCs and discussing adoption, but overlooking the need to really ensure that the financial literacy of our end users will allow them to make proper usage of the technology.

Interviewer: And how many people do you plan to, to include in the seven territories for the pilot? And also, were you able to actually like include all of them so far?

Ms Johnson: No, at this stage, we still are assuming the targeted numbers for all of our territories. In particular, our launch in the middle of COVID, which would have seen significant lockdowns in most of the islands would have impaired both our outreach in terms of public

education, as well as our merchant acquisition efforts and marketing efforts. The majority of the islands today have brought the pandemic somewhat under control of reopen their economies. And so once we have gone live with Anguilla, we're excited to take a more strategic targeted approach in each island specific to the needs of each island.

Interviewer: And talking more in depth about financial inclusion, are there alternatives in your currency union for digital payments such as mobile money technology providers?

Ms Johnson: Not to the degree of what we have seen Kenya and not to the level of M-PESA. We have a number of maybe private digital payment platforms, which still, they're in the process of trying to gain traction, we also have a mobile payment solution by the Regional credit unions, the umbrella body, again, at this, this point in time, it is a relatively new offering. And we may have one or two small providers within specific islands. But again, the extent of their outreach is not on the same scale as DCash, as these would be private offerings, and most are localized to the islands that they've been launched in.

Interviewer: So in your case, you think that the main advantage of the DCash to increase financial inclusion would be its greater outreach, and the fact that you're a trusted institution by the public?

Ms Johnson: Definitely, in addition to this being just a digital version of the Eastern Caribbean currency, there is parity with the physical version of the EC dollar, it really is legal tender, so it's one to one, it doesn't fluctuate. The other aspect of it is that our reserves which back the Eastern Caribbean currency extends to the cash. So it is, by those measures, a safer option than private electronic cash. Further to this, the fact that the CBDC has been introduced with no transaction costs, or no fees attached to it. And in our post commercialization efforts, we intend to keep fees, if they are introduced at all, as low as possible meaning that it will be the most accessible competitive payment method for most people in the ECCU.

Interviewer: Related to this, I read that you also intend to offer the cash wallet with an offline version. So also in that case, it could be something that may help people that lack access to the internet actually be included in the financial system.

Ms Johnson: This is definitely one of the intents of CBDC in recognition of still limited internet connectivity, but also in recognition of the frequency of natural disasters. We are in most of our countries in active hurricane zones, and from time to time we find that our telecom infrastructure is impaired by hurricanes, and so having the ability for the cash to function, while the system is offline, or in case of lack in connectivity is an important objective of the entire project itself.

Interviewer: And to touch a last point, I read that, for the moment, you plan to offer even cross border payments, as long as the two payment actors, have the cash wallet. So this, in terms of even receiving remittances, may be very important for the population. Would you also plan in the future to allow, for example, to receive the cash payments, but from people from abroad that may not be registered in the DCash system, per se.

Ms Johnson: I think for many of the CBDCs being piloted, the next obvious area for consideration is interoperability. Because the financial system itself is one that is very much interconnected. And so the value of a CBDC is really to be able to interact with the wider international financial system. So while we would want that, I think the achievement of this is perhaps less in our control. And it would be influenced by a lot of the projects being undertaken now, including the BIS is interoperability or interoperable exchange. That is being tested right now, including the Central Bank of Australia or Singapore. But it is a somewhat optimistic trial taking place that can very much offer the ability for us to use CBDCs in other circumstances outside of the currency union.

4.2.2 Analysis

From the interview with Ms Johnson, certain key points arise:

- As already mentioned financial inclusion is again considered as the main policy goal that should be achieved by the DCash project. This should ensure a greater facility in payments, a reduced cost for user and a limit in the use of cash, thus making transactions more controlled and formalised. These are all goals consistent with those identified by the Central Bank of the Bahamas for the Sand Dollar project.

- The ECCB envisages a larger role for the DCash, not only related to private individuals, but also including businesses to increase their competitiveness. Moreover, this CBDC will not exclude financial institutions but will rely on their previous knowledge for customer KYC information and on people's bank accounts which will provide an alternative method to convert conventional currency into DCash, which will then be a wholesale CBDC.

- The main advantage of the CBDC compared to traditional financial services in this regard, is that customers can open a CBDC account without having a bank account and can easily register remotely by providing an ID piece and then deposit money through an agent. This could bring some issues in terms of security and does not seem to bring a critical advantage over alternatives such as mobile money, which function in a similar way.

- The main benefits that could lead to a greater adoption of the CBDC compared to other digital finance alternative relate to the following

    - It is issued by a trusted institution as the central bank is, thus increasing users' confidence
    - The plan is to keep fees extremely low, so as to boost its use and make it viable for everybody
    - As the DCash is directly backed by central bank assets, it would a safer alternative than private electronic cash alternatives
    - It will envisage a much greater distribution and cover all countries in the currency union, while current digital finance methods are active at a local level
    - The system will work offline, so as to function in an area where connectivity is not completely widespread and where natural disasters often disrupt internet connection

- Potential issues related to the technology may regard low digital literacy among the population and low levels of broadband connections, which could impair the ability of users to adopt the technology.

4.3 ENAIRA

The eNaira is the CBDC developed by the Central Bank of Nigeria, which designed it during 2021 and deployed it in a pilot project in September 2021 in the most important municipalities of Port Harcourt, Abuja, Kano and Lagos, and made only be available to those who already have bank accounts. However, the eNaira is intended to be universal and, once a complete rollout will be made, expected during 2022, everybody will be allowed to access a digital wallet. The eNaira has the objective of enabling households and businesses to make fast, efficient, and reliable payments, while benefiting from a resilient and inclusive payment system. This goal is slightly different from that of the other studied cases, in the sense that it is more concentrated on payments rather than on other financial services, as bank accounts, credit and saving facilities. The latter have already been targeted by the government in the latest years, as shown by the fact that adult Nigerians with access to payment services increased from 21.6% in 2010 to 70% in 2020, while those with access to savings from 24.0% to 60%, and Credit from 2% to 40%.

The following interview with Professor Ozili Peterson from the Central Bank of Nigeria provides for a deeper understanding of the product, its rationale and its utility for financial inclusion.

4.3.1 Interview n°2

Interviewer: What has been the adoption rate of the eNaira so far?

Professor Peterson: In terms of retail eNaira adoption, there has been high adoption of eNaira among Nigerians working abroad. The eNaira has been used largely to increase remittance inflows into Nigeria. Nigerians working abroad use the eNaira to transfer money to family members and friends back home. Other than remittance inflow, there has been low adoption of eNaira for other retail uses in the country. Wholesale adoption of eNaira is also very low at the

moment. The reason for this is because existing payment systems are working very well so there is very little motivation for people to abandon existing payment alternatives for CBDC.

Interviewer: What are the main difficulties in developing adoption (digital illiteracy, financial illiteracy, lack of trust, lack of necessary technology, lack of financial means)? Response: The main difficulty, I would say, is the lack of widespread publicity about the cost-saving benefit and other benefits of the eNaira. The lack of publicity/awareness about the many benefits of the eNaira is the reason why people do not see a clear reason to switch from existing payments to CBDC. Since existing payment systems are working very well, people say that they do not see a real reason to abandon existing payment systems and switch to CBDC. So, the main difficulty in adopting the eNaira in Nigeria is majorly a lack of widespread publicity/awareness of the benefits of using eNaira. Now, talking about the difficulties you suggested (digital illiteracy, financial illiteracy, lack of trust, lack of necessary technology, lack of financial means), these are not major problems in Nigeria at the moment. This is because Nigeria has a well-developed payment system, and over 60% of the population already use mobile banking applications, so financial illiteracy, lack of necessary technology, lack of financial means are not much of a problem. Lack of trust is also not a problem because the eNaira CBDC is guaranteed by the central bank.

Interviewer: Are users satisfied with the eNaira technology and are using it as an alternative to payments?

Professor Peterson: Currently, the eNaira is doing what it was designed to do. It was designed to be a payment-CBDC. It was designed to be used mostly for retail and wholesale payments. Presently, the users of eNaira are satisfied with the eNaira technology, and the eNaira mobile application is user friendly and has similar features with existing mobile banking applications, thereby making it easy to use.

Interviewer: What are the main factors limiting financial inclusion in Nigeria? How can the eNaira mitigate them?

Professor Peterson: (i) burdensome documentation, (ii) high transaction costs, (iii) high cost of internet connectivity, (iv) digital illiteracy, (v) refusal of financial institutions to open branches in remote communities due to lack of enabling infrastructure in remote communities. Enaira

can mitigate these issues by ensuring that people can access financial services from anywhere at a very low cost and even without internet connectivity.

Interviewer: Have you noticed an increase in financial inclusion since the beginning of the eNaira project?

Professor Peterson: Yes, I have noticed an increase in financial inclusion especially among foreigners and among Nigerian living abroad who want access to the Nigerian financial system.

Interviewer: With respect to other digital alternatives, such as Mobile Money, how do you think that CBDC can improve financial inclusion (easier to access, greater public trust in CB, possibility of offline usage, etc.)?

Professor Peterson: CBDC can improve financial inclusion by making it possible for people to use CBDC for financial transactions without the strict requirement to own a bank account.

Interviewer: Do you see CBDC as a better alternative to these methods or a way to complement their offer?

Professor Peterson: I see CBDC as a better alternative to existing methods because CBDC offers a relatively low transaction cost, and it is guaranteed by the central bank which means that any loss in CBDC money will be refunded by the central bank. This guarantee gives people a level of safety that is not obtainable with money held in deposit with commercial banks. This is why I think CBDC is a better alternative.

4.3.2 Analysis

The interview with Professor Peterson allows to reach certain conclusions about the eNaira:

- Financial inclusion is one of the critical points behind the deployment of this CBDC, with a focus on creating a better access to the payments system for users.

- As in the other cases, financial inclusion is hampered by high transaction costs, connectivity issues and difficulty in reaching population living in remote areas. The

eNaira can be a solution to these problems, while another barrier like digital illiteracy would need complementary solutions, such a boosting education on such matters.

- A difference with the Sand Dollar and ECash is that the adoption of the eNaira has mainly involved Nigerian living abroad and the remittances they pay to relatives in the country. Therefore, this shows how CBDCs can target particular segments of the population and improve the living conditions of people by improving cross-border transactions.

- Also in this case the same conclusions about the benefits of a CBDC with regards to financial inclusions are reached, the possibility of being accessed offline and the fact that it is backed by a trusted institution as the central bank make it such that people would be more willing to use such technology compared to other digital finance services. Moreover, the very low transaction costs would ensure a better alternative to current methods.

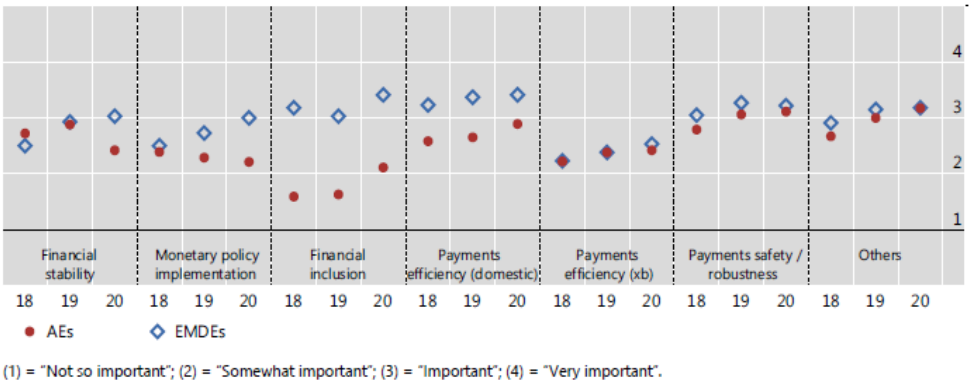
- Some issues related to its adoption relate mainly to the fact that it is not yet well-known by the population and that existing digital payments methods, as mobile money, are working very well and are appreciated by users. In particular, a greater knowledge of the cost benefits of the eNaira would boost its utilisation.

4.4 CBDCs AND FINANCIAL INCLUSION

As clearly shown by this analysis and by the different documentation published by central banks, financial inclusion is always one of the main, if not the main, objectives when developing a CBDC. This is true especially for emerging economies, which are still affected by many factors limiting financial services, such as higher transaction costs, high degree of informality in the economy and high cash usage, and dispersed population that often makes it unprofitable to have widespread bank branches. Digital financial services can mitigate these problems by providing online means of payment, as well as credit facilities or accounts, which can be reached everywhere and by offering lower transaction costs. However, even these methods may certain hurdles, in particular related to digital illiteracy, connectivity issues and lack of trust/issues with intermediary figures like agents. It is in this context that CBDCs are

regarded as a more complete solution to the problem and a better alternative to the existing services. In particular, the fact that they would be issued by a trusted institution which could control transactions and effective distribution of the currency, on a one-to-one basis with conventional ones, and by the fact that they would be accessible offline. Moreover, the lower transaction costs that would be demanded by central banks, due to their non-profit character, would constitute an additional advantage over current solutions. This is reflected by **Figure 10**, which shows how financial inclusion is indeed the first motivation behind implementing a CBDC for emerging economies, together with payment efficiency, a closely related goal, and how it has been increasing between 2018 and 2020.

Figure 10: Motivations for issuing a retail CBDC



Source: BIS Survey on Central Banks (2020)

This data is consistent with the interviews collected from the central bank officials and it is a further proof of how this technology can represent a turning point for developing economies in helping more and more people being included in the financial services, so that they are able to access efficient payments, credit and saving facilities and receive remittances, which are often critical for maintaining their living conditions. Sure enough, the fact of having digital money controlled by a public institution could guarantee a fair control over its deployment and transactions, while at the same time offering attractive utilisation conditions for users, in particular lower transaction costs.

4.5 CBDCs AND MOBILE MONEY

The effectiveness of CBDCs as a tool for greater financial inclusion needs to be measured against its digital finance alternatives, which were often developed with similar objectives of

increasing access to finance. Mobile money, in particular, which has been previously examined in this paper, is often considered as one of the technology that contributed the most to increasing financial inclusion in many developing countries, especially in Africa where the adoption was particularly high. It is thus critical to compare these two options to understand how CBDCs can improve the results that have been so far obtained by mobile money and how it can do so, as an alternative or complementary method.

Among the disadvantages of mobile money, there are certain that could be solved by a CBDC design:

- Low interoperability: as discussed before, mobile money providers are not perfectly integrated with other payment systems, which leads to higher costs when processing and accepting payments. CBDCs, due to their design and characteristics, would be universally accepted as they are sovereign legal tender and central banks would ensure compliance by all the actors in the payment ecosystem. This would guarantee a greater interoperability and facilitate the acceptance of CBDCs as a cash substitute. The fungibility of CBDC would also facilitate the interoperability of mobile money and thus enable mobile-money providers to send and receive CBDC from any mobile money operator, financial institution or point-of-sale facility with greater ease (Cooper, Esser, Allen, 2019).

- Liquidity constraints: an issue of mobile money is the great reliance on agents as providers of liquidity; in case they had liquidity constraints they may refuse withdrawals to users and even refuse the opening of a mobile money account. CBDCs would mitigate this effect, sure enough, their greater acceptance and inclusion of many actors of the payment ecosystem, such as banks, would reduce the pressure on agents, thus decreasing liquidity constraint. Moreover, as CBDC wallets can be opened in a decentralised way, agents would not have the same power over refusing new users.

- Transaction costs: the aforementioned issues of mobile money, such as regulatory constraints and low interoperability, lead to higher costs that are passed onto consumers. As discussed before, central bank officials intend to ensure very low or even zero transaction costs to ensure fair conditions and incentivise utilisation.

- Connectivity issues: another problem that could arise with mobile money technology is its reliance on having a working broadband connection, which is not always the case in the concerned countries, where remote areas may lack internet coverage. The fact that CBDCs are often designed to work offline is an additional source of advantage of using the latter technology.

From this, CBDCs look like a more valid alternative than existing technologies, however, some of the difficulties that these same technologies are facing cannot be solved by CBDCs alone, in particular any barrier related to poor digital literacy, poor financial knowledge and lack of trust for digital finance. For this reason, any project that envisages to strongly improve financial inclusion through CBDCs needs to have a complete effort by regulators, governments and institution in educating people and explaining very clearly what the benefits of using such services can be.

Whether CBDCs can represent a complete solution to financial inclusion or work together with other existing technologies is an important question that central banks should seriously take into consideration. In order to better understand how these new currencies can improve access to finance and work with alternative methods, the following interview with Antonia Esser and Michaela Allen, from the Centre for Financial Regulation and Inclusion (CENFRI), a non-profit think tank that supports financial sector development and financial inclusion in Africa, is provided as they are conducting extensive research on CBDCs and financial inclusion, especially in comparison to current technologies.

4.5.1 Interview n°3

Interviewer: What do you think are the main challenges related to financial inclusion, especially in the African continent? In particular, what are the main challenges that are still arising despite the current digital finance solutions, that are stopping people from accessing financial services and how you think that central bank digital currencies can actually solve these issues and improve them?

Antonia Esser: So the starting point for us was, of course, to understand why financial inclusion is still a challenge especially for developing countries. And it really comes down to the basics, I think. So for us what a developing country looks like, it's often a country that is facing a lot of structural challenges. So access to electricity is always going to be a problem, access to the

internet, but also reliability of the internet and being able to afford the internet is quite a challenge, particularly because individuals in developing economies often don't access the internet through sort of fibre or broadband, they're often accessing through their mobile phones. So we need to be able to afford mobile data. And sort of thinking through how people engage with digital financial services. Those are often the key access areas that stop them. And I think it's also important to realize that people don't go from cash to digital instantly, they often go through it in phases. So in order to move from using any paper based instrument to digital, there needs to be some sort of system that allows people to exchange cash for digital. So in the Kenyan context, agents, mobile money agents have been key players in cashing out my digital value for physical value. Creating those touch points for exchanging value one kind to another as being sort of a key, a key enabler for digitalization, but it's also been a struggle for other countries that don't have that sort of cash reticulation systems in a country. So by not having more touch points in rural areas, it means that rural individuals often don't have a lot of touch points to engage with the formal financial sector, because banks often don't want to have branches in remote areas, because within themselves is difficult to operate in a space without electricity or data. So because there's not a physical footprint in modern rural areas, it's difficult to engage with the formal sector, and also, of course, engage in digital financial services. So first of all, from an access point of view, but then from a user's point of view, there are issues around trust. And what has been interesting for our study is that trust differs across different countries. What people need to get their trust changes, because trust is built on a number of composite factors. So in order to build my trust, I need to have faith that the central bank has my best interest at heart, not going to manipulate my data, I need to feel that the service is reliable, so I'm not going to have the electricity or the internet sort of shut down for weeks without then having access to money. I need convenience, I need to know that my CBDC can be accepted by any business, anyone. I don't want to be rejected when I'm at the store trying to buy something. And it needs to be fast. So there's so many factors that go into trust. And in the current digital financial service space in at least Africa, and maybe in the developing world, they struggled to get everything right. I think they get some parts of it, right. But then maybe they struggle to get others, right, because I think taking a step back towards them, Antonia and I are working CBDCs originated from a more sort of payment ecosystem perspective, as, in order to get digital payments, it needs to be an ecosystem effect. So like, regulation, needs to work really well. Providers need to have the willingness and the ability to meet customer needs. But then you also have to have the consumer have the capability of engaging with digital financial services.

Michaela Allen: And one player often struggles to get everything right simultaneously. And I think that's what's been sort of the attraction with CBDC, is that because it's not really a provider led instrument, it's a central bank led instrument, this theoretically, a greater possibility that they could get everything right together, because they have such an influential role. And regulation is such an influential role on providers. So theoretically, a central bank could get all the players in order and catalyse change, and designers, to address the inequalities, etc. But that's very conceptual. And I think the stumbling block that we're encountering is that, just because central banks are involved, doesn't necessarily mean that they can do any better than a private sector player, for instance.

Antonia Esser: Adding up on the barriers, I think the big question is also what need does the financial service meet, for instance, we have a lot of rural customers that operate only in cash. And if they don't have a problem, why would they move over to digital financial services, it's often from a need that digital financial services take off. So in Kenya, or in Zimbabwe, it is a great example. A good one is where cash was in short supply, but people need to keep transacting, so their electronic money or mobile money really took off because it was a real need. And I think in many kind of rural communities, we don't have that need, for more convenience, because you actually introducing more hassle for them, if now everything is electronic, and they need to go with their cash, like Michaela said to an agent, cash it in. Now, you know, also pay the data, pay account fees, which are often very expensive. So it's the cost and the need. And like you also said, the lack of documentation is a real barriers. Often, even if you have lower tier accounts, you can only come with your identity document. And then you can only transact up to a certain amount, or you can only store so much money in your wallet, that doesn't really meet my full needs of financial services. So I will only use that for emergencies, perhaps. But then I need to bring like a water bill or utility bill, electricity bill, if I want to open a full account. And in a country where you don't really have addresses that are mapped, it just doesn't make any sense. And yeah, the convenience factor just isn't there as for a developed economy where everything kind of works, and you know, you have reliability. So these additional cost factors step in. But people don't perceive to have those with cash, even though you still need to often travel to an ATM, or you know, the provider somehow needs to pay for the Cash System in the background. So they probably charge it to you somehow through some dark alley way. But the point is to the consumer cash is the most convenient, and that is where a CBDC theoretically offers the most benefits because it operates exactly like cash, but for that the underlying system needs to work very well, 100% of the time never fails, and, if it

fails, I have to know exactly what to do where to go, if my money is gone, the consumer really needs to have that trust that the system works. Or you need to have an offline CBDC where you're going to need all this kind of supporting infrastructure. But then a merchant, for example, needs to be able to immediately access the payments that they've just got. Because that is another barrier you have today is yes, you pay by card or you pay mobile wallet in Africa, but then the merchant on the other side can't get the funds immediately, they can only get it at the end of the day, or you know, three days later. And this is where CBDC could really offer value. But only if really the infrastructure underpinning it works well.. But at the same time, you need to be able to pay with cash at the same time physical cash. Our finding, or at least on my side of the project is a bit of a pipe dream to really think that CBDC will fully replace cash, because paper based systems have developed over thousands of years. It should always be a parallel system, it's more than for those instances where a digital transfer is more convenient, people should be able to use it. And where it is offered, basically, they should always have an option for the most convenient instrument, because that is truly what financial inclusion is, it really needs that. Those that want to use it. And that's what the financial system is for not a product in itself.

Interviewer: Do you think that actually what you were saying about central banks being able to deploy every part of the financial ecosystem will be able to overcome these difficulties? So would you say, for example, whether that actually is the case in Nigeria?

Michaela Allen: I think, well, there hasn't been a lot of information released, as you know, I think they have maybe one design paper that they released. But Nigeria is an interesting case, because I believe it has quite a great ambition to be a leader in the CBDC space in Africa. But I also believe that they may be a bit too eager. I don't think that they move slow enough, because I think in getting CBDC right, you have to, as I said, get all your points in order. And I think that's, that's why the deployment or the launch has tripped up. Initially, there's been some growing pains. I know that it was a month ago that the IMF raised that flag that their KYC sort of protocols around CBDC weren't really very well defined. There was sort of the approach of the central bank seems to be like: we will develop it as we go. But that's quite a risky approach, as you want to make sure that you have all the KYC sort of requirements and classes defined before you put something out in the market. And I also think from the discussions that I've had is that the eNaira hasn't really pulled in the local private sector market as much as they maybe should have. Because I think in in my study, but I think also in other studies have been done on CBDCs, having market engagement and market buy in is essential to having a CBDC

flourish, because ideally, a CBDC should be launched in the economy using the sustained payment system. CBDCs should never create their own system because then it's going to fully disrupt the system, moreover, people don't trust them because they don't understand them. But that means that you have to get the buy in from providers and you have to take them along the journey, you have to make sure that you aren't just intermediating banks, you are sort of cutting into the role and the market share providers. And from what I've seen in Nigeria, I think they had a couple of conversations. But I think those sort of stumbling blocks are coming down to the fact that they're still having conversations with providers, rather than having had that and now deploying and delivering the reverse. And the reverse creates frictions. And then that creates mistrust for individual when they use CBDCs. But it's still early days. So I can't say too much whether you know, it's going to be a success or not. But I think these are these red flags. Now, that to me, suggests that they jumped the fence a little bit, and they haven't gone through all of the phases. Because, again, I'm not even sure that they did sort of like a needs assessment. Whereas like other countries, they first do a consolidated assessment. What is the use cases for the scenario? Is the country ready for that? And then they move to the next phase. I think they just jumped into the launch and sort of skipped learning by doing. And sometimes that can work. But when something on such a grand scale, which affects literally every single sector in an economy, and it's so systemic, you have to make sure that all the players in the market are on the same page, and that you don't create any sort of unintended consequences for anyone.

Antonia Esser: On top of that, what is also interesting is that Nigeria has, a very well-functioning instant payment system in the NIBSS instant payment system. So again, the need for the consumer isn't necessarily immediately there in terms of having now this parallel system, where merchants, for example, actually need to download a CBDC wallet, which, you know, is a separate system. Like Michaela said, what you want is for the consumer to not even realize that it's perhaps CBDC, they have their wallet, you know what happens, you know it is really a back-end efficiency system, it's good for the providers behind it, it's good for the central bank, for the consumer, and that nothing, you know, essentially would change. But now they're launching the separate wallet, people are like, why should I now download an extra app? I already have five apps on my phone. And those who don't have smartphones can't actually use it? Or if there's a USD function? I'm not sure whether there is. But we know that there is major network issues and electricity issues in Nigeria, especially in the northern parts of the country. So this would work in like a Lagos or in Abuja, or the more urban areas. But again, you need universal acceptance and adoption. And also what is very important, I think, is how you

introduce the CBDC, which is what we are also thinking in the Tunisia case. If the government is not well trusted, and yes, people will basically also loop in often the central bank into the government because they are all public authorities. So you really need to think how you introduce this, because people may think: oh, the government can track how money is spent. And you can tell them: no, we will do whatever and everything will be anonymized. People may still not use it. And I think that is a big thing for markets where governments are trusted like the UK and Sweden. People trust them more than like, say, Nigeria, Tunisia. If you're going to launch it like with big fanfare and make a big thing out of it. What do people actually need to know about it? What will be different or better for them to make them accept it? Or is it more the providers you actually need to work with and be like, we're going to use your systems, your roles are going to change X, Y, and Z. But you're actually going to save a lot more money in this regard, because they're all for profit entities. At the same time, you can serve a lot more consumers because now you know, you can reach them more cost effectively. So you really need to think smartly around how you get them on board. And like Michaela said, it needs to be universal. You can't just launch something on the side. This is not just the financial sector, this is like police. You know, this is a monetary system that basically all impacts everybody in the economy. So it can't just be a central bank alone that launches something, the tax authority needs to be involved in it. Those kinds of considerations have to be made. So the marketing around is actually almost as important if not even more important than kind of the technology that underpins it, because the technology can be improved, but how people perceive us and continue using something really depends on their first interaction with it and how you position it.

Interviewer: So given all the issues that you mentioned, do you think then that CBDCs will actually be able to have an impact, on financial inclusion alone, or if they work best as, for example, complementary system to mobile money, or if, as you mentioned, the existing digital payments, infrastructure is enough, without the need for this new technology?

Antonia Esser: After the first report we did with mobile money, I was like, okay, financial inclusion is a prerequisite for CBDCs to work. If we're talking from an access perspective, people need to have an account so that a CBDC can flow through, it's not like a CBDC will create more access, because, unless the central bank opens wallets for everybody, which we're not seeing in any country as there is no direct CBDC model, this is actually not going to have a major impact on financial inclusion. However, I've since changed my view slightly to be less dark in that I do believe that if you can get financial service providers to turn the cost and

efficiency savings that they have made through adopting CBDC into broadening and lowering the costs to accessing accounts, then it does improve financial inclusion. But it is through providers, not through the direct intervention of central bank.

Michaela Allen: I think I also have sort of a similar response. I believe there's a lot of potential with the retail CBDC through its design. I think we have, in our research, spoken to a lot of CBDC providers that can help create this sort of offline CBDC, which can work in very remote areas. And CBDCs can be tailored in a way to overcome some of the access and usage barriers. But I think in the developing country context that has so many different complex, interrelated barriers, adding a CBDC to that can add an additional layer of complexity. I am not saying that it's impossible for CBDCs to play a role. In fact, I kind of think that it's one of the tools that a country can use to stimulate financial inclusion but it will not be that silver bullet that will immediately address all of the constraints for farmers, the elderly, for businesses, everyone, but just a sort of one tool they can use. But in order to get that right, there needs to be sufficient political will, they need to revise regulations, they need to change how they think about identity. Providers need to change how they think about themselves in a market, consumers need to sort of change. The CBDCs should accommodate what the consumer wants and needs. However, this technology requires so much to get it right. And I think, unlike maybe developed markets, where CBDC is almost like the natural evolution of where the markets are, in developing countries, I think central banks are trying to force the CBDC into a market rather than letting the market sort of naturally evolve and design itself to meet the needs of consumers. So yes, we see they have potential and they could potentially trigger financial inclusion, but probably on the harder route. I think there's easier mechanisms and easier pathways to achieve what you want to achieve just by getting some of the basics right. And leveraging what you currently have and getting that right. Are they trying to introduce something foreign? Just because you think that that's what an economist should be doing.

4.5.2 Analysis

The interview provides some interesting insights in the usefulness and potential for CBDCs to become a clear driver of financial inclusion. According to the researchers, CBDCs can be an important instrument to improve financial inclusion in developing economies for the same reasons that were discussed above which limit the development of existing technologies. These are both on the users and providers' side.

For the users:

- Accessing a payment service with very low transaction costs

- Benefiting from a greater access, as the offline functionality is critical in such areas

- Less documentation and greater simplicity to open a bank account

- Greater trust in the service as the technology is backed by the central bank and it functions 100% like cash

For providers:

- The fact that it is a central bank-led system should bring a streamlined and clear process involving every payment provider, thus facilitating their operations and lowering their costs

- As central bank and government are involved, regulations on the use of CBDCs should be more simple than of other methods, such as mobile money, therefore also payment providers should have clearer guidelines and simpler KYC/AML requirements

Despite these advantages, there are also a number of issues that CBDC projects need to address in order to ensure a successful and complete deployment. Apart from the technological and technical side, which should be bulletproof to guarantee a smooth functioning, the researchers highlight certain areas of interest. These are both on the supply and demand side.

On the first, in particular the fact that CBDCs will not be a lever of financial inclusion alone, but they actually need to be implemented in an ecosystem, where multiple institutions, such as central banks, tax authorities and governments, are included and also payment providers are onboarded, so that the roles, the necessary information and data to gather, and the needed technology are clearly defined.

On the demand side, instead, the most critical areas that are identified are quite interesting as they were not previously mentioned by the interviewees from the central banks. The first issue is a very fundamental one in the sense that central banks should examine the need for digital payments and CBDC solutions in the economy, thus analysing whether consumers are open

and/or feel the necessity to carry out digital transactions or if they are already satisfied with the current technologies, like mobile money, and do not feel the urge to change as this would add on complexity. For example, this is the case for Nigeria, where instant payments work very well and users may not appreciate the advantages brought by the eNaira. The second issue goes beyond the technical features and involves a clear and well-deployed communication campaign to ensure that the population understands the aforementioned benefits of CBDCs, i.e. lower costs, greater coverage, greater trust, over current alternatives. According to the researchers, these aspects may have not been completely taken into account by the existing projects, which may have been implemented too quickly. For example, in the case of Nigeria, the eNaira can represent a parallel payment service which is not urgently needed, given the good conditions of existing technologies. At the same time, communication over the project has not been properly, as testified by the fact that the adoption rate in the country has not been particularly high, expect for Nigerians abroad, as explained by Professor Peterson. This is especially critical in a country like Nigeria, where the trust in government and institutions is not as high as in advanced economies.

Therefore, to conclude, CBDCs can be an important tool to improve financial inclusion but they cannot be considered the perfect and only solution to the problem, but rather as a complementary method that improves the utilisation of existing technologies. At the same time, when implementing CBDCs in emerging economies, central banks should pay attention in not adding extra complexity in what is already a complex context, thus including a clear and effective communication campaign to involve the population and explain them the benefits that could arise from their use, while at the same time developing a payment ecosystem that comprehends all the actors, i.e. payment providers, businesses and institution to ensure their functioning with existing technologies and regulations.

Chapter 5. CONCLUSIONS

This research paper investigates the potential of CBDCs to improve the access to financial services and increase financial inclusion, especially in developing economies, where many people are still excluded from having a bank account, from credit facilities, or receiving remittances thus impairing their living conditions and economic development. More in depth, the purpose of the research is to examine whether CBDCs can represent a better tool for financial inclusion with respect to other digital finance technologies, mobile money in particular, which, over the last years, have proven to be an important solution and greatly improved the issue with a large adoption rate, especially in Africa. CBDCs could represent a valid alternative to these technologies or also a good complementary service to further boost their accessibility and utilization.

According to this research, which investigated more in depth the currently functioning CBDC projects, namely the Sand Dollar in the Bahamas, the ECash in the Eastern Caribbean Currency Union and the e

Naira in Nigeria, CBDCs do have the potential to mitigate many barriers to financial inclusion, especially on the customers' side, with the possibility to offer lower transaction costs, offline access, greater simplicity in opening an account, and a lesser need for intermediatory figures like mobile money agents. These advantages are due to the fact that public institutions, namely the central banks, are directly involved in the project, therefore, their lower necessity to earn profits, leads to favourable conditions for the users. Moreover, this factor should increase trust among customers and lead to a greater predisposition to share personal data. Certain advantages would be present on the providers' side as well, in particular, with the fact that regulation in CBDC projects should be simpler and clearer by providing a single payment system that works like cash in a digital way, thus becoming easier to implement than mobile money, where providers are often fragmented and transaction recordings can be more difficult and costlier. Therefore, these simplicity, greater affordability and clarity represent advantages for both users

and providers over existing technologies that could boost CBDC adoption and further increase financial inclusion by improving access and utilisation.

However, what is clear from the interviews, is that CBDCs are still facing certain issues that may limit their adoption. Especially, low digital literacy in the concerned countries is still a big hurdle, both to digital finance technologies and CBDCs, therefore central banks and authorities should improve financial and digital education among the population. Moreover, another barrier for CBDCs is the fact that they should be launched not a standalone solution but as part of a larger ecosystem, where users, institutions and payment providers are all on the same page in terms of regulation, transaction acceptance and functionality with other technologies, which, according to the collected data, is not always the case. On top of that, the effectiveness and utility of CBDCs should be considered at a very fundamental level, so as to analyse whether customers really need a new payment solution or if they current ones are already working well and adding another alternative would just increase complexity for users. Thus, central banks should carefully examine this aspect and develop effective communication campaigns that can clearly explain how CBDCs represent a more efficient and better solution than existing technologies.

Therefore, to conclude, CBDCs do have the potential to become a very effective tool in improving financial inclusion in developing economies, but, what emerges from the data is that their deployment should be tailored more carefully than what has been done so far, so as not to rush into it without analysing users' needs and that CBDCs could actually work better as part of the solution, not the only one, by working together with other technologies and being particularly effective for a niche in the market. This is confirmed by the fact that in Nigeria, the eNaira has been particularly appreciated by Nigerians living abroad to send remittances, while domestic use has not been very large. Due to the early stage of all the projects and the technology itself, the availability to collect more data in the future should allow to better investigate the potential of CBDCs and to better study the adoption and any struggle related to it among the population.

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