

CENTRAL BANK DIGITAL CURRENCIES: CONSIDERATIONS FOR A NOT-TOO-DISTANT FUTURE*

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ABSTRACT

The central bank digital currencies (CBDC) are subjects of the rising interest of central banks from advanced and emerging economies. Given the relevance and topicality of the subject, this paper seeks to organize the debate that encompasses what is understood as CBDC in the recent international literature, as well as to analyze the possible implications of its implementation. Given that CBDC may assume various forms, there's still high uncertainty regarding its potential costs and benefits. The decisions concerning the features of the CBDC may have deep implications on various aspects such as the resilience of the domestic financial system, monetary policy effectiveness, functioning of the credit system, and means of payments, among others. Despite the uncertainty associated with the range of possible CBDC architectures, we argue that the strategies of the central banks regarding CBDC may be seen as defensive, as a way to keep up with the technological and cultural changes whilst managing to conduct the process and sustain its central role on the financial system.

Keywords: Central bank digital currency; means of payment; monetary policy; central banks.

JEL Classification: E42; E51; E58

* Acknowledgements: We thank the participants of the Financialization and Development Research Group of the Fluminense Federal University (FINDE/UFF), the XIV Brazilian Keynesian Association Meeting and the Italy-Brazil Debates for a New Economy Workshop (FINDE/UFF and Department of Law of the University Federico II, Naples), for useful suggestions.

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1. Introduction

Technological innovations have been transforming the means of payment used by households, businesses, financial institutions, and, therefore, national and international financial systems for decades. However, the changes resulting from these transformations do not occur in a void but depend on the preferences and balance of power of the parties involved.

In recent years, the emergence of cryptocurrencies has raised discussions about the possibility of sovereign currencies losing space in payment systems. This topic gained greater relevance when Facebook, with billions of users worldwide, expressed its plans to have its currency. Furthermore, the “traditional” payment systems, such as transfers and cards, enjoy great trust and credibility and are becoming increasingly faster and more secure. Instant payment systems that allow transfers any day and time, such as PIX in Brazil, reinforce this trend¹. These factors raise questions about the role of physical currency issued by the central banks (CB), as in many countries, it no longer represents the main form of payment.

Central bank digital currencies (CBDC²) are one of the most recent elements in this discussion. The debate has been motivated by different factors, such as technological innovations in the financial sector, new entrants to payment and intermediation services, reduced use of currency in some countries and greater attention to so-called private digital tokens (Commission on Payments and Market Infrastructures - CPMI³, 2018, p.3). CBDC would have the property of combining innovative technology with the trust and credibility of central banks, which can combine their payment system supervisor and operator functions to develop a new set of payment arrangements based on digital currencies (BIS, 2020).

For now, the discussion around CBDC presents more questions than answers. There are open gaps throughout all phases of the process, from the motivations that lead CB to create their digital currencies to the variety of designs that their configuration and operation can take, and finally, the possible impacts on the financial system arising from its implementation. Thus, the topic in question is vast, involving aspects such as security and privacy, the role of private financial institutions, monetary policy, and technical limitations, among others. Therefore, this article aims to organize the debate about what is understood by CBDC based on recent international literature and to analyze possible impacts arising

¹ In 2020, such systems were present in 51 countries (Carstens, 2021).

² Despite having the same meaning, the term “central bank cryptocurrency” is no longer used. Here, the acronym CBDC is also used to refer to the concept in the singular.

³ Linked to the Bank for International Settlements (BIS).

from the above transformations. Given the subject's topicality, we understand that the development of such objectives can offer a relevant contribution as an introduction to the debate. As will be shown, the theme earns growing interest in the international literature and has been the object of study by several central banks (CB) and the Bank for International Settlements (BIS), indicating the opening of a vast and fertile research agenda.

The article is divided into three sections. The first presents the definition of CBDC and the mapping of how central banks have seen them, as well as their main motivations for implementation. The possible configurations and potential impacts of CBDCs are addressed in the second and third sections, respectively, with final considerations closing the article.

2. Central banks and the CBDC: concerns, reasons, studies and actions

In the wake of the digital transformation of the economy, the wave of financial innovations gives great relevance to the debate about money and payment services. In the meantime, the CBDC are presented as another element of innovation with the potential to bring about changes in the means of payment in the not-too-distant future. Since it can take on very varied designs and formats, the definition of CBDC presented by the BIS is broad. It refers to a form of digital currency denominated in a national account unit, which is a direct liability of the central bank (BIS, 2021, p. 65). Thus, CBDC is legal tender, risk-free and can exercise the three traditional functions of money⁴, contributing to an accessible and secure monetary system that accommodates financial innovations and meets the interests of consumers (BIS, 2021).

Considering the scope of the concept, it is necessary to understand what it has in common and how it differs from other types of assets, from paper money to those that, despite exercising some of their functions, are not exactly currency. Such distinction will be necessary for the analysis of the possible impacts of the CBDC. Bech and Garratt (2017) present a typology of money that is classified based on four criteria: i) issuer, which may be the central bank or another; ii) form: digital or physical; iii) access, which may be retail, for general purpose for daily operations, or wholesale, for restricted use for large amounts; and iv) transfer mechanism, which can be intermediated or decentralized (peer-to-peer). Regarding the latter, an important criterion is the form of verification, that is, how the settlement of a transaction or access to the resources takes place. The decentralized or peer-

⁴ The possible limitations of a given CBDC in being a risk-free asset and exercising these functions would be the same as the currency issued by the central bank.

to-peer system would use a token, a representative object⁵ such as paper money itself. In the case of CBDC, the token would be digital, generated by an encrypted system with a password to validate transactions, without the need to verify identities (“I know, therefore I own”)⁶. On the other hand, a centralized system would be based on accounts⁷, and validation would take place by confirming the identity (“I am, therefore I own”), ensuring that a certain person is the actual owner of the resources (Auer; Böhme, 2020; Carstens, 2021).

Whether in account systems or via token, the architecture of the validation and registration system can be direct (single-tier retail) or indirect (two-tier retail). In the direct mechanism, the operationalization of the payment system (processing and recording) of all transactions with CBDC would be the responsibility of the central bank. In the case of indirect transactions⁸, the intermediary may be a commercial bank or other financial institution. The CBDC remains a liability of CB, but with a system for processing and recording transactions via messages by payment service providers (PSP) (Auer; Böhme, 2020). Despite the different possibilities, the recommendation presented in BIS (2021) is that central banks and PSPs continue to act in a complementary manner⁹.

Figure 1 illustrates the general scenario of the typology of money based on the four criteria mentioned above in a Venn diagram.

⁵ CPMI (2018, p.4) refers to the token as a “payment object”.

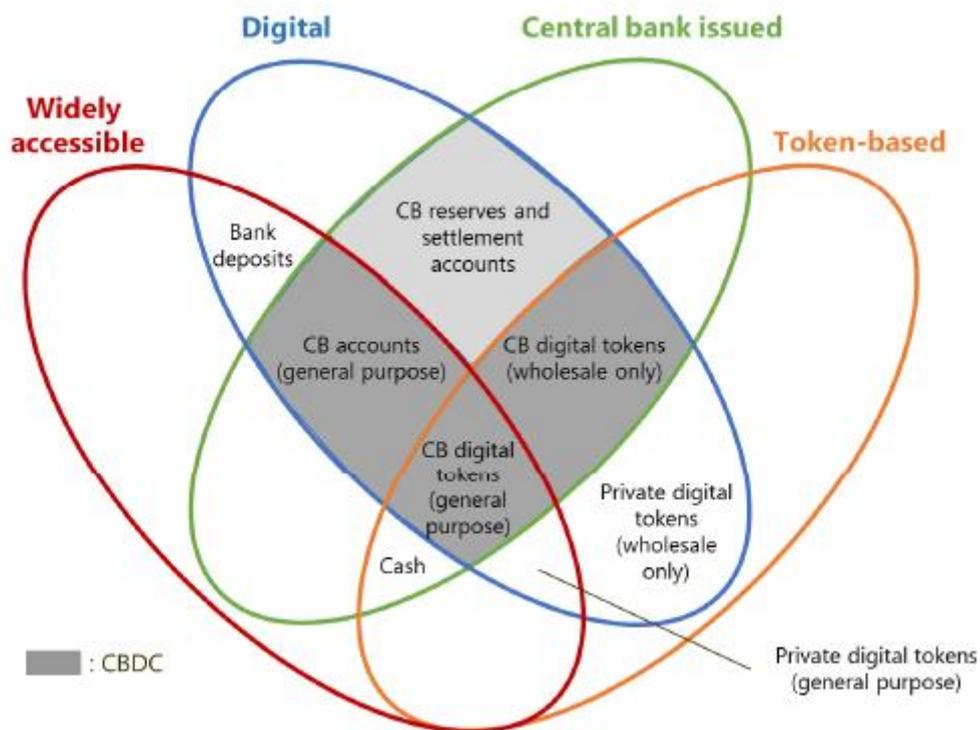
⁶ In the case of the physical token, the verification is on the object itself (if it is not spoofed).

⁷ In account-based systems, there would even be the option for individuals and companies to have accounts at the central bank.

⁸ In this case, the mechanism can be intermediated or hybrid, a distinction that refers to the operation of the registration of transactions between intermediary institutions and the CB. See BIS (2021, p. 78).

⁹ This issue is explored in section 3.3.

Figure 1- The money flower



Source: Bech and Garrett (2017, p. 60) and CPMI (2018, p. 5).

Entitled by Bech and Garratt (2017, p.59) as “money flower”, the figure allows observing four types of digital coins issued by central banks (shaded area). To analyze possible changes brought about by the CBDC, settlement or reserve accounts (light shaded area) are disregarded. After all, they have been in operation for a long time. Furthermore, the diagram analysis points to other assets with money characteristics, with some distinct attributes but also some in common with the CBDC.

Regarding local currencies, complementary currencies to the Real circulate in Brazil – not issued by the Central Bank – with different designs and characteristics, such as the ‘Palma’ and ‘Mumbuca’, which circulate, respectively, in Fortaleza (CE) and Maricá (RJ). Unlike Palma, Mumbuca exists only in digital format. Therefore, according to the Money Flower diagram, Mumbuca can be considered a local digital currency and would fit into the same subset of cryptocurrencies, differing from these by having guaranteed convertibility.

The so-called cryptocurrencies, such as Bitcoin and Ethereum, fall into the general-use private digital token category, along with stablecoins. The main differences between them are that cryptocurrencies do not have an identified issuer, nor are they backed by other assets. Instead, stablecoins are backed by one or more assets (such as commodities and sovereign

currencies), which would give greater stability to their value (G7-WGS¹⁰, 2019), hence the nickname stable. These “currencies” seek to equate one of the main flaws that make it difficult to use cryptocurrencies as means of payment, namely, the volatility of value. Diem Coin stands out in this group, a stablecoin issued and managed by the Diem Project, formerly called Libra Association (which Facebook, Spotify and Uber are part of, among other companies).

As will be seen in the following section, stablecoins have been raising concerns to central banks about their regulatory aspects, especially those with the potential to be used in international transactions, which is why they are called global stablecoins (FSB, 2020). This caution was made clear in the October 2020 report of the Financial Stability Board (FSB), which states that before they start operating, payment systems based on global stablecoins must conform to existing regulatory standards and new ones that may be needed (Ibid).

In short, CBDCs have been the subject of increasing interest by central banks in advanced and emerging economies. Furthermore, with the downward trend in the use of paper money and the greater preference for digital payments, a digital currency could serve as a secure, robust and convenient alternative payment instrument. Therefore, Mancini-Grifolli et al. (2018) claim that, through strengthening benefits and reducing costs and risks, CBDCs can be an instrument of financial inclusion. However, the authors make the caveat that the creation of a digital currency, by itself, does not guarantee user adherence. Thus, the demand for CBDCs will be related to their design and consequent attractiveness.

Therefore, the efforts of central banks around CBDC may also be seen as a strategy with multiple simultaneous objectives, such as financial inclusion, security and integrity of digital payments, a resilient, fast and cheap payments system, and the encouragement of continuous innovation (BIS, 2020). Among the motivations and intentions of central banks concerning CBDC, we can point out i) interest in technological innovations for the financial sector; ii) emergence of new participants in payment and intermediation services; iii) reduced use of cash in some countries; and iv) growing attention to so-called private digital tokens (CPMI, 2018).

By June 2022, four CBDC had been launched, circulating in ten countries. The first to enter circulation was the Bahamas sand dollar, launched in 2020. The second CBDC was

¹⁰ The G7 Working Group on Stablecoins involves, in addition to the G7 itself, the International Monetary Fund (IMF) and the CPMI.

the DCash, in March 2021, issued by the Eastern Caribbean Central Bank (ECCB)¹¹. DCash circulates in seven of its member countries. In October 2021, Nigeria created its CBDC, e-Naira. Finally, the most recent release was JAM-DEX, from Jamaica. All CBDC in operation have the characteristics of general purpose and intermediated architecture in common. That is, they are a central bank liability, but with operation eased through intermediaries such as commercial banks.

Among the largest economies¹², CBDC at the most advanced stage of development is currently the digital renminbi (e-CNY) and the Russian ruble, with pilot projects already underway. The e-CNY was launched in a test phase in 28 major cities in 10 regions. As of October 2021, 123 million e-CNY wallets were registered by individuals and 9 million by companies (Sorderberg et al., 2022). Its launch raises the debate about the internationalization¹³ of the Chinese currency and the maintenance of control of the domestic payment system by the Chinese government. Since the use of bitcoin is prohibited, the e-CNY can also be implemented to reduce the power of widely used private electronic payment systems, mainly Alipay and WeChat, controlled by the giants Ant Group and Tencent (Kynge; Yu, 2021). In Russia's case, the digital ruble platform prototype was launched in the testing phase in February 2022. The Russian central bank has partnered with 12 commercial banks, two of which have successfully operated the full cycle of transactions. Given the sanctions applied to the country since the beginning of the Ukrainian War, the implementation's main motivation – and haste – is to reduce dependence on the US dollar for financial and commercial transactions (Schnapper-Casteras, 2022).

In addition, the European Central Bank (ECB) released in October 2020 a report on the digital Euro, but still without a defined operational design or technology. The ECB (ECB, 2020) understands that although cash is still the dominant mean of payment, the growth in demand for digital and instantaneous means is evidenced by the expansion of new technologies for such. In addition to being able to offer citizens a secure form of digital currency in a rapidly changing environment, the ECB also expresses concerns about significantly reducing the use of cash. One of the reasons would be the dependence on the operation of private electronic payment methods, which are beyond the operational control

¹¹ The Organization of Eastern Caribbean States is an intragovernmental entity with seven members: Antigua and Barbuda, Dominica, Grenada, Monserrate, Saint Kitts and Nevis, Saint Lucia and Saint Vincent and the Grenadines.

¹² Besides China and Russia, countries such as Sweden, South Korea, South Africa and Saudi Arabia have already implemented pilot projects. Furthermore, most IMF members actively develop their own CBDC (Sorderberg et al., 2022).

¹³ For a more detailed debate on the topic, see Peruffo, Ferrari and Cunha (2020).

of the ECB and may be temporarily unavailable. Another concern the ECB expresses is that, in the absence of the digital Euro, digital foreign currencies could end up replacing the existing means of payment. Last but not least, the ECB warns that the decline in the use of paper money can accentuate the financial exclusion of the unbanked population and social groups in vulnerable situations (ECB, 2020).

In Brazil, the central bank announced, in August 2020, the constitution of a study group to create a prototype and propose a digital currency model for the country. Then, in May 2021, they released Brazil's general guidelines for a digital currency¹⁴. Finally, in April 2022, the central bank announced that the pilot project would be implemented in the second half of 2022.

The objectives of the creation of the CBDC were summarized in four items: i) to follow the dynamism of the technological evolution of the Brazilian economy; ii) to increase the efficiency of the retail payments system; iii) to contribute to the emergence of new business models and other innovations based on technological advances, and iv) favor Brazil's participation in the regional and global economic scenarios, increasing efficiency in cross-border transactions. Despite the numerous possibilities for configuring the CBDC, the guidelines published by the Brazilian central bank point to a well-defined design, and among them, the following stand out: i) plan of use in retail payments; ii) ability to carry out online operations and possibly offline operations; iii) issuance by the Brazilian Central Bank, as an extension of physical currency, with distribution to the public intermediated by custodians of the National Financial System (SFN) and the Brazilian Payment System (SPB); and iv) lack of remuneration. Therefore, the guidelines presented allow us to conclude that the impact on the structure of the financial system will be small, with the maintenance of the functions of the CB and other financial institutions.

As Araujo (2022) highlights, the digital real can become a key part of an "intelligent" payment system in Brazil, completing an already modern system that offers solutions such as a Real-time Reservation Transfer System since 2002, electronic payments in the PSP format since 2013, and recently the PIX, an instant payment system implemented in 2020 and which in 12 months already had more than 45 million users. In particular, the PIX represented a significant inclusion in the payment system but only a first step towards deeper financial inclusion in Brazil (Araujo, 2022). According to the author, the implementation of the digital real can represent an increase in operational efficiency that, if combined with

¹⁴ The note may be found (in Portuguese) on <https://www.bcb.gov.br/detalhenoticia/17398/nota>, accessed on November 28th, 2021.

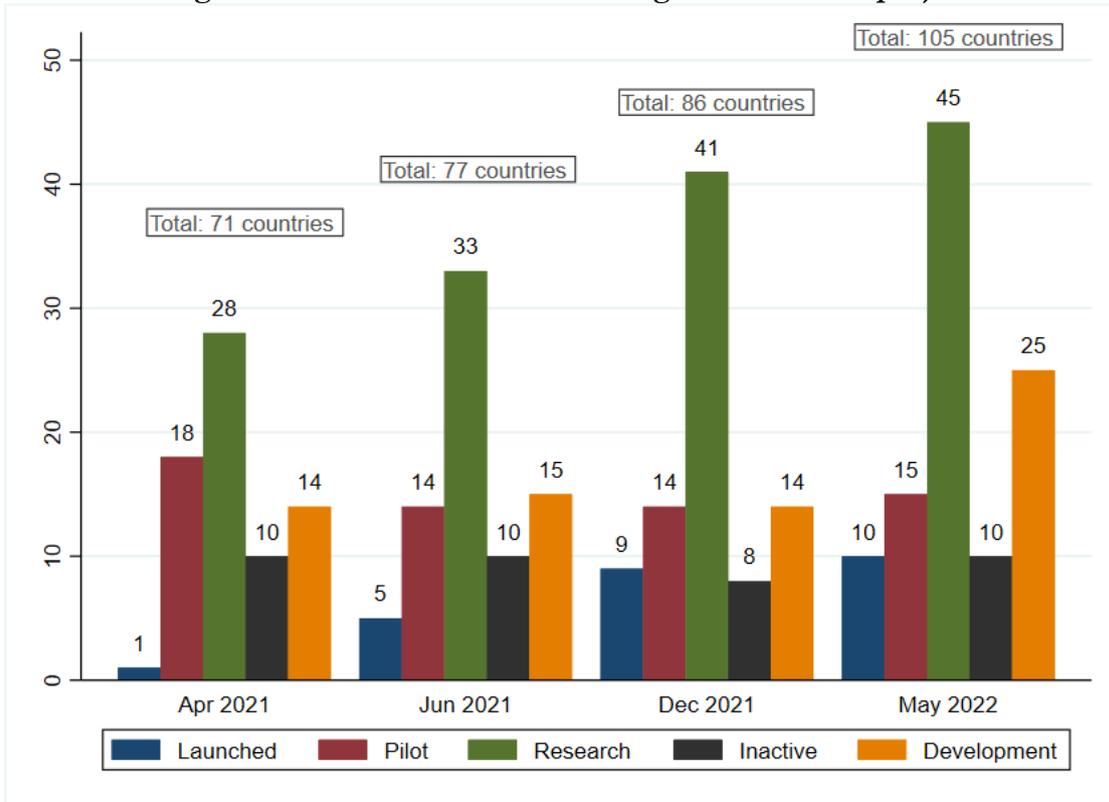
public policies and infrastructure improvements, can represent a true inclusion of financial services in Brazil, whose main challenges are the precarious internet network and lack of financial instruction (ibid).

An interesting aspect about CBDC is that CB are not working individually. There are currently seven cross-border CBDC projects. This cooperation is mainly related to the possible implications that CBDC may have on international flows. The pioneer was the Multiple CBDC (m-CBDC) Bridge, a project with the central banks of China, the United Arab Emirates, Hong Kong, and Thailand in partnership with the BIS Innovation Hub¹⁵. The objective is to enable an international payments system that would work at any day and time and would use wholesale CBDC. With similar motivations, there are the Dunbar projects (Australia, Singapore, Malaysia and South Africa); Helvetia (Switzerland and BIS), Jasper (Canada, UK and Singapore); Aber (Saudi Arabia and the United Arab Emirates); Jura (France, Switzerland and BIS) and Onyx (France and Singapore).

Boar and Wehrli (2021), in a survey that involved 65 central banks in 2020, highlight that 86% (about 30% more than in 2017) of them developed some type of work (from initial research to implementation projects) associated with CBDC, both general use (most) and wholesale. Since then, there has been rapid and significant progress, with 50 countries having advanced stage CBDC projects as of May 2022 (either under development, piloted or launched). In total, 105 countries – representing 95% of global GDP – were at least exploring the possibility of creating a CBDC. Figure 2 shows the evolution of different CBDC projects by status.

¹⁵ See <https://www.bis.org/press/p210223.htm>. Accessed on March 2nd, 2021.

Figure 2 - Status of Central Bank Digital Currencies projects



Source: Own elaboration based on Atlantic Council – CBDC Tracker data.

Concerning the motivations for adopting a CBDC, the research investigated the importance that CB give to the following factors: i) financial stability; ii) implementation of monetary policy; iii) financial inclusion, the efficiency of payment systems (iv) domestic and (v) external transactions; vi) security and robustness of the payment system and vii) others.

Considering the set of factors, in general, developing countries signaled a greater motivation for the creation of CBDCs, so much so that of 8 CB in advanced stages of CBDC creation, 7 are from developing countries (Boar; Wehrli, 2021, p.9). Motivations (iv) and (vi) were high for both groups of countries, while (iii) was identified as the most important for developing countries and the least relevant for developed countries. This discrepancy is not surprising, given that financial inclusion tends to be higher in high-income countries. It is also worth noting that in the “others” group, reasons were mentioned, such as protecting monetary sovereignty in the face of a possible “digital dollarization” to provide a public alternative in the event of a possible adoption of private digital currencies (Ibid, p.8). Also, according to the report, interest in analyzing the impacts of stablecoins is greater than that of cryptocurrencies (which would be used in niches and more unstable countries). However, there is no widespread concern about their use as an alternative means of payment.

3. CBDC: Possible designs and implications

The definition of CBDC based on the criteria presented in section 1 helps to differentiate them from other types of currency and those already issued by central banks. The discussion, however, is far from being exhausted by this distinction. Based on additional criteria, we can make distinctions between the different forms that CBDC can assume as a means of payment and reserve of value. In other words, CBDCs can have very different characteristics and functions and, consequently, very different impacts on the payment system, monetary policy transmission mechanisms, user benefits, the role of the central bank and commercial banks in the system, and financial stability, among others.¹⁶

To be successful, a general purpose CBDC must perform at least the functions already performed by the current set of means of payment (cash and demand deposits), which include, among others: convertibility at par with cash and private currency (demand deposits); broad and permanent availability¹⁷; the convenience of use, ease of use even for different age groups; low or zero cost of use; high resilience to system crashes and cyber-attacks, provide security and integrity to the payment system and ensure user privacy (BIS, 2020; Bank of Canada *et al.*, 2020). In addition, it would have to comply with requirements regarding the identification of customers and combating money laundering and terrorist financing (KYC and AML/CFT¹⁸) (CPMI, 2018).

For the general public, using cash combined with efficient private payment systems, such as cards and real-time transfers, is already a reality in several countries. In this sense, depending on the design and operationalization of the CBDC, it would not imply a significant change, nor would it offer substantial benefits. Countries with efficient and reliable banking systems may be indifferent to the general public whether your electronic balance in an account is in CBDC or a demand deposit. According to Mancini-Griffoli *et al.* (2018), in jurisdictions with limited banking penetration and low trust, CBDC may be more attractive than deposits. However, between inefficient and secure systems, the latter could even be more attractive. On the other hand, some configurations can be genuinely innovative and could considerably change the role of agents in financial systems.

¹⁶ Agur *et al.* (2022) offer an analysis of an optimal design for CBDCs based on a model of payment instruments that assumes individuals with heterogeneous preferences. The main conclusion is that the optimal CBDC is the result of the balance between banking intermediation and the social cost of maintaining different payment instruments.

¹⁷ This includes the ability to make transactions offline, even if for limited time and amounts.

¹⁸ Know your customer and anti-money laundering and combating the financing of terrorism, respectively.

First, it is possible to do an exercise on how monetary aggregates would be affected. Taking the traditional aggregates, the monetary base (B) would be composed of currency in circulation (CC), bank reserves and CBDC¹⁹:

$$B = CC + \text{reserves} + \text{CBDC} \quad (1)$$

And the M1 money supply by:

$$M1 = CC + \text{Demand deposits (DD)} + \text{CBDC} \quad (2)$$

The CBDC could change the volume and composition of both, and the possible implications of such changes are dealt with in the following paragraphs. Consequently, the calculation of the bank multiplier would be altered. In addition to the $\frac{DD}{M1}$ (d) and $\frac{CC}{M1}$ (c) ratios, we would also have $\frac{CBDC}{M1}$ (f), where $d + c + f = 1$. The demand for CBDC could occur with a corresponding decrease in CC ($\Delta c = \Delta f$), which would change the composition of the monetary base without changing its stock, the same being true for the means of payment. On the other hand, if the demand for this new asset occurred with a reduction in demand deposits or even in assets that do not make up the means of payment (outside M1), this would affect the base and the means of payment more substantially.

Moreover, how would CBDC be seen concerning CC and DD, or: how does CBDC place itself in the liquidity spectrum of different asset classes? This question can be answered based on Keynes's concept of monetary interest rate on assets (1936, Ch. 17), given by the sum of yield or output (q), liquidity-premium (l), expected percentage appreciation (a), deducted carrying costs (c):

$$r = q + l + a - c \quad (3)$$

The expected percentage appreciation would be the same for the three assets (CC, DD and CBDC): zero in nominal terms and negative (positive) in real terms, in the same magnitude as inflation (deflation). The CBDC rate is expected to be higher than that of cash because it has an equally high l (since the central bank issues it), but due to the functionality of being virtual, and even smaller c , especially for large values. In comparison with demand deposits, the l of CBDC would be higher. The carrying costs of the CBDC concerning the DD will depend on the functionality and costs of the CBDC system. One option for an account-based CBDC would be for the CB to administer them (direct system). Ultimately, an individual could have a central bank account, and the banking system would become

¹⁹ Mersch (2018) uses the concept of digital base money.

virtually irrelevant for those whose only bank account functionality is to receive and make payments.

On the other hand, the difference between the liquidity premiums could be very low in the case of a resilient financial system that enjoys the confidence of agents (due to the existence of deposit insurance, for example), making the two types of assets almost perfect substitutes. It should also be taken into account that banks offer a set of services that go well beyond demand deposits, such as credit cards, loans of different types, and insurance, among others. (CPMI, 2018). Therefore, the agents' preferences will fundamentally depend on the CBDC architecture.

According to CPMI (2018), a system allowing central bank accounts would technically be feasible. However, the question is more about how this would affect financial intermediation. If, concerning means of payment, the central bank could replace commercial banks without significant consequences, the same cannot be said for the credit system.

One of the choices for the CBDC architecture is between a system via accounts or (digital) tokens. In the case of a token-based system, it would be possible to keep transactions anonymous, as in the case of cash and cryptocurrencies, since access would be via password. In the case of accounts, as it is a system validated by identification (I am, therefore I own), there would be a record of all transactions of a person or company. However, access to them could be protected with appropriate legislation. As seen in section 2, one of the goals of the development of a CBDC is to create a substitute for physical currency²⁰, which requires guaranteeing anonymity and the possibility of direct transfers, dispensing with financial intermediaries. In this sense, a system via token is necessary. Furthermore, the main requirement is that it is not an exclusionary system, hence the even greater importance of complying with the requirements mentioned in the previous paragraph, especially regarding availability, convenience, cost and resilience.

The other criteria would be direct (peer-to-peer) or intermediated transfers and operational availability, whether instantaneous (accessible 24 hours a day, seven days a week – 24/7) or with limited hours and days. There is also the possibility of instituting CBDC retention limits, something whose feasibility would be more significant in systems via accounts than via tokens. Table 1 below compares the different types of central bank liabilities based on the criteria listed above.

²⁰ Although in the short term, this seems to be an objective restricted to the Riksbank (Sweden), in the medium term, this may become a more relevant issue for other countries.

Table 1- Key design features of central bank money

	EXISTING CENTRAL BANK CURRENCIES		CENTRAL BANK DIGITAL CURRENCIES		
	Cash	Reserves and settlement balances	General purpose		Wholesale
			Token	Accounts	Only token
24/7 AVAILABILITY	R	S	R	(R)	(R)
ANONYMITY VIS-À-VIS CENTRAL BANK	R	S	(R)	S	(R)
PEER-TO-PEER TRANSFER	R	S	(R)	S	(R)
INTEREST BEARING	S	(R)	(R)	(R)	(R)
LIMITS OR CAPS	S	S	(R)	(R)	(R)

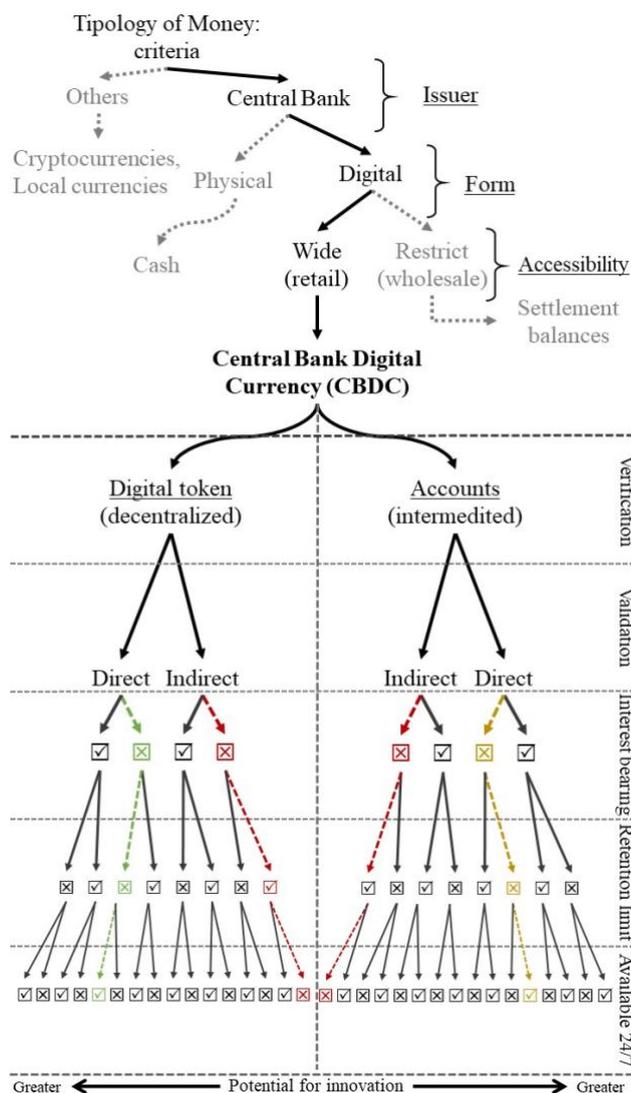
R = existing or likely feature; (R) = possible feature; S = not typical or possible feature.
Source: CPMI (2018, p. 6).

As seen in Table 1, some of the additional possibilities of general-purpose CBDC over cash are to allow interest payments and impose retention limits²¹. On the other hand, the possibility of anonymity and direct transfers would be weakened. The availability of an instant payment system (24/7) is increasing in several countries, but, unlike cash, it is susceptible to failure.

These different criteria are not only similar but complementary and help to analyze the implications of different forms of CBDC made in the following section. Given the high number they can reach, it is by no means intended to exhaust the discussion. Figure 3 below shows some of the different forms a CBDC can take. Some “paths” are highlighted and will be analyzed shortly.

²¹ Although not covered in the reviewed literature, CBDC could also have a limited period of use. Recently, China made transfers using its digital currency with a limited period of use, which prevents recipients from using the resource for savings, making the fiscal policy more effective. See (in Portuguese): <https://valor.globo.com/financas/noticia/2021/04/06/governo-da-china-cria-sua-propria-moeda-digital.ghtml>. Accessed on April 6th, 2021.

Figure 3 - Different CBDC possibilities



Source: Authors' elaboration

The green path indicates the closest configuration of a digital currency that can replace paper money, as it would not pay interest, have no retention limits, have 24/7 availability and allow anonymity and direct transfers (see table 1). The combinations highlighted in red, on the other hand, would result in a CBDC with low attractiveness, as they would not have permanent availability, would not pay interest and would be subject to retention limits. Finally, with a CBDC whose elements are highlighted in yellow, the opening of central bank accounts would be allowed, something whose implications are not trivial, as discussed in the following subsections.

Wholesale-type CBDCs will not be analyzed as, despite expected efficiency gains in clearing and payment systems, they do not have the disruptive potential of general-purpose ones. (Carstens, 2021).

4. Different designs, potentials and implications

4.1. Interest bearing

Regarding the choice between cash, demand deposits and CBDC based on the interest rate, there is no possibility that the yield (q) is different from zero for the former. In contrast, for CBDC and demand deposits, it is a matter of choice. In the case of remunerated CBDC, we would have, so these would become more (less) attractive than bank deposits whenever the interest rate was positive (negative) unless these also started to pay interest. There could, however, be a positive differential in the remuneration of CBDC and demand deposits without this leading to a flight to the former. Due to the aforementioned services provided by commercial banks, which go beyond the movement of funds, depositors tend not to be as sensitive to small differences in costs or remuneration (CPMI, 2018).

Furthermore, there would be an option for the rate to be equal or not to the basic rate and to be differentiated based on the nature of the holder, amount or another criterion, precisely to encourage or discourage its use (*Ibid*).

In addition, an interest-bearing CBDC could become more attractive than government bonds for institutional investors (even if the interest is lower than the base rate), affecting the Treasury's financing conditions. (CPMI, 2018). One obvious impact is that the interest payment creates an expense on the CB's liabilities. If, on the one hand, the drop in issuance costs and a possible increase in demand for CB bonds positively impact seigniorage, on the other hand, interest payments reduce it. In short, the effects are ambiguous but not negligible, with possible distributional consequences since they transfer from the State to CBDC holders (Panetta, 2018).

The possibility for the central bank to pay interest on CBDC also opens up some possibilities regarding monetary policy. First, it would be easier to work with negative interest rates, breaking through the "zero lower bound" represented by cash²² (CPMI, 2018). On the other hand, for Bindseil (2019) and Mancini-Griffoli *et al.* (2018), CBDC would not significantly affect the main transmission mechanisms of monetary policy. Mancini-Griffoli *et al.* (2018) claim that CBDC could increase monetary policy's power if they promote financial inclusion, as families would be more exposed to changes in the basic interest rate since these affect the cost of credit and the return on financial investments. And

²² Simply speaking, the zero rates would be the minimum limit of monetary policy, as this is the nominal rate of money, a safe asset to which agents could direct their wealth if the central bank instituted negative rates. The zero boundaries would still be relevant if there were still significant circulation of high-value notes.

if bank funding depended more on the wholesale market (as discussed in the next section), funding costs would also be more affected by the base rate. Kumhof and Noone (2018), in turn, argue that CBDC will only be an additional monetary policy instrument if there is a differentiated treatment between CBDC and reserves and if they are not convertible to each other. In this way, the CB would maintain control over the amount of reserves and, consequently, the base rate, in addition to controlling the interest rate of CBDC.

4.2. Anonymity x identification

The choice of the degree of anonymity of transactions of CBDC involves several factors, such as the citizens' right to privacy vis-à-vis the State and private institutions' regulation of data usage. With a completely anonymous system via tokens, privacy would be fully preserved since, like cash transactions, they would not leave any records about the parties and the transaction itself. Conversely, a system via accounts would allow the State to monitor transactions to different degrees. In favor of identification would be the need to combat fraud and money laundering operations. Mancini-Griffoli et al. (2018) argue that limiting transactions to small amounts would help in these aspects but that there is no easy solution in reconciling anonymity and financial integrity (KYC and AML/CFT compliance). The defense of a system with some degree of identification also involves facilitating financial inclusion. For banks and financial institutions in general, the history of customers is essential for granting credit and other financial services (Carstens, 2021). Furthermore, financial inclusion can be of great value for operationalizing and controlling the payment of social benefits and other types of transfers by the State (Ibid). Another possible risk of a completely anonymous system is that the loss of a digital token password would imply the loss of the CBDC balance, which has already occurred with holders of cryptocurrencies.

The BIS has defended the account-based system (and consequently identified), and existing projects indicate this trend. The concern, in this case, is with the use of transaction data by private or public institutions, so access would have to be regulated along the lines of bank secrecy (BIS, 2021). In each country, the value placed on civil society for privacy is different, as is the State's willingness to grant it. Hence, the type of CBDC implemented tends to reflect these preferences.

4.3. The role of the central bank and commercial banks in the financial system

It was seen that different factors condition the choice of agents between demand deposits and CBDC. Even starting from a specific configuration, it would be difficult to predict how this distribution would occur. It does not, however, prevent inferences about possible impacts of a hypothetical significant migration to CBDC at the expense of demand deposits.

In the same way that they passively accommodate the public demand for cash through the conversion of demand deposits (and subsequent adjustment of the level of reserves in the interbank market), commercial banks would have to do the same for CBDC. If the demand for CBDC were to occur without a reduction in the demand for physical currency but through a drop in deposits, there would be a fall in banks' reserves, which would resort to the interbank market²³. The central bank, in turn, would have to increase the monetary base so that banks could meet their liquidity requirements and/or so that there is no increase in the base rate. Moreover, as the raising of reserves in this market is done using government bonds as collateral, an increase in demand for reserves could require central banks to expand the types of assets accepted as collateral (CPMI, 2018). This means that the central bank would affect the liquidity and pricing of a broader spectrum of assets. As a result, its importance in the financial system would be increased (Bindseil, 2019).

Another potential consequence for commercial banks is that in episodes of instability, the risk of bank runs (demand for CBDC to the detriment of deposits), called digital runs by CPMI (2018), would be higher, given the lower cost of holding these assets (compared to physical currency) and the greater ease of movement. The imposition of retention limits (Panetta, 2018) or negative interest rates (reducing the attractiveness of CBDC) would be ways to reduce this risk.

The structure and functioning of the financial system, particularly the granting of credit by commercial banks, could also be affected. If bank deposits have to remunerate their holders at a rate above that of the CBDC (whether zero or positive), there would be a lower supply and higher cost of demand deposits, the main source of funds for commercial banks, which could reduce the volume and increase the cost of credit. (Bindseil, 2019; CPMI, 2018). It would also make banks increase funding in the wholesale market (via commercial paper, bonds, equity, etc.), more expensive and unstable sources of funding (Mancini-Griffoli *et al.*,

²³ Given a fractional reserve banking system, a withdrawal affects more the reserves than the demand deposits of a bank, so such an operation can take the reserve or any other liquidity requirement below the minimum.

2018). In other words, there would be a reduction in the bank multiplier due to changes in the public's preference for liquidity (DD/M1 ratio) and the lower demand for credit if its cost were to rise. In this scenario, banks would tend to lose competitiveness and market share in economic financing compared to other forms of financing, such as capital markets and non-banking intermediaries²⁴.

As Bindseil (2019, p.6) argues, it is essential to develop a CBDC capable of increasing the efficiency of the payment system without threatening the prevailing monetary order. This could be done through a tiered remuneration system²⁵, which CB already has extensive experience with. For example, the CB could institute a tier 1 in an amount sufficient to fulfil the function of the means of payment that would have the highest remuneration (and even the commitment to never operate with negative rates). Above this level, which would configure CBDC retention as a store of value, the amount would be in tier 2, on which lower and even negative fees would apply. In addition to disintermediation, such a measure would also prevent bank runs. Another way to preserve the role of banks in providing credit would be to allow them to leverage themselves by issuing tokens or stablecoins from CBDC funding. It would be the same principle as the current deposit-based system, following the same regulatory limitations. This could be one of the attributes of the digital Real²⁶. Given existing concerns about the impacts of CBDCs on the financial system, the recommendations have been very clear in preserving the two-tier system. In such a system, the central bank maintains its role as regulator and supervisor, in addition to executing monetary policy, and banks and payment service operators would be responsible for operating the payment system and financial intermediation, maintaining the division of functions (BIS, 2021; Carstens, 2021). Initial proposals from central banks go in the same direction²⁷. One of the reasons for this is the alleged expertise and innovation capacity of financial institutions in these operations and the relationship with customers. In turn, the handling of retail accounts by central banks would bring additional attributions and costs, especially in complying with KYC and AML/CFT standards (BIS, 2021).

²⁴ The greater the market power of banks, the greater their ability to pass on costs to the borrower without losing market share, preserving profit margins (Mancini-Griffoli *et al.*, 2018).

²⁵ This proposal is a counterpoint by the author to Kumhof and Noone (2018). They place more restrictive conditions, including no guaranteed, on-demand convertibility of bank deposits into CBDC at commercial banks.

²⁶ For further details, see (in Portuguese): <https://valor.globo.com/financas/noticia/2022/06/09/banco-podera-se-alavancar-na-moeda-digital-do-bc.ghtml>. Accessed on June 6th, 2022.

²⁷ Like the BCB, mentioned earlier, and the e-CNY (PBC, 2021).

Due to the limitations of the scope of the article, another aspect that was not addressed is the potential impact of international transactions with CBDC, which should be materialized from the cross-border CBDC projects mentioned in section 1. However, it is worth pointing out that the possibility of a CBDC being used outside its jurisdiction as a means of payment or store of value would make the issuing entity's control over money laundering and other related matters even more compromised. In addition, the possibility that a resident of a certain country could legally and inexpensively hold a CBDC from another country could generate strong demand for internationally accepted currencies and an abandonment of the local currency, especially in emerging countries, compromising the capacity of local monetary authorities to stabilizing the financial system and the foreign exchange market, what Cohen (2000) called monetary substitution. A CBDC via accounts, however, would make it more difficult, as the holding of foreign currency balances by a resident would have to be permitted and regulated both by the issuer and the domestic regulators (BIS, 2021, p.86).

5. Final remarks

Payment habits and systems have been undergoing profound transformations, and digital private currencies, cryptocurrencies, and instantaneous means of payment are gaining more and more space and trust among agents. As a result, several central banks, individually and jointly, have been seeking alternatives to accompany the digital evolution of the means of payments. The CBDC is how they plan to enter this changing environment. However, there are still many uncertainties about the potential costs and benefits of CBDC. These, in turn, are directly linked to the different configurations they can assume. Therefore, it will still take time for CBDCs to become widespread, if at all, as each central bank has to consider different design options according to the specifics of their jurisdictions.

In this sense, it is impossible to approach the CBDC in a general and homogeneous way, much less present an assertive answer about its consequences. The definition of how the CBDC will be will have profound implications on different aspects, such as the resilience of the domestic financial system, the effectiveness of the monetary policy, and the role of financial intermediaries, among others. A relevant political issue is that the role of the central bank in financial systems can change considerably depending on the configuration assumed by the CBDC. Issues such as the balance between privacy, oversight of illegal practices, and financial inclusion also lack simple solutions and have been the object of great attention.

One of the aspects to be taken into account is that some of the possible benefits of CBDC do not represent significant advances in relation to existing options, such as instant payment systems, especially where financial systems are sound and efficient. In these cases, what additional benefit could CBDC bring? This question raises an even broader question, which is: are CBDC necessary or desirable? The answer certainly requires a cost-benefit analysis, but it goes much further. In economies with a significant share of informal workers, such as Brazil, the use of cash continues to be a relevant alternative. Except for countries like Sweden, an end or a drastic reduction in the use of paper money is not yet on the horizon. For now, it seems that the development of CBDC by central banks is not intended to replace physical money but to expand the range of possibilities for users and accompany the wave of financial innovations and technological transformations in financial markets. If or when creating a substitute for paper money is a more direct objective of central banks, this process must not be exclusionary, ensuring access and ease of use for different income and age groups in different regions.

Thus, despite the CBDC appearing as a reality on the horizon of the international monetary and financial system, the tendency to adopt account-based systems indicates that the objectives of their issuance are not intended to cause major changes but to ensure that the current design of the banking system and financial support is maintained. In this sense, the movement of central banks can be seen as a defensive strategy so that they are not excluded from payment systems (and eventually lose the capacity to fulfil other functions). Furthermore, if the world is becoming increasingly digital and new generations tend to use less and less cash, it is up to central banks to monitor and even lead this process. Therefore, far beyond the costs and benefits in isolated aspects, the creation of CBDC must be thought of as the only possible action for the State, and the monetary authority, in particular, to continue to play a relevant role in economic systems.

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