NEXT CURRENCY: DIGITAL CURRENCY ISSUED OF THE CENTRAL BANK

Ph.D., Professor Marius GUST
"Constantin Brâncoveanu" University of Pitești, Romania
E-mail: mariusgust@yahoo.com

Abstract: *For more than a decade, several processes that have taken place in the global financial economy, such as declining public use of cash, the growing dynamics of the use of electronic money issued by commercial banks, but also by non-banking intermediaries, the unprecedented proliferation of digital currencies and, in particular, cryptocurrencies, has led many central banks to explore the possibility of issuing their own currencies digitally. First of all, what would be the central banks that are interested in a digital currency, but also a series of questions, such as why a central bank would issue a digital currency, what advantages and what effects would this have, what are the criticisms of issuing such a coin. At the same time, the issuance of a digital currency by central banks would create a serious competitor for commercial banks and the electronic currency they issue. Or maybe the new currency will be complementary to the one issued by commercial banks. Finally, the issuance of a digital currency by central banks raises questions about the solutions chosen for its implementation, will copy the decentralized register (blockchiain) used by cryptocurrencies or, another question, will be remunerated for holding the digital currency issued by central banks, as is the case with electronic currencies issued by commercial banks.*

Keywords: *central bank, digital currencies, electronic currencies, decentralized register.*
JEL Classification: *G21.*

1. Electronic currency - Digital currency - Cryptocurrency

Money in the traditional sense includes money in a physical format (banknotes and coins, usually with legal payment status) and various types of electronic representations of money, such as central bank money (deposits in the central bank that can be used for payments) or the money of commercial banks. Electronic currencies, defined as value stored electronically on a device, such as a chip card or a hard drive in a personal computer, are increasingly used in the world of today. These categories (cash, central or commercial bank money and electronic money in the narrow sense) are traditionally perceived as "money" denominated in a certain currency (BIS, 2015).

Recent developments in the field of electronic money have broadened the concept to include a variety of payment mechanisms used by the general public, including digital currencies. Although, technically, digital currencies can overlap with electronic money, legally and conceptually they do not meet the legal definition of electronic money. For example, the legal definition of electronic money includes the requirement that (1) the balances issued be a claim on the issuer and (2) it be issued upon receipt of the funds. But many digital currencies cannot be considered electronic money in the legal sense, because they are not issued in exchange for funds (even if they can later be bought and sold) and cannot be issued by any natural person or institution. Moreover, although in the case of digital currencies the value stored and transferred is expressed in a sovereign currency, however, in many cases digital currencies are not denominated or linked to a sovereign currency, but are denominated in their own units of value.

Recent history shows that in the last few years hundreds of digital currencies based on distributed registers have invaded the market, some are still working or developing, but there are also some that have disappeared. However, a number of features distinguish them from traditional electronic coins.

In most cases, the value of these digital currencies is determined by supply and demand, similar to commodities, but unlike commodities, their intrinsic value is zero.

Unlike traditional electronic currencies, digital currencies are issued automatically and are not an obligation of any person or institution (of the issuing bank, central or

commercial bank, etc.) nor are they supported by any authority. So their value is based only on the belief that they can be exchanged for other goods or services or for a certain amount of sovereign currency.

The issuance of new digital currency units is usually determined by a computerized protocol, in many cases a cryptographic algorithm (hence the name of cryptocurrencies) and there is no entity that manages the supply of currency and are not named or linked to a sovereign currency, in terms of creation. There are also different predetermined rules for the creation and issuance of new units that do not take into account the needs of the market and cause a supply deficit, which raises their price/market value.

There are also serious differences between digital currencies and traditional currencies in how value is transferred from a payer to a payee. Traditionally, the exchange between the parties in a transaction, in the absence of reliable intermediaries, such as, but not only, banks, was usually limited to money in a physical format. The emergence of traditional electronic currency has made exchanges, i.e. payments, to be made through centralized infrastructures, where a trusted entity settles and clears transactions. The key innovation of some of these digital currencies is the use of blockchain to allow remote peer-to-peer electronic value exchanges in the absence of trust between the parties and without the need for intermediaries. Usually, a payer stores his digital coins in a digital wallet, access to which is possible through a series of cryptographic keys. The payer then uses these keys to initiate a transaction, through which he transfers a certain amount to the payee. That transaction then goes through a confirmation process that validates the transaction and adds it to a single register, copies of which are distributed in the peer-to-peer network between members. The amount of information stored in the register can vary from a minimum, so that the identity of payers and beneficiaries is difficult to establish, keeping only information about the distribution of coins between participants, up to a maximum, in which a multitude is kept in the register, information that may include details about the payer, payee, transactions and balances.

Other distinctive features of the new digital currencies relate to the institutions involved in the payment arrangements. In traditional e-money schemes, there are several service providers: e-money issuers (who present in their balance sheets the e-money issued), network operators, providers of specialized hardware and software, e-money users and e-money transactions. In contrast, many digital currency schemes are not operated by any specific person or institution. Moreover, the decentralized nature of digital currencies means that there is no identifiable network operator, a role that is usually played by financial or clearing institutions in the case of electronic money. There are a number of intermediaries in digital currency schemes that provide various technical services. For example, intermediaries that can provide "e-wallet" services to enable digital currency users to transfer value or intermediaries that provide exchange services between digital currencies and sovereign currencies.

Some digital currency schemes based on a distributed register aim to create a network that works in isolation from, or with a marginal connection to, existing payment mechanisms. Thus, system users opened their accounts directly in a single distributed register and sent and received peer-to-peer payments denominated in the network's native digital currency, the only connection to the existing payment system appears on trading platforms, where digital currencies can be exchanged for sovereign currencies, at quotations that usually reflect supply and demand.

2. Factors influencing the development of digital currencies

Digital currencies based on the use of a distributed register represent a new development in the payments landscape. Many of the factors that have driven the

development of digital currencies have also stimulated innovation in traditional payment methods: technology, low costs, increased speed of transactions, including in the areas of e-commerce and cross-border transactions.

The development of digital currencies based on the use of a distributed register has been largely driven by private sector non-banking operators. Banks initially rejected digital currency intermediaries due to perceptions of risk and uncertainty, but have recently begun exploring potential opportunities.

Another category of factors that led to the abundance of digital currencies are the profit-related reasons, resulting from the issuance of digital currency units (i.e. income similar to the seniority brought to the state by sovereign currencies), from the currency units in circulation (the value of which increases), from the payment and exchange schemes, but also from the transaction fees collected at the intermediation of payments. Digital currencies can also generate revenue by selling associated items or services.

There are also cases (BIS, 2015) in which the issuance of digital currencies was generated by non-profit reasons: the utility gained from experimentation and innovation, ideological motivations related to the desire to create and use alternatives to the traditional financial infrastructure or to facilitate financial inclusion.

In order to increase their acceptance and use, digital currencies based on distributed registers should offer end users a number of benefits over traditional services:

Security. An important risk related to the use of digital currencies based on distributed registers (blockchain) is the risk of loss for users, which can undermine users' trust in digital currency and can also affect intermediaries dealing with trading for users. If a user loses the information that gives them the "ownership" of digital currency units stored in a distributed register, then those units are unrecoverable. Some users of digital currencies rely on intermediaries to keep and store information relevant to their ownership of digital currencies and must trust them to reduce the risk of loss, operational failure or embezzlement.

Cost. Issuers of digital currencies based on distributed registers argue that they can offer lower transaction fees than traditional payment methods, because payment processing is rewarded in monetary units and can offset lower transaction fees. In addition, because transactions through these schemes do not require intermediaries to make payments, the processing costs would have an additional reason to be lower. However, the transaction costs in these schemes are not always transparent and, in addition, conversion fees may arise between the digital currency and a sovereign currency if the user does not wish to hold the balances denominated in the digital currency.

Ease of use is a key reason for joining the payment mechanisms and takes into account elements such as the steps to be taken in the payment process, the intuitive nature of the interfaces, ease of integration with other processes. The use of digital currencies depends on these advantages compared to existing methods and that is why many digital currency providers are trying to improve the user experience in digital payment schemes.

The volatility of the value of digital currencies is another risk faced by holders of such assets when users choose to keep them denominated in digital currency received as payment and which may generate costs and losses associated with price and liquidity risk. These losses are proportional to the volatility of digital currencies. At the same time, some users may choose to keep their denominations in digital currencies, precisely because this volatility can bring them substantial speculative gains. However, it should be noted that the variability of the prices of these digital currencies and, inherently, their exchange rates can be significant obstacles to the widespread adoption of these currencies.

Irrevocability. Most digital currencies based on a distributed register do not have dispute resolution procedures and do not offer irrevocability of payment, i.e. the payee may face a reverse payment due to fraud or refunds.

Processing speed. Issuers of digital currencies based on distributed registers argue that they allow for a faster settlement of transactions than traditional systems, but often innovations in retail payment systems and real-time gross settlement systems appear to be faster, given the conditions in that the registration of transactions in the distributed registers, especially those of small value and which do not offer substantial remuneration for validators, is done in a longer time.

Cross-border coverage. Digital currencies based on distributed registers are global open networks, allowing the transfer of value between users from different countries, which may lead to circumvention of restrictions that may be applied to cross-border transactions by some national authorities.

Data confidentiality. There are many cases of digital currencies based on distributed registers that allow transactions to be carried out without disclosing personal details. Anonymization, avoidance of banks and regulations are sought by those who want to circumvent the laws, hence the fact that many digital currencies are potentially vulnerable to misuse.

Other factors have limited the development of digital currencies. Here are some of them:

Fragmentation. On April 14, 2021, https://www.coingecko.com/ counted 6693 digital currencies in circulation, with different protocols for processing and confirming transactions and with different approaches to increasing the supply of digital currencies and which are obstacles to achieving the critical mass needed to create a payment network based on digital currency.

Scalability and efficiency. Due to the limited acceptance of digital currencies, the number of transactions in digital schemes has marginal values compared to those made through traditional payment systems, so they are less comprehensive and have a low efficiency, being resource consuming in terms of the energy required to process too few transactions, which limits improvements in processing power and speed and the downward trend in computing and hardware costs.

Pseudonymity. Although digital foreign exchange transactions are usually observable on a public register (insofar as they are not intentionally disguised by so-called anonymizers), many aspects of these registers remain difficult to analyse. Also, the degree of anonymity offered by some digital currency schemes discourages a number of participants from using or facilitating the use of digital currency by their customers, as regulations can be difficult to meet.

Technology and security. Digital currencies based on the use of a distributed registry must be built on a consensus among network participants to ensure the uniqueness of the registry. That is, there must be a single version of the register, distributed over the network, with the full history of transactions and balances. But, in practice, many digital currencies can be affected if different versions of the register coexist for long periods of time or if the procedures for obtaining consensus are faulty. Malicious actors may seek to make a profit by entering fraudulent transactions into the general register and bringing other participants to verify the falsified register.

Sustainability of the business model. Building a long-term sustainable business model for some digital currencies is limited by their constructive characteristics: (a) the incentives for certain actors supporting the scheme (e.g. to verify transactions and their entry in the register) are dependent on the issuance of the currency; and may be limited or may decrease in time; (b) the costs incurred by actors involved in the issuance and administration of digital currency may be significant and there may not be sufficient appropriate incentives for the system to operate when the supply of new digital currency

units decreases or disappears; (c) trading fees may increase to offset the loss of revenue (due to lower issuance of new digital currency units), which could affect the demand and long-term sustainability of the scheme.

3. The reasons why a central bank would issue digital currency

The main reasons why a central bank will sooner or later issue a digital currency along with the physical currency are (Dyson, Hodgsonm, 2016):

The decline of physical money. Although the total amount of cash currently in circulation continues to grow, its use as a means of payment is declining, while the use of credit and debit cards for payments is increasing. Already, in many countries, cards generate more payment transactions than cash. This situation will certainly increase with the growth of contactless payment cards, payment applications on mobile devices. Therefore, physical payments are replaced by electronic ones and it is normal for central banks to want to replace physical currency with electronic, digital ones. Neglecting this trend would lead to the situation where the only form of money used in the economy would be bank deposits issued by commercial banks, and central banks would lose the role of issuer of the sovereign currency.

The implications of alternative financing and money creation. Changes in the financial industry in recent years have made non-bank financial institutions compete with banks and take on a growing share of lending to the economy. This situation also has implications for money creation, because when a bank gives a loan, it creates new deposits for the borrower and therefore money. But when a non-bank financial firm lends, it transfers pre-existing deposits from a saver to the borrower. It does not create new money. The consequence is that if the loans granted by non-banking financial firms increase and the bank loans are reduced, the less money will be created. Therefore, central banks must find solutions, to replace the situation in which the new intermediaries do not create money, without which the economy can enter a recession.

Decrease in central bank revenues from "seigniorage". Seigniorage refers to central bank revenues resulting from the issuance of cash (Dyson, Hodgsonm, 2016). But as cash issuance is declining, it turns out that many central banks are facing declining revenues from this source, a situation that could be remedied by the introduction of digital currencies. Currently, seigniorage is limited by the extent to which the public wishes to hold cash, an asset whose retention has risks attached and is disconnected from the electronic payment system. The public demand is sure to increase if central banks make it available to the public in digital form and in the same form as bank deposits, connected to the electronic payment system.

Increasing financial stability by reducing liquidity risk. Central banks issue an electronic currency equivalent in the form of bank reserves held by commercial banks and a number of financial institutions. In order to connect to the national payments system, an entity must have an account with the central bank and hold reserves issued by the central bank. This means that only banks and financial institutions that have reserve accounts with the central bank can participate as members in the national payment systems. By issuing a digital currency available to all citizens, central banks would also allow other entities to provide payment services, allowing new entrants to compete with banks in terms of technical innovation and diversification of customer services. With the introduction of digital currencies, in which all the public would have access to settlement and payment services managed by the central bank, they would no longer have to access these services through commercial banks and use the latter's money to extinguish their obligations. The fact that the public will use the central currency, be it digital, will mean a lower liquidity risk because they should no longer be exposed to the risk of a large bank.

Increasing the efficiency of monetary policy, especially in times of recession, central banks promote low interest rates, even negative ones, to stimulate the economy, and commercial banks to avoid taxation/loss focus on converting liquidity, trying to convert money from bank deposits into cash. Specifically, when non-bank customers immobilize large amounts of currency in bank accounts (in order for the bank to avoid paying negative interest to the central bank), the latter will try to activate them in the direction of investments or current uses (payments) by commissioners, and holders, to avoid taxation, will try to convert them into cash. The existence of digital currency and the replacement of cash with it, would make the aforementioned conversions impossible and amplify the effects of monetary policies, and the non-existence of cash will reduce exceptions to the application of monetary policies (Dyson, Hodgsonm, 2016).

4. Digital currency infrastructure

National banking authorities (central banks) that aim to issue CBDCs (Auer et al, 2020) have four architectures in mind:

Direct CBDC. In this case, CBDC is a direct claim on the central bank, the payment system would be operated by the central bank, which would provide retail services. The central bank would also keep a record of all transactions and execute all retail payments.

Hybrid CBDC. This is an intermediate solution, running on two systems: (a) CBDC is a direct claim on the central bank, which also maintains a central register of all transactions and operates a technical backup infrastructure that allows it to restart payments in if the other intermediary systems record failures; and (b) the intermediaries handle retail payment and, therefore, manage the main payment system.

Intermediated CBDC. It is similar to the hybrid CBDC architecture, but the central bank keeps only a wholesale register and not a general register with all retail transactions. As with the hybrid system, the CBDC is issued by the central bank and is a receivable from the central bank, and payments are made by private intermediaries.

Indirect CBDC. In this case, the CBDC is provided indirectly through financial intermediaries, the consumer not being able to directly access the digital money issued by the central bank, the consumers having claims on these intermediaries, which operate all retail payments. These intermediaries must guarantee all their obligations to retail customers with claims on the central bank.

The source (Auer et al, 2020) indicates that four central banks would consider the direct model, which would improve financial inclusion, another seven would consider hybrid or intermediate options (in some cases alongside the direct option), and none, indirect architecture.

In the direct access approach, the central bank should provide each citizen with an account opened in their own records, which would also involve the issuance of payment cards, so that the money from these accounts can be used to make payments. In addition, customers would need a way to check their balance and transactions, so internet or mobile banking would be a minimum requirement. A dedicated branch network would be financially unviable, although agencies of other service providers could be used to interface with the general public (e.g. the post office branch network). The Central Bank should implement fraud prevention procedures and money laundering prevention regulations through these accounts. It should be noted that in 2015 the Central Bank of Ecuador implemented a draft of "electronic money" accounts for all citizens, but the system was stopped in 2018 (actually transferred to the private sector), because the system had not reached critical mass of users. The system assumed that the Central Bank of Ecuador (CBE) was the only electronic money issuer in the country and although central banks did not normally offer retail banking services, the people of Ecuador could still open

an electronic money account at CBE. Ecuadorian electronic money accounts could be opened remotely, using any mobile phone and national identity number. All taxes and fees paid by customers were set by the EPC. However, in financially advanced countries, the central banks of these countries are unlikely to take over the administration of accounts for the entire population because they would neglect their duties in regulating the activity of banks and managing monetary policy. There is also a perception that the state-owned central bank would compete with commercial banks for the provision of payment services. In addition, the impetus for innovation in the system would be missing.

That is why central banks are more likely to support approaches based on hybrid-intermediated architectures.

In this approach to indirect access, the central bank would create and keep track of the digital currency issued, but all payment services and, in general, customer relations would be provided or managed by private sector intermediaries. In this model, banks or technology companies, such as, for example, smartphone application developers (usually called DCA providers) would provide digital currency (DCA) accounts. DCA providers would be responsible for providing account statements and payments, cards, checks, banking and customer support. They would also be responsible for providing the interfaces through which the public holding the WFD would make payments to national settlement networks. So, from a technical point of view, DCA holders would spend digital currency as they do with currency in bank accounts. Any funds paid from the WFD would be denominated in the digital currency created by the central bank, which means that the holder of a WFD is always "completely liquid" and could pay their partners the full account balance at any time, while traditional banks can pay their customers only a fraction.

Digital currency held in a DCA would legally belong to the account holder and not to the DCA provider. That is, the digital currency would be held by the customer in a separate account at the central bank and would not appear in the balance sheet of the DCA provider. The DCA provider would only "manage" digital currency and never own it. It is a difference from traditional banks, because traditionally, when physical currency is deposited in a bank, it becomes the property of the depository bank, which in turn offers a bank deposit (which is an obligation of the bank to the depositor).

Another important consequence is that DCA providers would not hold their customers' digital currency and that these funds would be wholly owned by the central bank, DCA providers could never lend the customer's digital currency and expose it to risk. Therefore, DCA providers would not grant loans or overdrafts, and DCAs would be risk-free from this point of view. That is, just like physical currency.

Threats to DCA holders could be the possibility of fraud or the possibility of the DCA provider going bankrupt. But even so, DCA holders would not lose a penny, as the funds would be kept entirely at the central bank and could not be available for confiscation by the creditors of the DCA provider.

Because the funds in digital currency accounts would be kept at the central bank (they would be liabilities), as in the case of physical currency, they would be secured with risk-free assets.

The advantages of this architecture are that it minimizes the burden on the central bank by giving up the provision of account services and focusing on issuing digital currency and providing a payment system for it. This architecture is also market-oriented, because the provision of services would be done by competing companies, providing a competitive incentive that will encourage companies to innovate to improve and expand the services they offer.

5. Implications of the existence of two electronic currencies

With the introduction of digital currency issued by the central bank, there will be two "competing" electronic currencies: bank deposits, which have an electronic existence and are usable by electronic means and the new digital currency issued by the central bank (Dyson & Graham, 2016). These two forms of electronic money are almost equivalent and would be effectively in competition. Digital currency and bank deposits would be equivalent in a way that bank deposits and physical money have never been. Both digital currency and bank deposits would be connected to the electronic payment system and thus could be spent electronically. The choice for the consumer would no longer be between holding physical currency or electronic deposits, but between holding physical currency, electronic money issued by banks (deposits) or digital currency issued by the central bank.

The major difference between these two different forms of electronic money is that bank deposits have a risk above the level of the government guarantee (currently over €100,000 in Europe). This means that for those who have money in larger quantities, above the value covered by government guarantee, such as companies, digital currency can be more attractive because it is risk-free, regardless of the amount held. The same logic applies in the case of economic and financial crises when risks increase, depositors may find digital currency more attractive.

At the same time, it should be noted that the preference for digital currency issued by the central bank will decrease the value of existing deposits with commercial banks, thus a contraction of their balance sheets and, hence:

- a contraction in lending by commercial banks;
- lower liquidity of banks, because they will have fewer deposits to hold in reserve with the central bank;
- but at the same time, for commercial banks, smaller assets also at the same value as deposited capital, which means stronger banks with better solvency.

Another issue that arises in relation to the digital currency created by the central bank is whether it will be remunerated. The physical money issued by the central bank is not remunerated, but the account/electronic currency issued by the central bank (the reserves of commercial banks kept at the central bank) are remunerated, and the interest rate paid by the central bank to them is essential for monetary policy as they set the minimum interest rates at which banks lend to each other.

So the question arises as to whether the central banks should pay interest on digital currency, i.e. on the reserves that are held in DCAs.

If digital currency were not remunerated and central bank reserves (i.e. digital currency held by banks) continued to be remunerated, then this would give preferential treatment to those held by banks.

However, the remuneration of digital currency would create a number of significant problems:

- If its size reaches significant values, it is possible that it will have an impact on the central bank's finances/expenditures.
- The level of digital currency remuneration issued by the central bank may discourage open deposits with commercial banks, if the latter have lower remuneration than premiums and would force commercial banks to increase interest rates on deposits, affecting their profitability and making credit products more expensive.
- Furthermore, we should ask ourselves whether this remuneration will be received by the holder of the digital currency or will have to be transferred to the payment processor and the administrator of the digital currency account.

6. Explorations for the issuance of the central digital currency (CBDC)

Many central banks around the world have analysed the concept of a digital currency (Auer et al, 2020). For example, since 2014, the Central Bank of Ecuador has launched a project called "dinero electrónico" (electronic money) to allow individuals to make mobile payments through a system operated by a central bank. But, the system failed to attract a significant number of users and was discontinued in 2016.

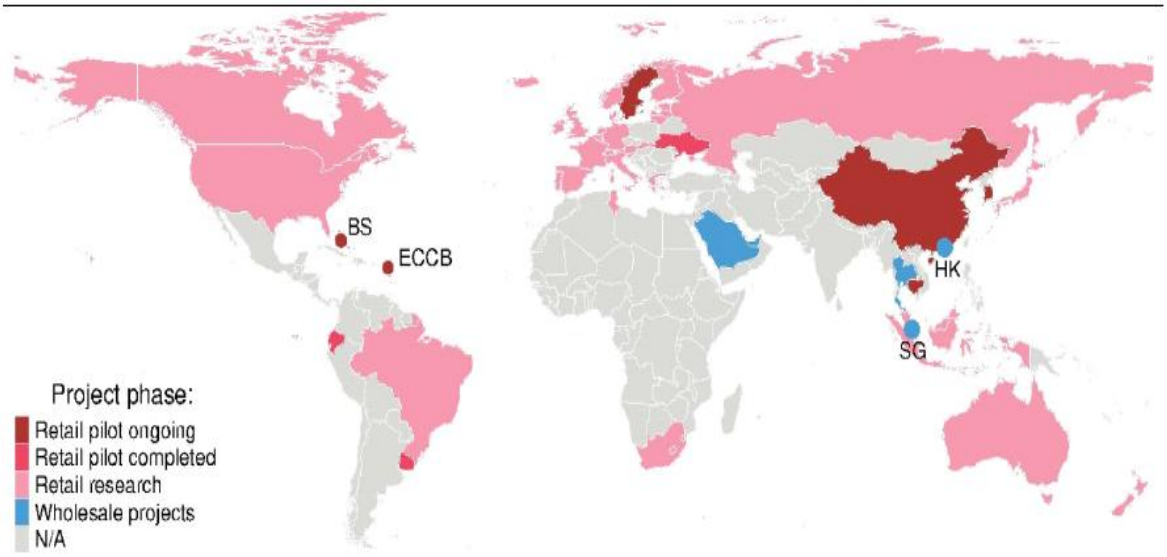
At the same time, with the growing popularity of Bitcoin and the distributed registry (DLT), a number of central banks have initiated projects to better understand DLT technology and its application in the issuance of central digital currencies (Alonso et al, 2020):

- In the Netherlands, the Netherlands Bank ("De Nederlandsche Bank", DNB) has been exploring the issuance of a currency based on distributed registers (DLT), called Dukaton, since 2015.

- The Bank of England, the Monetary Authority of Singapore, the Bank of Canada conducted similar domestic experiments, concluding that DLT was not yet mature enough to be used for major payments administered by the central bank.

- In March 2016, the Bank of England analysed the implications of issuing a CBDC.

Figure no. 1. Geography of explorations for digital central currencies



BS = The Bahamas; ECCB = Eastern Caribbean central bank; HK = Hong Kong SAR; SG = Singapore.

Source: Auer et al, 2020

- The Bank of Canada launched Project Jasper, which focused on using a DLT to settle high-value interbank payments.

- The Singapore Monetary Authority has launched its Ubin project, which focuses on interbank payments and a DLT currency.

- The Hong Kong Monetary Authority launched the LionRock Project in January 2017, which explored the issuance of a DLT.

- In 2017 the European Central Bank (ECB) and the Bank of Japan launched the Stella Project for cooperation between two central banks on CBDCs, focusing on cross-border payments.

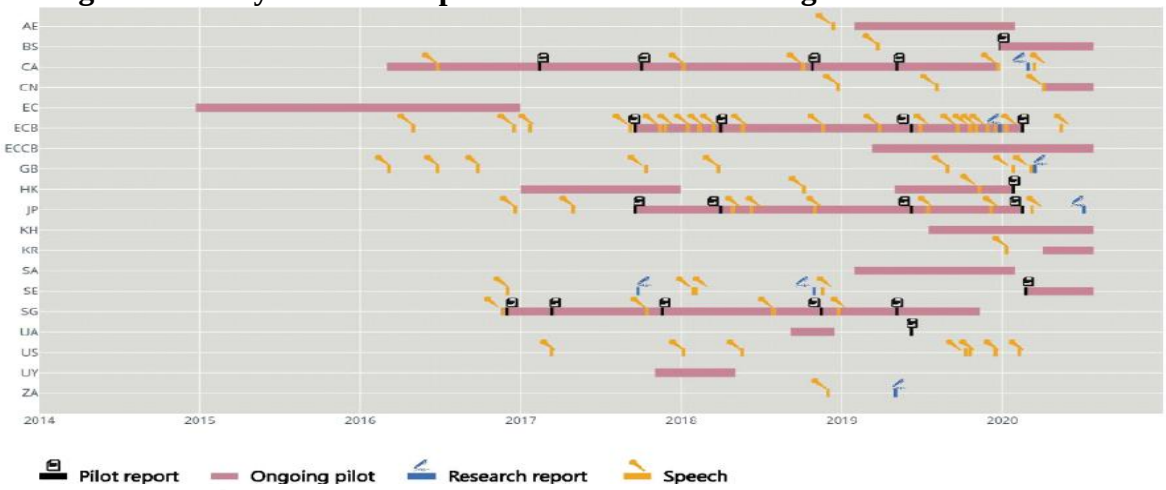
- The monetary authorities of Saudi Arabia, the United Arab Emirates, Hong Kong and Thailand announced in 2019 a cross-border project on CBDCs.

- Riksbank, the Swedish Central Bank, started a project a few years ago to issue a CBDC for the entire population, and in February 2020, Riksbank announced that it would initiate a project to develop a technical solution for an e-krona.

- The People's Bank of China has the most advanced project for a CBDC, as a currency available to the general public, including foreign visitors from China, and which is currently being trialled in four cities in China.

- Other CBDC exploration projects have also been announced by the Central Bank of the Eastern Caribbean, and the Central Bank of the Bahamas has even launched a pilot project to issue a Sand Dollar.

Figure no. 2. Dynamics of explorations in the field of digital central currencies



Source: Auer et al, 2020

The Covid-19 pandemic, which has changed payment-related behaviours, stimulated greater use of digital payments and could have wider effects in the future, has accelerated work on CBDC issuance in many countries:

- In the United States, bodies adjacent to Congress have drafted a bill for a "digital dollar," and the Federal Reserve has continued its research on CBDCs for the population.

- In China, pilot testing for the new CBDC has begun with the phasing out of pandemic mobility restrictions.

- In Sweden, e-krona testing has continued.

7. CBDC examples

People's Bank of China's (PBC) project. CBDC development efforts in China began in 2014 (Auer et al, 2020), and in late 2019, PBC announced that it would conduct a pilot study for a retail CBDC. On April 20, 2020, PBC confirmed that pilot tests were underway in: Shenzhen, Suzhou, Chengdu, Xiong'an and the "2022 Winter Olympics Office Area" in Beijing. In China, the introduction of a CBDC should be seen in the context of a high level of digital economy and the widespread use of private digital payment services. If the decision is to go beyond the current pilot stage, the Chinese CBDC will become a counterpart to the central banknotes and coins and deposit accounts. The Chinese CBDC is not intended to replace physical money in its entirety, and the architecture of the issue describes it as a "hybrid CBDC", in which the issuance belongs to PBC and the payment services are operated by intermediaries (called "authorized operators"). The central bank receives and periodically stores a copy of its holdings and transactions. The backbone of the Chinese CBDC infrastructure would be a mixed system with conventional database and distributed registry (DLT), PBC adding that DLT is not yet mature enough for such a large application. To settle

transactions, the system must be able to host 300,000 transactions per second (TPS). The system would be a retail one, non-residents (e.g. tourists and business travellers) could access the CBDC with a foreign mobile phone number for an entry-level wallet.

The e-krona project of Sveriges Riksbank. First of all, it is the oldest project. Its foundations have been laid since 2014 (Auer et al, 2020). The Swedish CBDC is designed as a supplement, not as a money substitute. The architecture designed by Riksbank reveals a hybrid CBDC. CBDC is a direct claim on Riksbank and payments are made by payment service providers. The infrastructure and technical implementation are based on a distributed register, and the system is presented as a decentralized database of all e-krona transactions in circulation at a given time, and Riksbank verifies all transactions before completion. The CBDC access technology issued by Riksbank is based on the classic account (Riksbank issues CBDC, which are stored in wallets at intermediaries, and access to the wallet is based on the identification of the wallet owner), but an option for low value prepaid cards is also considered. Non-residents (e.g. tourists) could access the system by using prepaid cards for small purchases.

Bank of Canada and its CBDC. Despite its early start (2014), the Bank of Canada has so far not announced that it is developing a pilot project for its CBDC. Instead, it has detailed a plan under which Canada should develop a CBDC (Auer et al, 2020). The Bank of Canada has considered (i) a scenario in which the use of physical money is reduced or eliminated altogether and (ii) a scenario in which private cryptocurrency becomes essential as a means of payment. Thus, the Canadian CBDC would be a receivable in Canadian dollars from the Bank of Canada, which explores three potential architectures, which correspond to "direct CBDC" (Bank of Canada provides the entire CBDC payment system), "hybrid CBDC" (Bank of Canada issues CBDC, and private sector intermediaries provide end-user services) and “intermediated CBDC” (identical to the hybrid model, but the Bank of Canada does not have full access to the trade register). Although there were no details about the infrastructure, it should be noted that the Bank of Canada has experience in using distributed registers (DLT).

Digital euro. The Governing Council of the European Central Bank (ECB) set up a high-level working group in January 2020 to analyse the prospects for a central bank digital currency (CBDC) in the euro area, which presented in November 2020 (ECB, 2020) a report on this topic. The report considers that a digital euro would be just another way of providing the euro, not a parallel currency, and should therefore be convertible into other forms of the euro, such as banknotes, central bank reserves and commercial bank deposits. A digital euro would also be a responsibility of the Eurosystem, and therefore risk-free central bank money. The digital euro should be widely accessible, on an equal footing, to potential users in all euro area countries and supervised private intermediaries should be able to use their expertise and participate in the provision of payment and new services, this new form of currency should not discourage nor eliminate private solutions for digital retail payments in the euro area.

The report states that the Eurosystem should consider introducing instruments to limit the use of the digital euro and to prevent the excessive conversion of commercial banks' money into digital euros. The amount of digital euro that individual users may hold would be maintained in such a way that the overall value of the digital euro in circulation remains below a reasonable threshold, which means that digital euro users are identified and anonymity would not be possible. Also, if the holding limit is exceeded, the surplus would be automatically transferred to the payee's account, but in private money. The report also explores the solution of a digital euro with restricted access, but usable internationally, for non-EU citizens visiting euro area countries.

A digital euro could be provided either through an account-based system or as a bearer instrument.

In an account-based system, user holdings would be recorded by a third party who would determine, on behalf of the payer and the payee, whether a transaction is valid and would update the balances of the two. This would allow the ECB, which issues CBDCs, to control transaction flows (either directly or through supervised intermediaries), but this system could not be used if users or the central third party are not online.

When using the digital euro variant on the bearer, the payer and the payee would be responsible for verifying any transfer of value between them, and the system would fall outside the direct control of the Eurosystem or its supervised intermediaries and would mean, inter alia, that holdings and value of international transactions are limited. In addition, in the case of payments using bearer instruments, it would be necessary to require that only authorized users participate in transactions, whose payment devices would require the parties to validate their identity through the physical attributes of the intended user (biometric data, e.g. fingerprint and iris recognition). An electronic payment that is not confirmed online - either through the user network or in a central register - can be considered final only based on reliable hardware devices/equipment. This would be the offline functionality, which avoids sharing the details of the transaction with parties other than the payer and the payee, and the equipment would take the form of smart cards, mobile devices and payment terminals. Payment could be settled immediately as a transfer between devices preloaded with digital euro units of the payer and the payee.

The basic infrastructure for providing a digital euro could either be centralized, with all transactions recorded in the central bank register, or have some decentralization of responsibilities to supervised users and/or intermediaries, thus allowing the provision of a digital euro to the bearer. Regardless of the approach, the back-end infrastructure should ultimately be controlled by the central bank. The main difference between a direct and intermediate model is the role of the private sector. While in a direct model, supervised intermediaries are mere administrators, in an intermediate model, they would play a more important role, including that of settlement agents.

8. Conclusions

In order to increase their acceptance and use, digital currencies based on distributed registers must offer end users a number of benefits over traditional services: security, minimum costs, ease of use, minimum volatility, transaction irrevocability, high transaction processing speed, cross-border coverage and data confidentiality.

Other factors have limited the development of digital currencies, such as fragmentation, scalability and low efficiency, pseudonymity, low sustainability of the business model.

The main reasons why a central bank might issue a digital currency along with the physical currency are the decline in use of physical money, the implications of alternative financing on money creation, declining central bank revenues from "seigniorage", increasing financial inclusion, increasing financial stability by reducing liquidity risk, increasing the efficiency of monetary policy.

National banking authorities (central banks) that intend to issue CBDC have four architectures in mind: a direct CBDC (CBDC is a direct claim on the central bank, the payment system would be operated by the central bank, which would provide retail and the central bank would keep track of all transactions and execute all retail payments), hybrid CBDC (an intermediate solution, running on two systems: (a) CBDC is a direct claim on the central bank, which also keeps a central register of all transactions and operates a technical back-up infrastructure that allows it to restart payments if other intermediary

systems are down and (b) intermediaries that handle retail payments and, therefore, manage the main system of transactions, intermediated CBDC (similar to hybrid CBDC, but the central bank keeps only a wholesale register and not a general register retail), indirect CBDC (CBDC is provided indirectly through financial intermediaries, the consumer not being able to directly access the digital money issued by the central bank, consumers having claims on these intermediaries, which operate all retail payments).

With the introduction of digital currency issued by the central bank, we will have two "competing" electronic currencies: bank deposits, which have an electronic existence and are usable by electronic means and the new digital currency issued by the central bank, which will be almost equivalent and will effectively be in competition. Another issue that arises in relation to the digital currency created by the central bank is whether it will be remunerated.

Many central banks around the world have looked at the concept of a digital currency. As early as 2014, the Central Bank of Ecuador launched a project called "dinero electrónico" (electronic money) to allow individuals to make mobile payments through a system operated by a central bank, but the system failed to attract a significant number of users and was discontinued in 2016. The Covid-19 pandemic that changed payment-related behaviours, stimulated greater use of digital payments and could have broader effects in the future, accelerated work on CBDC issuance in many countries.

The most advanced projects to create a central digital currency are the People's Bank of China's (PBC) project, the Sveriges Riksbank e-krona project, the Bank of Canada's project, and the digital euro.

Finally, the exploration of a digital euro should be mentioned. Thus, the Governing Council of the European Central Bank (ECB) set up a high-level working group in January 2020 to analyse the prospects of a digital currency of the central bank (CBDC) in the euro area, which presented a report on this in November 2020. The report considers that a digital euro would be just another way of providing the euro, not a parallel currency, and should therefore be convertible into other forms of the euro, such as banknotes, central bank reserves and commercial bank deposits.

References:

1. Alonso, S.L.N., Fernández, M.Á.E., Bas, D.S. and Kaczmarek, J., 2020. *Reasons Fostering or Discouraging the Implementation of Central Bank-Backed Digital Currency: A Review*. Department of Economics, Catholic University of Ávila, Canteros St., 05005 Ávila, Spain, Department of Economics and Organization of Enterprises, Cracow University of Economics, Rakowicka 27, Economies 2020, 8, 41. Available at: <www.mdpi.com/journal/economies> [Accessed 2 March 2021].
2. Auer, R., Cornelli, G. and Frost, J., 2020. *Rise of the central bank digital currencies: drivers, approaches and technologies*. Working Papers, No 880, Bank for International Settlements, Monetary and Economic Department.
3. Bank for International Settlements, 2015. *Digital currencies*, Committee on Payments and Market Infrastructures. Available at: <www.bis.org> [Accessed 2 March 2021].
4. Dyson, B., Hodgsonm, G., 2016. *Digital Cash, Why Central Banks Should*. Start Issuing Electronic Money. Available at: www.positivemoney.org> [Accessed 2 March 2021].
5. European Central Bank, 2020. *Report on a digital euro*. Available at: <https://www.ecb.europa.eu/euro/html/digitaleuro-report.en.html> [Accessed 2 March 2021].