AGORA International Journal of Economical Sciences, http://univagora.ro/jour/index.php/aijes
ISSN 2067-3310, E-ISSN 2067-7669
Vol. 18, No. 2 (2024), pp. 387-399

THE EVOLUTION OF DIGITAL CURRENCIES: FROM PRIVATE INNOVATION TO CENTRAL BANK IMPLEMENTATION - A COMPREHENSIVE ANALYSIS OF CBDC DEVELOPMENT

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Abstract: *This paper traces the development of digital currencies and central bank digital currencies (CBDCs), and how their conceptual models and implementation have evolved over the past decade. First conceptualized as private digital assets operating independently from central banking systems, digital currencies have evolved in that monetary authorities started to develop their own versions. Drawing from an explanation of CBDC projects under construction all over the world and their defining features, the study reveals that modern CBDCs are widely perceived as digital manifestations of national fiat currencies that perform largely similar functions to cash. While DLT in CBDC implementation is fairly typical, it certainly isn't a requirement. Analysis of data from 138 active CBDC projects underscores that most are in the research or development stages; only four are fully operational. Most target retail, but wholesale CBDCs have higher rates of DLT adoption, mainly for cross-border payments. The key drivers toward CBDC development include efficiency in the payment system, increasing financial inclusion, and maintaining monetary sovereignty. This paper, however, argues that consensus on the nature and functionality of CBDCs will only emerge once more pilot programs have been completed and real-world implementation data become available. This research adds to the understanding of the evolving nature of digital currencies and their potential impact on monetary systems.*

Keywords: *central bank digital currency, digital currency, blockchain, distributed ledgers, CBDC, DLT*

INTRODUCTION

The active development of cryptocurrencies over the last decade has attracted the attention of both academic researchers and monetary authorities. The phenomenon of cryptocurrencies is interesting both because of the consequences of its development for the monetary and financial system and some aspects of its technical implementation. The principle of non-national issuance of means of payment, in which there is no fundamental need for a state intermediary, is interesting in itself, but it would not be realized without the technology that allows, in the absence of a state intermediary-regulator, to act as a guarantor of each specific transaction in particular and the history of transactions in general. In the most famous cryptocurrency bitcoin, the distributed ledger technology (DLT), called blockchain, has been successfully used as such a guarantor.

However, since the emergence of the concept of Bitcoin as a digital non-state currency, the functioning of which is based on cryptographic methods, to the present day, when the central banks of the largest countries are busy developing digital currencies and implementing distributed ledger technologies, many variations of cryptocurrencies and products on the blockchain and other distributed ledgers, as well as approaches to defining and classifying the phenomenon of digital currencies have been developed; cryptocurrencies have demonstrated their actual suitability for performing the functions of a measure of value, a means of payment and accumulation, as well as de facto, but not de jure, world money **(**Bank of England, 2022), but not all states and monetary authorities are ready to recognize them as money. In this variety of interpretations, there is a difficulty in identifying the essence of digital currencies and central bank digital currencies, what are their inseparable and inherent qualities only to them. Therefore, tracking how the concept of digital currencies has evolved and how the definition of central bank digital currencies (CBDCs) emerged is of interest – especially in a situation where several central banks are preparing to launch their own digital currencies.

The article presents a study of the evolution of the concepts of digital currencies and central bank digital currencies, the practice of introducing digital currencies by central banks and the problems they solve in this way, in order to understand what constitutes the nature of digital currencies at the moment.

Digital currencies: evolution of the concept

It is useful to trace the evolution of the concept of digital money in recent years, since the interest in this phenomenon has emerged, since in some cases digital money has been defined in terms of the opposite of what we now call central bank digital currency.

Ideas for creating digital currencies based on cryptographic methods have been put forward since at least 1998, when anonymous remailer user Wei Dai published the concept of electronic assets based on decentralized B-money systems. In addition, the concept of a digital currency called Bit Gold was proposed by user Nick Szabo. Researchers C. Bronk, S. Monk and J. Villasenor, whose work was also used by researchers at the European Central Bank, also classified E-Gold as a digital currency. It was launched in 1996, ceased to process transactions in 2008 due to criminal prosecution of its creators for illegal financial transactions, and ceased to exist in 2015. However, this project differs significantly from B-money and Bit Gold: firstly, it was implemented, while B-money and Bit Gold were only concepts; secondly, E-Gold was backed by a real asset - real gold in the e-gold Ltd Gold Fund, while B-Money and Bit Gold were digital currency projects that were not backed by a real asset such as precious metals; Thirdly, E-gold was a centralized and privately managed payment method from the US, while Bit Gold and B-money were conceived as decentralized digital assets that did not have a single issuer and regulator. For this reason, the projects of users under the names or pseudonyms of Wei Day and Nick Szabo are much more similar to those digital currency projects that would later be called cryptocurrencies, and the document describing the principle of the most famous of them, Bitcoin, contains direct references to the B-money project. (Bank of Canada, 2020).

In 2008, Bitcoin: A Peer-to-Peer Electronic Cash System was published by Satoshi Nakamoto, an author or team of authors (Nakamoto, 2008). It outlined the concept of the first

of the digital assets that later became known as ‘cryptocurrency’ - bitcoin. Based on advances in cryptography, such as hashing and electronic signature, as well as on the principles of the distributed blockchain registry and the proof-of-work consensus algorithm (PoW), it was based on the principles of the blockchain. ‘The concept was to create in a network a register of transactions with a unit of account - bitcoin - accessible to all network participants, the updating of which, as well as the issuance of this unit of account, would be decentralized, uncontrolled and at the same time secure, confirmed by cryptographic methods. Among other things, this meant the concept of a private, monetarily independent currency that could be circulated and issued without the involvement and supervision of intermediaries such as banks or the state.

The number of digital currencies that exist today has not yet emerged, and researchers have had to rely on the only digital currency project that has been implemented, Bitcoin, and it has not been possible to isolate common qualities from a large sample. However, another paper used by the European Bank, “Bitcoin: An Innovative Alternative Digital Currency” by R. Greenberg, provides a very precise characterization of Bitcoin as a digital, decentralized, partially anonymous currency that is not backed by any government or other legal entity, and relies on a peer-to-peer network and cryptography to maintain integrity (World Economic Forum, 2021). The definition also states that Bitcoin is “not redeemable for gold or any other commodity.” In this context, this could mean that it is not necessarily redeemable for gold or any other commodity, just like the US dollar (for which the same wording is used). The definition of Bitcoin given in this paper includes a wide range of characteristics that would be common to many other digital currencies.

After some time, Bitcoin gained great popularity, the outlines of its functionality became approximately clear and, importantly, analogues began to appear on a mass scale. Researchers and government agencies came to the understanding that Bitcoin is not the only asset of its kind, but gave rise to a class of assets, the most common designation of which is digital currencies.

Whether the term "cryptocurrency" is a complete synonym for "digital currency" is debatable, or at least was previously, when the concept of digital currency was closely associated with decentralization and the DLT system. Even now, it is difficult to talk about one, generally accepted approach to how digital currencies and cryptocurrencies are related. In some cases, cryptocurrency is defined as a type of digital currency, the peculiarity of which is its private nature and the ability to carry out transactions with each other directly (International Monetary Fund, 2021), or (not only for cryptocurrencies, but for crypto-assets within digital assets) the defining feature is the combination of a non-state issuer and cryptographic methods that ensure the security of the value or rights embodied in electronic form. As of the mid-2010s. the boundaries between digital and cryptocurrency have become even more blurred, cryptocurrencies have been the most active and have attracted the most attention among all digital assets, so digital currencies and cryptocurrencies have often been used (and sometimes continue to be used) as synonyms. (Edward L. 2012)

One important course of action with regard to cryptocurrencies, or more generally digital currencies, is regulation and legislative recognition. Although even with the serious impact of cryptocurrencies on the financial system, states have not always had time - and still do not always have time - to regulate the digital currency market, which by 2015 reached

billions, and later hundreds of billions and trillions of US dollars (according to www.tradingview.com, accessed on 05.05.2024). The first definitions of digital currencies were characterized by the fact that researchers placed a great, if not the main emphasis in their attempts to identify the nature of digital currencies in definitions on the private nature of digital currencies.

Examples of this early stage of defining the nature of digital currency are two definitions from the European Central Bank and the Bank for International Settlements from 2015. The European Central Bank, in its 2015 document "Virtual Currency Schemes – A Further Analysis", which is a continuation of the research work initiated by the above-mentioned publication "Virtual currency schemes", does not distinguish between the concepts of virtual and digital currency, using primarily the former term. For example, the authors of the report call Bitcoin a virtual currency and cite other researchers on digital currencies in the context of discussing virtual currency. The report defines virtual currency as a digital representation of value, not issued by a central bank, credit institution or institution specializing in electronic money, which in certain circumstances can be used as an alternative to money, although the authors of the report specifically emphasize that they do not consider digital currency to be full-fledged money.

The Bank for International Settlements (BIS) paper Digital Currencies does not provide a separate, full definition of digital currencies; it merely states in a footnote that they are assets in digital form. However, beyond the definition, the paper does discuss the qualities of digital currencies in some detail, identifying three sets of characteristics, or three aspects, of digital currencies. First, it notes that they have some of the characteristics of currencies (e.g., being used as a means of payment), but are not typically issued in or linked to a sovereign currency, are not obligations of any entity, and are not backed by any authority, have zero intrinsic value, and therefore derive value only from the confidence of users that they can be exchanged for other goods or services or for a specified amount of sovereign currency at a later point in time. Second, the authors highlight the way these digital currencies are transferred or distributed, typically through an embedded distributed ledger, as "a truly innovative aspect." Third, the authors note the variety of third-party institutions, almost exclusively non-banks, that are actively developing and operating digital currency and distributed ledger mechanisms.

It should be noted that distributed ledger technology is not limited to the transfer of currency from one user to another; a transaction is an entry in the ledger, which in turn is copied among all network participants, or "distributed," hence the name distributed ledger technology.

Both definitions highlight the fact that digital (or virtual) currencies are not issued by central banks. There is some difference in the way the reports emphasize distributed ledger technology. The European Bank stated that a virtual currency may or may not use DLT, the BIS stated that DLT is typically used as the "transfer technology" of digital currencies. DLT was thus a popular but optional feature of digital currencies.

It is worth noting that by 2014, at least two of the most authoritative monetary institutions saw one of the main features of digital currencies as independence from central banks, the private nature of these assets.

Classification of money.

Since 2014, monetary authorities in different countries have begun to announce the start of studying the prospects of central bank digital currencies. In 2014, information appeared about the start of preliminary research in the field of CBDC by the Bank of Uruguay. In 2016, the Stella project was launched - a series of studies on the use of DLT in financial architecture as part of cooperation between the European Central Bank and the central bank of Japan (Bank of Japan, 2020). In 2017, their report on the first phase of the project was published. One of the most significant and well-known events in this area was the launch of the development and subsequent testing of the digital yuan (official name DCEP, also referred to as Digital Renminbi in English sources). As central banks have become increasingly interested in digital currencies and cryptocurrencies, and many have begun researching central bank digital currencies, the contradiction between the supposed independence of central banks from central regulators and the fact that monetary authorities are planning to issue digital currencies has become increasingly apparent.

A major influence on the popular understanding of digital currencies has been the taxonomy of money by M. Bech and R. Garratt in 2017, the so-called money flower in the work “Central Bank Cryptocurrencies”. This method of classifying money is based on the identification of four characteristics of a monetary unit: issuer (central bank or other); form (electronic or physical); availability (universal or limited); transmission mechanism or peer-to-peer nature of the transaction network (centralized or decentralized, i.e. peer-to-peer). In the latter case, a centralized transmission mechanism implies the presence of a hierarchy of at least two participants in the transaction: the parties to the transaction at the lower level and the regulator, who is also the guarantor of the transaction at the upper level. Cryptocurrencies that run on a distributed ledger can be considered a peer-to-peer network because DLT eliminates intermediaries; cash can also be considered a peer-to-peer network because a cash transaction does not require a guarantor like a bank. (Federal Reserve Bank of New York, 2018)

Current CBDC Projects

At present, a relatively large number of central banks have already announced plans to create CBDCs. It is worth paying attention to how they define the nature of their own digital currencies.

The People's Bank of China in its Working Group on E-CNY Research and Development of the People's Bank of China, 2021, defines the digital yuan as a digital version of paper currency issued by the PBOC and managed by authorized operators. It is classified as a "retail" CBDC, and its prospects for use at the interbank and cross-border levels will be assessed after its domestic implementation. It should be noted that despite its status as a central bank digital currency, DCEP cannot be called an unambiguously decentralized peer-to-peer currency, and even the use of DLT remains questionable.

The Reserve Bank of India is developing both a retail and wholesale version of the CBDC. According to the concept of the digital rupee published by the FinTech Department of Reserve bank of India, 2022, it will not differ significantly from banknotes, but, being a digital form of national money, it will probably be simpler, faster and cheaper. It also has all the transactional advantages of other forms of digital money. The Central Bank of Brazil is still in

the development stage of the CBDC, but according to information on its official website (Banco Central do Brazil, 2024), it is planned to build an ecosystem based on DLT, in which regulated financial intermediaries convert the balances of demand deposits and e-money into Drex - a digital real, so that their clients have access to various smart financial services. The digital currency itself will also have the status of a digital form of the national currency. The European Central Bank in its glossary describes the digital euro as the retail digital currency of the European Central Bank, and generally defines a retail digital currency as a central bank liability in digital form offered to the general public (e.g. individual users, business users and governments or other public bodies) for retail payments.

It can be noted that a constant attribute of all definitions of CBDC is some form of reference to the central bank digital currency being a digital form of the national currency; it is often directly referred to as a central bank liability. Often, in addition, an analogy with cash is encountered, indicating their similarity. This is fully consistent with the typology of money by Bech and Garratt.

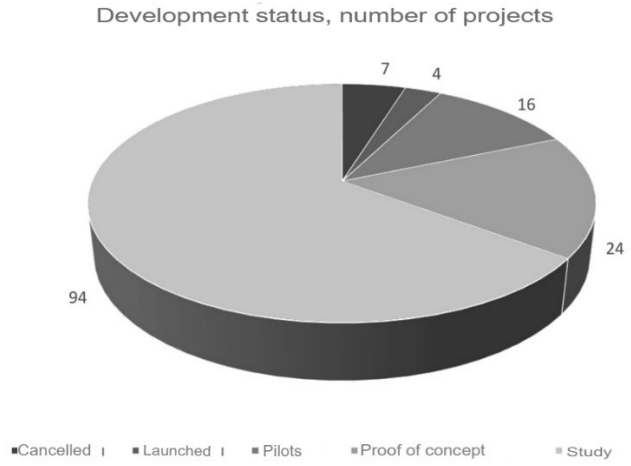
Stages of CBDC development: quantitative data

For the purposes of the study, data were collected and aggregated from the CBDC Tracker portal, a resource that semi-automatically collects and presents information on the stages of development and implementation of digital currencies by central banks, which is referenced, in particular, by the IMF (Nathaniel Popper, 2015). - with seven cancelled projects, 138 CBDC projects have been launched and not cancelled, 94 are at the research or development stage, 24 are at the concept testing stage, and 16 projects are at the pilot launch stage. The resource calls four projects fully launched as of 08.05.2024: Nigerian e-Naira, Bahamian Sand Dollar, Jamaican JEM-DEX and Zimbabwean ZiG. We will consider further statistical data only for currencies that have not been cancelled. (Reserve Bank of Zimbabwe, 2023).

It should be noted that the data on the portal may be updated. Thus, earlier, in October 2023, the DCash currency, issued by the Eastern Caribbean Central Bank, was listed as a fully launched central bank digital currency on the resource. At the time of the request on May 8, 2024, DCash was already listed on the portal as a pilot, which is confirmed by the statement on the official website (https://www.dcashec.com/). In October 2023, the Haiti CBDC currency was mentioned among the cancelled digital currencies, which was absent from the database at the time of the request on May 8, 2024, although in both periods the Gourde Digital currency was present at the research stage, developed by the same country (which makes it possible to assume the elimination of a duplicate under a different name, albeit with a different status). Thus, when working with CBDC data, including aggregated data from news and press releases such as those presented on the CBDC Tracker resource, it is worth considering the fragmentation of information, unclear wording in official press releases, the possibility of currencies rolling back from a later stage to an earlier one (for example, in the case of unsatisfactory results of the pilot - return to the study) and the emergence and elimination of duplicates.

Taking this into account, it should be noted that in addition to the above-mentioned Zimbabwean digital currency ZiG, the resource data also indicates an unnamed currency, the retail Zimbabwe CBDC, which is under development. With some probability, it may also be understood as ZiG, but since we do not have reliable information that this is the same initiative, in the analysis we will proceed from the data provided by the resource.

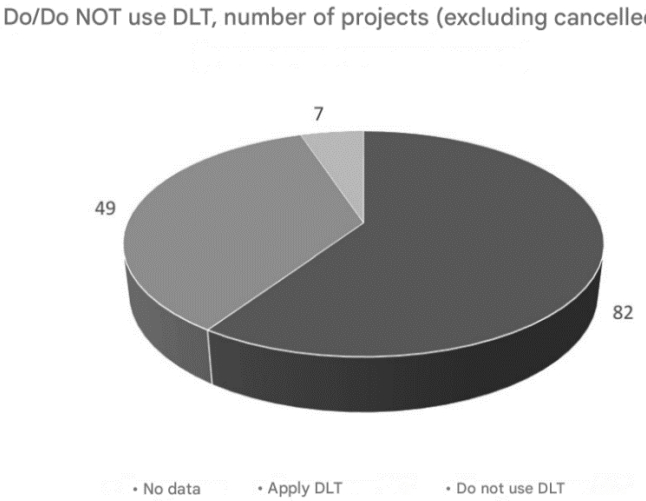
Figure 1. Development status, number of projects



Source: prepared by the author based on CBDC Tracker

Most central banks developing digital currencies have not yet decided whether they will use DLT, but the vast majority of those that have, say yes. Of the 138 projects that have not been cancelled, DLT is used in 49 projects, 7 are not (the digital yuan falls into this category), and the majority, 82 projects, have no information on this yet. Thus, DLT is used in the majority of projects for which there is data. However, a significant number of projects are still in the early stages of development - only 24 and 16 have moved to the pilot or proof-of-concept stage, respectively, against 94 in the development stage (another 4 CBDCs can be considered fully launched).

Figure 2. Data on the use of DLT in active CBDC projects, number of projects

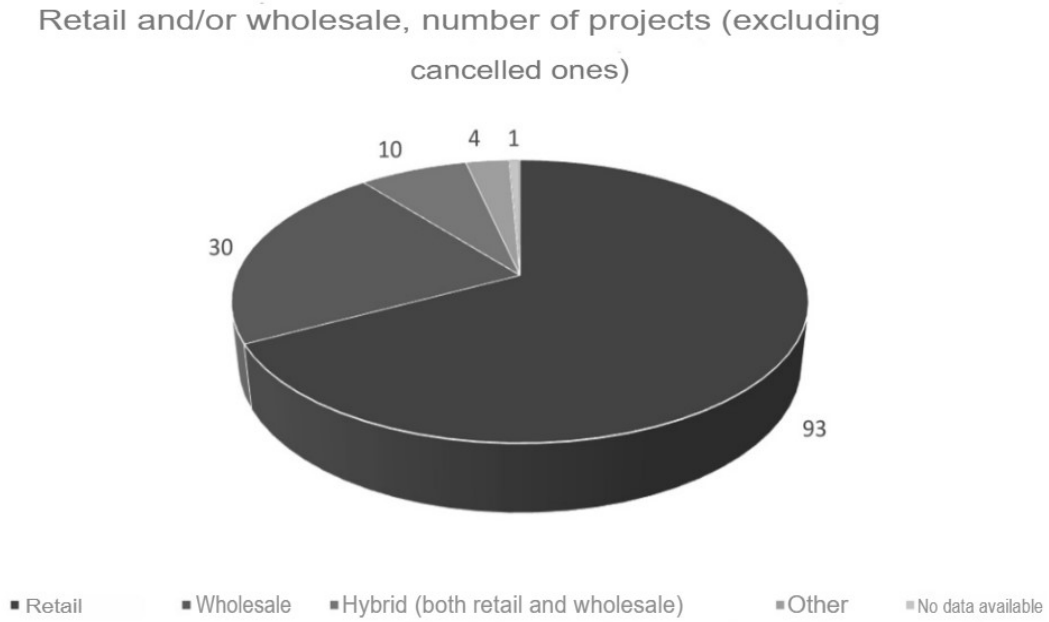


Source: prepared by the author based on CBDC Tracker data

It can be noted that the use of DLT is a noticeable trend, although it is too early to talk about it as a mandatory or inherent property of digital currencies in the overwhelming majority of cases: the first excludes the existence of digital currencies projects such as the digital yuan, and for the second statement there are too many projects with an unspecified transaction accounting technology.

It is also interesting to see the data on what currencies are mostly being developed by central banks: retail or wholesale. Most of the CBDCs being developed are of the retail variety. There is no information yet on the purpose or technology of the Ethiopian central bank digital currency announced in 2024. The currencies classified in the “Other” group by functionality include two projects that are not digital currencies as such, but rather experiments with technologies. These are the Stella project between the European and Japanese central banks, dedicated to studying the prospects of DLT in the field of transnational payments, and the Hamilton project, an experiment by the US Federal Reserve. This group also includes the stablecoin project of Palau, which does not have its own central bank, and the above-mentioned Zimbabwean currency ZiG. The resource does not indicate the exact reason for classifying these currencies as "Other", but the small amount of information on their account does not allow us to clearly classify these currencies as one group or another. The press release on the official website of the Reserve Bank of Zimbabwe does not answer this question and only indicates that the new currency will be backed by gold.

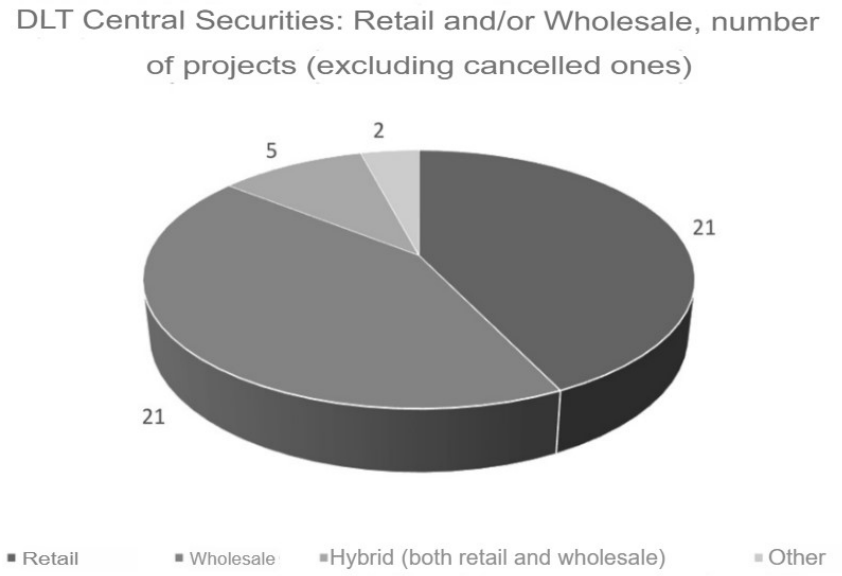
Figure 3. Data on active CBDC projects models (retail or wholesale models), number of projects



Source: prepared by the authors based on CBDC Tracker data.

All projects, with the exception of one (Agila), that claim not to use DLT, belong to the retail model of the CBDC system. Those developments that use distributed ledger technologies are equally divided in the access model between retail and wholesale models, with a slight advantage for wholesale.(**Eswar S**., 2021).

Figure 4. Data on active CBDC projects models using DLT (retail or wholesale models), number of projects



Source: prepared by the authors based on CBDC Tracker data

Of the 30 wholesale digital currency projects, 22 have already decided whether they will use DLT, and all but Agila have answered this question positively. It can be assumed that a significant portion of these wholesale currencies are being developed with the prospect of being used for cross-border settlements: since credit institutions are much more active participants in cross-border settlements than individuals, they are interested in the currency intended specifically for them performing cross-border payment tasks more efficiently. DLT has great potential in cross-border payments. Therefore, the prevalence of DLT among wholesale currencies can be attributed to the fact that distributed ledger technologies have demonstrated good results in cross-border settlements. As noted by I. O. Nesterov, the speed of international payments is low due to the above-mentioned strict security checks - KYC (Know Your Customer) and AML/CFT (Anti-Money Laundering / Combating the Financing of Terrorism) procedures, due to which the average international payment period took several days. Added to this are the high commission and poor predictability of commission and time costs for cross-border transfers due to the high and poorly defined number of intermediaries. Together, this increases transaction costs with all the ensuing negative consequences. (World Bank Group, 2021)

Research and testing in the area of merging the systems of the centralized digital currency exchanges of different countries, conducted by the monetary authorities of Thailand and Hong Kong, and later by China, the UAE and the Hong Kong hub of the Bank for International Settlements, have demonstrated an increase in the speed of international transfers from several days to several seconds, while maintaining control over all transactions by each of the monetary authorities. Since a significant part of international payments occurs in the interbank sector, such technologies can be developed as a specialized instrument for interbank exchange, i.e. a wholesale version of the centralized digital currency exchange. (The Committee on Payments and Market Infrastructures (CPMI), 2017).

Purpose and reasons for developing the CBDC

As we found out from the analysis of definitions and data on the CBDC projects under development, there is a tendency to develop a retail version of central bank digital currencies, with a significant part of the projects being considered as a digital analogue of cash. From this, we can make a preliminary conclusion that some of the functions that the digital currency is planned to implement are comparable to those of cash. If we talk about CBDC projects for cross-border payments, the functions of such digital currencies are also partly known - facilitating faster and less expensive international payments.

The report “Central bank digital currencies: foundational principles and core features”, produced by the Bank for International Settlements in collaboration with a number of central banks and monetary authorities , takes a closer look at the motivations of institutions exploring or developing CBDCs (Bank of Canada, 2023).

Most of the reasons are related to payments. These include: constant access to central bank money in regions and jurisdictions where access to cash is declining, which can be attributed to the above-mentioned functionality of digital currencies as a banknote substitute; increasing the operational resilience of the financial system in the event of technical problems with telecommunications or energy, which is also one of the functions of cash in the modern economy, as well as theoretically greater resistance to cyberattacks (however, the authors attribute this only to general-purpose CBDC systems); increasing the diversity of payment systems, which prevents their monopolization and fragmentation; encouraging financial inclusion and removing barriers of mistrust and low financial and technological literacy (although for CBDCs to have an effect in this regard, they need to be included in a whole array of reforms aimed at removing these barriers; they are unlikely to cope with this task alone). theoretical partial increase in the so-called public privacy and anonymity in electronic payments; the above-mentioned improvement in cross-border payments; facilitation of financial transfers, such as those carried out during the COVID-19 pandemic, i.e. direct transfer of money to citizens and businesses (however, either the advantage over the usual transfer to accounts will not be so great, or, on the contrary, so great that the line between fiscal and monetary policies and the independence of the latter will be erased to some extent).

The document also mentions the theoretical possibility of creating a CBDC with an interest rate, which would allow changes in interest rates to be transmitted directly to holders of the digital currency, but this would greatly change the transmission mechanism and increase the risks of destabilization of the financial system, so the authors of the report note that this possibility is not the main motivation of central banks and the main option for implementing a CBDC.

There is some uncertainty about the motives of the People's Bank of China. The report “Progress of Research & Development of E-CNY in China” prepared by the Working Group on E-CNY Research and Development of the People's Bank of China, Progress of Research & Development of E-CNY in China. People's Bank of China, 2021, explicitly states that the internationalization of a particular currency is a consequence of market competition, depth and openness of the financial markets of the issuing country. Therefore, as stated in the report, despite the technical readiness to use the digital yuan, including for cross-border payments, it

is currently focused only on servicing payments within the country. At the same time, researchers D.K. Lee, L. Yang and W. Wong point out that one of the reasons for the introduction of the digital yuan may still be to "counteract the hegemony of the dollar," which is difficult to imagine without the processes of internationalization of the national currency, at least at the regional level.

Another motive that periodically appears in publications is what researchers, both the authors of the BIS report in collaboration with central banks (International Monetary Fund, 2016). and Lee, Yang and Wong, call "asserting monetary sovereignty" (although the latter mention it in the context that this issue is of greater concern to the authorities of the G7 countries than to the Chinese regulator). This is understood as competition from private digital currencies. (G7 Working Group, 2021).

When assessing the prospects for the success of CBDCs in competition with private digital currencies, one should be cautious. It is highly likely that the reasons why different people and organizations prefer cryptocurrencies to fiat money lie outside the functionality — or, at least, the implemented functionality — of central bank digital currencies. One of the reasons for turning to them is high, albeit not absolute, anonymity and non-accountability to government institutions. Despite the motive for partially increasing the anonymity of payments indicated above in the BIS report, the same report notes that central banks will most likely be forced to take into account both anti-money laundering and combating the financing of terrorism (AML/CFT) requirements and specific supervisory requirements of their country's legislation when developing the architecture of a digital currency. People and organizations that turn to cryptocurrencies are not necessarily engaged in money laundering or terrorist financing, but may be motivated by a lack of trust in their own state or monetary authorities, or in states and regulators as an institution. For such economic agents, a CBDC will not have sufficient competitive advantages over cryptocurrencies.

Another common reason for turning to cryptocurrencies is speculative or investment interest. In this capacity, an interest-free digital currency can be considered a profitable investment to the extent that the national currency as a whole is considered to be such (although much will depend on the specific scheme of implementation and circulation of the digital currency: dependence on the infrastructure of commercial banks, the presence or absence of mechanisms for competition with the interest income of non-cash funds, etc.). Theoretically, the introduction and use of a digital form of the national currency, especially in the international payment system, can contribute to the growth of demand for the national currency, but in this case the national currency, including its digital form, will compete not only and not so much with cryptocurrencies as with other currencies and assets attractive to investors.

CONCLUSIONS

The concepts of digital currencies and central bank digital currencies have undergone rapid changes in the last decade. In the early stages, there was little understanding of what constituted the nature of digital currencies. Over time, some consensus developed that digital currencies were digital assets that could partially function as money, but were issued by private entities, not by national monetary authorities, and were likely to use DLT. This view came into conflict with reality: central banks began to develop their own digital currencies, and therefore

the premise of digital currencies being independent of monetary authorities, by which they were previously defined, no longer held true.

Current central bank definitions of their digital currencies suggest that they all view digital currencies as a new form of money, similar in many ways and functions to cash, but in digital form. The use of DLT remains an open question: although most central banks have not yet published data on whether they use distributed ledgers or not, those that have confirmed that they do. However, most of the definitions reviewed do not postulate the use of DLT. For now, it is an optional, albeit common, attribute of central bank digital currencies.

The intended functions of the CBDCs under development are largely determined by the motives that prompted central banks to develop them. Some of them, such as competition with cryptocurrencies and private currencies, are skeptical, while others are driven by current demands from society and financial system participants, but will only be effective in conjunction with large-scale reforms in other areas (for example, if we talk about the task of financial inclusion).

It can be said with relative certainty that consensus on what a central bank digital currency is and what its functionality will be will not be achieved until a significant number of CBDC pilots are launched. It will be clear whether a CBDC is a digital analogue of cash, whether most counterparties perceive it as a central bank obligation equivalent to banknotes, whether DLT will be a ubiquitous feature of CBDCs with some exceptions or will remain only an option, and which central bank currencies will be more widespread - for retail or wholesale payments. The highly important research - analyzing how wholesale and retail payments will affect the benefits of different economic actors, governments, households, businesses - will be fully possible after researchers have data on the implementation of CBDCs in other countries or at least a detailed description of how these currencies function. The concepts will again be tested by reality and adapted to it.

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