KOCHERGIN, Dmitry; DOSTOV, Victor; YANGIROVA, Alsu; SHUST, Pavel (2019): Central banks digital currency: prospects for monetary and payment systems, In: 34th International Business Information Management Association Conference (IBIMA), Madrid, Spain, 13-14.11.2019, ISBN 978-0-9998551-3-3, *IBIMA Publishing, King of Prussia*, PA, pp.

Central banks digital currency: prospects for monetary and payment systems

Dr. Dmitry KOCHERGIN,
Professor, Department of Credit Theory and Financial Management, Saint-Petersburg State University, 199034, 7-9 Universitetskaya Emb., St Petersburg, Russia, kda2001@gmail.com, https://orcid.org/0000-0002-7046-1967

Dr. Victor DOSTOV
Saint-Petersburg State University, 199034, 7-9 Universitetskaya Emb., St Petersburg, Russia; Russian Electronic Money and Remittance Association, 107078, 5/2 Orlikov per., Moscow, Russia, dostov@npaed.ru, https://orcid.org/0000-0003-4518-2883

Alsu YANGIROVA
Postgraduate Student, Department of Credit Theory and Financial Management, Saint-Petersburg State University, 199034, 7-9 Universitetskaya Emb., St Petersburg, Russia, alsu-rf@mail.ru,
https://orcid.org/0000-0002-1771-1306

Dr. Pavel SHUST
Saint-Petersburg State University, 199034, 7-9 Universitetskaya Emb., St Petersburg, Russia; Russian Electronic Money and Remittance Association, 107078, 5/2 Orlikov per., Moscow, Russia, dostov@npaed.ru, https://orcid.org/0000-0002-2276-7523

Abstract

Purpose of this paper is to study of process of implementation of central banks digital currencies (CBDC) as a new form of central bank money. The CBDC are placed within the typology of modern monetary forms. The comparative analysis of different CBDC types, as well as the CBDC effects on the monetary and payment systems is presented as well. The properties of CBDC have much more in common with cash issued by central bank than with the electronic money of private issuers or with cryptocurrencies; they can be considered as a new form of money that can be issued for use in both retail and wholesale payments.

Keywords: central banks digital currencies (CBDC); distributed ledger; electronic money; forms of money.

Introduction

New digital information technologies have been mainstreamed in the financial market over recent years. Distributed ledger technology (DLT)[i] is one of the most advanced information technologies applied in the financial sector (Hancock, Vaizey, 2016, p. 14).

The CBDC seem to be one of the most important application for DLT in the central bank activities, despite of the many other options for its implementation. It is associated with a fundamentally new money equivalent issued by the central bank rather than with modernization of the current technologies for providing payment and settlement services. However, implementing digital currencies into the existing monetary and credit system is not straightforward. It involves financial and systemic risks both for the regulator and the participants in the monetary and credit and payment systems. In particular, neither characteristics and forms central bank digital currency will have, nor what advantages and disadvantages digital currencies will have compared with the contemporary monetary forms are yet understood. The most important, it is not clear what potential impact digital currencies will have on the monetary and credit system.

Today, the possibility for issuing CBDC is a hot-button issue among economists and monetary regulators around the world in terms of the stability of national monetary systems and the future of central bank money. This concern is caused by the rapid development of a new class of financial instruments, crypto-assets[ii], which are based on DLT. Among them, virtual currencies[iii] or

cryptocurrencies hold a special place (Kochergin, 2017, p. 120). Decentralized cryptocurrencies are not nominated in any national currency. In the future, they can become common means of payment, if their legal status is clearly defined. The widespread use of cryptocurrencies for payment purposes can significantly diminish the demand not only for cash, but also for funds in settlement accounts of the central bank (Mau, 2019, p. 10). Despite the possible similarities in the technology for issuing CBDC and cryptocurrencies, they have many differences. The main one is that the central bank digital currencies have a central issuer represented by the national monetary regulator. It is the lender of last resort. This means high liquidity and stable purchasing power of digital currencies, as well as the possibility to regulate their issuing volumes based on the goals of monetary and credit policy.

Also, CBDCs differ from the so-called national cryptocurrencies issued in countries in difficult economic and financial situations, compounded by economic sanctions. Examples of such countries are Venezuela (El Petro), Iran (PayMon). In such countries, the decision to issue national cryptocurrencies is made by the political leadership, and central banks are not actually independent monetary institutions. At the same time, central banks in these countries can not provide a stable purchasing power of the national currency, so they are forced to use physical commodity assets, such as oil in Venezuela or gold in Iran, as a security for the issuance of state cryptocurrencies. State cryptocurrency projects primarily aim to attract external funding and circumvent economic sanctions and, not to increase the efficiency of the monetary and payment systems.

The aim of the article is to interpret and classify central bank digital currencies, to identify key characteristics of digital currencies and possible models of issuing CBDC, as well as to identify the main effects of digital currencies on the monetary and credit and payment systems.

The interpretation of CBDC and their place in the modern typology of money

Currently, there is no universally accepted definition of CBDC, as there are multiple models of their implementation. In general, CBDC can be defined as an obligation of the central bank in electronic form expressed in a national monetary unit and acting as a means of exchange and store of value. At the same time, CBDC should be considered as a new form of central bank money, different from traditional central bank money, and presented either as cash or as money on reserve and bank accounts in the central bank. CBDC, as a new form of central bank money, can take an intermediate place between traditional money forms as it can be both universally accepted (like cash) and issued electronically (like cash balances on reserve and settlement accounts in the central bank). Figure presents a possible place of digital currencies in the general structure of modern monetary forms.

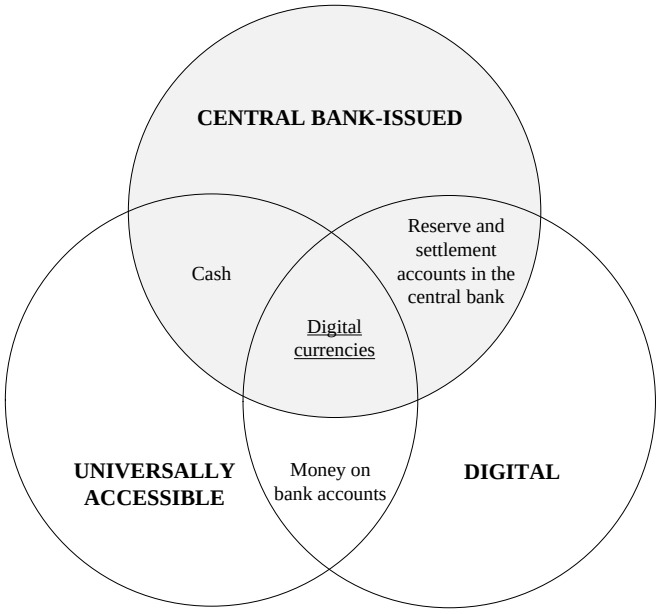

Figure. The typology of modern money forms including central bank digital currencies
Source: compiled by the authors.

KOCHERGIN, Dmitry; DOSTOV, Victor; YANGIROVA, Alsu; SHUST, Pavel (2019): Central banks digital currency: prospects for monetary and payment systems, In: 34th International Business Information Management Association Conference (IBIMA), Madrid, Spain, 13-14.11.2019, ISBN 978-0-9998551-3-3, *IBIMA Publishing, King of Prussia*, PA, pp.

Despite the similarity in the form, CBDCs should also be distinguished from virtual currencies or cryptocurrencies issued, as a rule, in decentralized systems that do not have a clearly identifiable issuer, as well as electronic money issued by clearly identifiable issuers, but on a private basis. Table 1 shows the comparative properties of CBDC, central bank cash, electronic money of private issuers and cryptocurrencies.

Table 1: Properties of CBDC compared to other forms of money

Factor	**CBDC**	**Central bank cash**	**Electronic money**	**Cryptocurrencies**
Demand factors				
Intrinsic value	No	No	No	No
Liability of the issuer	Yes	Yes	Yes	No
Means of exchange	Yes (or limited)	Yes	Yes (limited)	Limited but growing in a networked environment
Monetary unit (at national level)	Yes	Yes	Yes	No
Store of value facility	Yes, but with inflation risk	Yes, but with inflation risk	Yes, but with inflation and liquidity risks	Yes, but with great volatility
Supply factors				
Issuer competition	Monopoly	Monopoly	Centralized	Decentralized
Source of issue	Public	Public	Private	Private
Volume of issue	Flexible	Flexible	Relatively flexible	Not flexible
Rules of issue	Not defined	Issuance based on inflation targeting	Issuance based on equivalent exchange for other monetary forms	Computer protocol with limits
Change of issue conditions	Yes	Yes	Yes	Yes, subject to agreement with main miners
Cost of issue	Low	Low	Low	High (due to the cost of electricity for computing)

Source: compiled by the authors.

As seen from table 1, CBDC properties have much more in common with the cash of central bank than with the electronic money of private issuers or cryptocurrencies, since the issuer's legal status and its ability to choose the order of issue and manage currency supply are of key importance. At the same time, the specific CBDC properties will depend on the model of their implementation.
Currently, there are two main options for issuing a CBDC (Cœuré, Loh, 2018. p. 7):
• for retail (general purpose) payments[iv];
• for wholesale (specialized) payments[v].
Technologically, digital currencies can be issued either in the form digital tokens[vi], or in the form of accounts. A key distinction between token- and account-based money is the form of verification needed when it is exchanged. Token-based money relies on the ability of the payee to verify the validity of the payment object. The problems for digital tokens are electronic counterfeiting and

double-spending. There is a risk that a payer could try to use the "same" token on two different transactions. By contrast, systems based on account money depend on the ability to verify the identity of the account holder. A key concern is identity theft, which allows perpetrators to transfer or withdraw money from accounts without permission. Based on the empirical experience in the development of payment systems, it is most advisable to use a token-based digital currency for retail payments and an account-based digital currency for wholesale payments.

A general purposed CBDC for retail payments could be an alternative safe, robust and convenient payment instrument that could supersede traditional cash. Unlike non-cash payment instruments, the digital currency of the central bank can inherit important characteristics of cash, namely: to be a legal means of payment and to maintain the anonymity of payment transactions. One of the main advantages of wholesale CBDCs is that they may enhance settlement efficiency for transactions involving securities and derivatives. Currently proposed implementations for wholesale payments — designed to comply with existing central bank system requirements relating to economic efficiency, capacity and operational safety — look broadly similar to, and not clearly superior to, existing infrastructures.

Key characteristics of CBDC

Each of the CBDC forms may have different economic, functional and technological characteristics. There are seven key characteristics of central bank digital currencies which include: 1) technology of issue; 2) currency storage; 3) anonymity; 4) mechanism of transfer; 5) integration into the monetary and credit system; 6) access to funds; 7) paying of interest (Lannquist, 2019, p. 7).

Technology of issue. In most modern cryptocurrency systems, the issue and accounting of transactions with digital payment tokens is carried out on open digital ledger, where tokens are issued within peer-to-peer horizontal networks without a clearly identifiable issuer. However, in the case of the central bank digital currencies, some kind of a closed distributed ledger, in which access to data, as well as to the sending of transactions is limited to a certain narrow circle of organizations, or on the basis of other emission technology, which would allow central bank to centrally control and manage the money supply. A number of key technological advantages of decentralized DLT will be lost, including partial anonymity, transparency of transactions, and low transaction costs. Therefore, central bank will have to choose technology for CBDC, which would balance the ability to control the money supply and maintain an acceptable level of anonymity and ensure low transaction costs for its users.

Currency storage. In most cases, when digital currencies are issued for retail payments in the form of digital tokens, electronic wallets directly owned by the owner of the funds act as a storage device. In case of wholesale CBDCs, the currency can be stored in the form of accounts directly at the central bank.

Anonymity. A token-based CBDC can, in principle, be designed to provide different degrees of anonymity in a way that is similar to private digital tokens. A key decision is the degree of anonymity vis-à-vis the central bank, balancing, among other things, concerns relating to money laundering, financing of terrorism and privacy which is a technologically challenging task[vii].

Mechanisms of value transfer. The transfer of cash is conducted on a peer-to-peer basis, while central bank deposits are transferred through the central bank, which acts as an intermediary. In this regard, retail CBDC may also have to provide direct transfer analogous to cash. The only difference will be that such digital currency will be transferred using electronic storage devices. A CBDC may be transferred either on a peer-to-peer basis or through an intermediary, which could be the central bank, a commercial bank or a third-party agent.

Integration into the monetary system. Digital currencies can be implemented into the existing monetary system in three ways. First, as a substitute for cash in circulation (the transition from cash to digital currencies as a legal means of payment). Secondly, in a 'supplementary' role to cash while maintaining cash in circulation (competition with non-cash payment systems). Third, as a form of money, which has a parallel treatment on a par with cash (competition with deposits in commercial banks). The question of how a digital currency can be transformed into cash and non-cash money depends on the chosen model of digital currency.

Accessibility of funds. Currently, access to traditional central bank money, except cash[viii], is limited to central bank operating hours. In the case of digital currency for retail payments, it seems that the central bank will need to provide mandatory access to such funds 24/7. A wholesale CBDC could be

available only during certain specified times (such as the operating hours of wholesale payment systems).

Interest payments. it is technically feasible to pay interest on both token- and account-based CBDC. The positive interest rate (for example, with a fixed interest below the key rate or differentiating interest depending on the amount of funds in the account) on CBDCs can encourage demand for CBDCs, especially at the stage of their initial integration into the monetary and credit system, and stimulate competition with deposits of credit institutions. The ability to charge interest for the central bank has its additional advantages, since a change in the rate on CBDCs would make it possible to vary the cost of money and, as a result, the demand for it (Cœuré, Loh, 2018. p. 6).

Modern projects for the production of digital currency

Historically, the Bank of England was the first central bank to initiate a global discussion about the prospects for introducing central bank digital currencies in 2014 (Ali, Barrdear, et al., 2014, p. 7). Then, the central banks of other countries, including the Bank of Sweden, the Bank of Canada, the Bundesbank, the US Federal Reserve and the Monetary Authority of Singapore began to study possibility and legality of CBDCs. At the beginning of 2019, 70% of central banks conducted research on the issue of CBDC (Barontini, Holden, 2019, p. 7). Of the 63 central banks participating in the Bank for international settlements (BIS) survey in 2019, all regulators at least conduct research on the feasibility of issuing CBDC. However, such work is mostly analytical and does not necessarily constitute plan for the production of CBDC. Only 8% of regulators have progressed to running pilot projects, while few of them have successfully completed test runs.

The Central Bank of Sweden (Riksbank) has come closest to creating a model for issuing retail CBDC, electronic krona (e-Krona). The initiative of the Bank of Sweden is largely due to a sharp decrease in cash use (Ingves, 2018, c. 11) and the desire to move to a non-cash society. Riksbank suggests two possible models for issuing e-Krona: based on DLT and account-based[ix].

The first model is a system where private or legal entities can open an account in e-Kronas directly at Riksbank and gain access to a single database allowing for the exchange of information and transfers using the interface of the Central Bank of Sweden payment system. In this model Riksbank is responsible only for the main functions, such as storing e-Kronas in their accounts, crediting and withdrawing funds from accounts and transfers between accounts. Direct communication with account holders in e-Kronas will be a responsibility of the third-party payment service providers

The second model is a system where digital currencies will be stored locally in an electronic wallet or in an app on a mobile phone. Payments and transfers will go through card readers or contactless payments, ensuring offline payments. As in the case of electronic money (Kochergin, 2011, p. 123–140), the value-based e-Krona stored on the device can ensure anonymity of payments within the framework established by laws on combating money laundering and limits. The responsibilities of Riksbank will include: developing and testing the system, ensuring the protection of payment information, developing technical specifications of cards, issuing cards, currency exchange and customer service.

The Central Bank of Uruguay was the first in the world to introduce an experimental model of a retail CBDC — electronic peso (e-Peso). Launched in October 2017, the six-month pilot program was implemented among users of the ANTEL mobile operator, who were asked to download a mobile application to get access to a digital wallet. The platform made it possible to make payments in a number of outlets and make money transfers to other registered users through the national Red Pagos payment card system. Moreover, the e-Peso digital notes circulating in the pilot program had their unique serial numbers and corresponding registration with the Central Bank of Uruguay. (Licandro, 2018).

The regulator and the participants of the pilot project were satisfied the experience of the e-Peso experimental use in retail payments and noted the high coordination of work and the absence of technical incidents during the entire testing period. At the same time, the head of the Central Bank of Uruguay, M. Bergara, expressed the opinion that at present, there is no demand for the full-scale issue of e-Peso in circulation to replace paper banknotes. If the regulator decides to switch to digital banknotes, the citizens will be offered a transition period to get used to the new payment technology.

The intentions to develop CBDC based on the DLT have already been voiced by the Bank of Canada (CAD coin) (Engert W., Fung B., 2017, p. 12), the Bank of Thailand (Project Inthanon) (Santiprabhob, 2018), the US Federal Reserve (Fedcoin) (Garrat, 2016, p. 4-6) and the Monetary

Authority of Singapore (Project Ubin) (Mohanty, Sin, 2017, p. 12). At the beginning of March 2019, the Bank of Canada and the Monetary Authority of Singapore completed a joint test of cross-border payments using their own digital currency systems "Jasper" and "Ubin", built on two different networks of distributed ledgers. The tests showed great potential for increasing efficiency and reducing risks when using different systems of digital currencies in cross-border payments[x].

The idea of issuing CBDC is also supported by a number of international financial institutions, such as the International Monetary Fund (IMF). At the fintech festival in Singapore in November 2018, the IMF Managing Director C. Lagarde suggested that such projects will help increase the availability of financial services, security and consumer protection, while maintaining confidentiality of payments (Lagarde, 2018).

According to a more conservative point of view of the BIS Committee on Payment and Settlement Systems, implementing CBDCs in the existing monetary and credit system can lead to instability in financing deposits in commercial banks.

Incentives and risks of digital currency issuance

One of the main incentives to issue a central bank digital currency for the population can be a safe and universally accessible payment instrument at declining demand for cash. While technological innovations on the whole have significantly increased the convenience and efficiency of electronic tools compared to cash in retail payments at the national level, there is no such trend at the cross-border level. As a rule, cross-border payments are slower, less transparent and more expensive than domestic payments. In this regard, digital currencies seem to be the most perspective in this area.

An important incentive for the issuance of CBDC is the possibility of increasing the stability of existing retail payment systems, for example, in the event of a technical failure In this regard, CBDCs can increase liquidity and reduce credit risk in payment systems.

The potential benefits of using CBDCs may be further enhanced if non-bank credit institutions are involved in the settlement by facilitating the use of new technologies for asset transfer, authentication and risk management.

However, a number of legal, technical and operational restrictions must be removed so that CBDCs became widely accessible. In particular, it is necessary to resolve the issue of whether CBDCs will be legal tender in national jurisdictions. Another important condition for issuing CBDCs is the development of reliable mechanisms to mitigate cyber risks, especially in systems based on DLT. The potential consequences of violating the integrity of the CBDC accounting system as a result of cyber-attacks can be significant due to the universal use of digital currency. The projects on issuing CBDC should be developed while keeping the international requirements of the Financial Action Task Force (FATF) in mind, as the number and the volume of transactions using digital currencies may be significant and used not only in national, but also in cross-border payments.

Impact of digital currencies on the monetary system and monetary policy of central bank

The issuance of a CBDC is unlikely to change the basic mechanism for implementing the monetary and credit policy of the central bank, including using open market operations and regulating the key interest rate. However, if the volumes of CBDCs keep growing and are not compensated by a corresponding decrease in cash circulation, there may be problems concerning the need to expand assets that the central bank can hold as collateral[xi]. At the same time, introducing a CBDC in one country may have negative effect on the countries that do not use such currencies. There may be an overflow of deposits in the country that issued the digital currency, especially if they bring interest income.

The influence of CBDCs on the monetary and credit policy will largely depend on the form and method of their integration into the monetary and credit system. Table 2 presents scenarios for introducing digital currencies and groups them in increasing order of influence of the central bank's regulatory role in the monetary and credit sphere.

KOCHERGIN, Dmitry; DOSTOV, Victor; YANGIROVA, Alsu; SHUST, Pavel (2019): Central banks digital currency: prospects for monetary and payment systems, In: 34th International Business Information Management Association Conference (IBIMA), Madrid, Spain, 13-14.11.2019, ISBN 978-0-9998551-3-3, *IBIMA Publishing, King of Prussia*, PA, pp.

Table 2: Scenarios of the introduction of CBDC

Method to integrate digital currencies	**Description of integration scenario**	**Digital currency profits**	**Influence on monetary and credit system**	**Influence on monetary and credit policy**
1. Cash replacement (competition and replacement of cash in circulation)	Transition from cash to CBDC	Usability and possible anonymity in payments	Component replacement in MO unit	Insignificant
2. Addition to cash (competition with payment systems)	Outflow of funds from current accounts in CBDC	Easy payments for goods and services and improving stability in the operation of payment systems	Possible impact on the structure of components in M1 aggregate	Significant: the growing role of the central bank in the market of payment systems
3. Simultaneous use of cash (competition with deposits in commercial banks)	Outflow of funds from deposits in CBDC	Easy payments for goods and services, as well as possible interest accrual	Possible impact on both the structure and volume of the components of aggregates M1 and M2	Significant: change in liabilities of the central bank and commercial banks

Source*:* compiled by the authors using the data from the Bank of Russia Research and Forecasting Department

As can be seen from the table 2, CBDC can be a substitute for cash, be an addition to them, or circulate in parallel with cash. If cash is replaced, the effect on monetary policy will be negligible. At the same time, the storage of digital money by individuals directly in central bank can cause two main directions of influence on monetary policy: 1) to strengthen its transmission mechanism; 2) to reduce the volume of lending provided by credit institutions.

Strengthening the transmission mechanism of monetary policy can be achieved through a direct impact on the value of money. Let's imagine that CBDC stored in central bank will accrue interest income tied to the key rate. In this case, the reaction of economic agents will be faster and the demand for digital currency among depositors of credit institutions will grow, which will lead to a corresponding decrease in the volume of investments in other forms of money or assets (Mancini-Griffoli et all., 2018, p. 4). As a result, the change in the key rate of central bank will have an impact on economic agents directly, and not through intermediaries (i.e. commercial banks).

Central banks are likely to be able to compensate for the reduction of deposits in the accounts of credit institutions by providing them with liquidity. If the demand for CBDC is significant while there is insufficient liquidity from commercial banks, the central bank will need to increase its balance sheet assets through the acquisition of additional assets from the non-financial sector (Gürtler, Nielsen, 2017, p. 14). Thus, the issue of CBDC can increase the efficiency of traditional instruments to influence interest rates in the financial system.

However, the advantages of such centralization of assets are not obvious. First, the implementation of monetary policy in the accumulation of funds on the balance sheet of central bank will become more difficult, as it may increase the number and volume of operations carried out by the regulator. In addition, the growth of central bank's balance sheet assets may lead to changes in the debt and capital markets. Secondly, the CBDC will compete with the funds of commercial banks. In this regard, the prolonged decline in bank deposits due to the growth of CBDC can reduce the size and change the structure of commercial banks' liabilities, and hence the cost of funding (Juks, 2018, p. 92), which can lead to a decrease in the volume of assets of commercial banks intended for lending to individuals and legal entities.

KOCHERGIN, Dmitry; DOSTOV, Victor; YANGIROVA, Alsu; SHUST, Pavel (2019): Central banks digital currency: prospects for monetary and payment systems, In: 34th International Business Information Management Association Conference (IBIMA), Madrid, Spain, 13-14.11.2019, ISBN 978-0-9998551-3-3, *IBIMA Publishing, King of Prussia*, PA, pp.

In most cases, an ill-designed approach to the issuance of CBDC can lead to a decrease in bank lending operations and have a negative impact on the real sector of the economy. However, some researchers admit that with a certain method of issuing digital currency, the amount of loans issued by commercial banks may remain unchanged (Kumhof, Noone, 2018, p. 20). This will happen if CBDC is secured by government bonds and purchased only in exchange for them. Thus, either banks or non-bank financial institutions will sell assets (e.g. through repo transactions) and acquire digital currency for themselves or their customers. In the end, government bonds disappear from the assets of the real sector, while bank deposits – from the liabilities. Lending to non-financial organizations does not suffer; instead, the volume of circulating public debt is reduced, part of which through the mediation of banks goes to the balance of central bank, reducing the rates on public debt (Barrdear J., Kumhof, 2016, p. 40).

Due to increasing use of decentralized and private cryptocurrencies, as well as stablecoins, implementing CBDCs has more potential advantages than disadvantages. If legal, technical and operational issues are solved and cyber risks are mitigated, digital currencies issued by the central bank can increase the efficiency and security of operations of the monetary and credit and payment systems.

Summary

As a result of research and analysis of the global experience, we came to the following conclusions:

1) Issuing CBDC using DLT or other information technology may lead to the emergence of a new form of central bank money different from cash and traditional cash balances in reserve or settlement accounts. High liquidity coupled with low risk of digital currencies compared to high-risk and volatile decentralized virtual currencies may be the main motive for central banks to issue digital currencies.

2) Digital currencies can be issued and used not only for retail payments, but also for wholesale payments. The issue of digital currencies can be technologically implemented either through the issue of digital tokens, or based on the accounts opened with the central bank. At the same time, the characteristics of digital currencies for token-based retail payments can largely coincide with modern characteristics of cash, except for payment anonymity.

2) The key characteristics of CBDC are: the technology of emission; the method of currency storage; the degree of anonymity; the mechanism of mutual settlement; the method of integration into the monetary system; the ability to access funds; interest payments. Most of the projects on issuing digital currencies, analyzed as part of the study, use DLT to issue digital currencies when funds are stored either in accounts with the central bank or in electronic wallets of users. Most systems do not provide an opportunity to transfer funds without an intermediary. Today, the most advanced retail CBDCs projects are e-Krona (Central Bank of Sweden), e-Peso (Central Bank of Uruguay) and others. Wholesale CBDCs are developed as part of CAD coin projects (Central Bank of Canada), Inthanon (Central Bank of Thailand).

3) The introduction of CBDC for both retail and wholesale payments can bring a number of potential benefits for payment, clearing and settlement systems, including the possibility of providing an alternative and universally available legal means of payment and ensuring faster, transparent and cheaper cross-border payments. The main drawbacks of the issue of digital currencies are the potential risks of the financial stability of credit institutions, reducing their liquidity in the stock market, as well as cyber risks.

4) The impact of digital currencies on the modern monetary system largely depends on the way they are implemented. In the case of a cash substitution scenario, the expected effect would be negligible. However, if CBDC are issued as an addition to cash or circulate in parallel, they can strengthen the transmission mechanism of monetary policy and increase centralization of assets on the balance sheet of central bank, as well as reduce the amount of funding provided by credit institutions.

[i] A distributed ledger is a decentralized or distributed accounting system for data on financial transactions, in form of chains built of certain transaction blocks according to certain rules. The key features of DLT are: 1) decentralized distribution of equivalent copies of data among the system participants; 2) sharing and synchronizing data in the system according to the consensus algorithm; 3) lack of an administrator responsible for generating, managing and transmitting data.

KOCHERGIN, Dmitry; DOSTOV, Victor; YANGIROVA, Alsu; SHUST, Pavel (2019): Central banks digital currency: prospects for monetary and payment systems, In: 34th International Business Information Management Association Conference (IBIMA), Madrid, Spain, 13-14.11.2019, ISBN 978-0-9998551-3-3, *IBIMA Publishing, King of Prussia*, PA, pp.

[ii] Crypto-assets are a new class of financial assets that are created and operate on the basis of the DLT. They may comprise assets of various economic and legal natures: monetary, equity, debt, etc. Crypto-assets may include virtual currencies, stablecoins, security tokens, utility tokens and others. In some countries, including Russia, the term “digital financial assets” is used as an equivalent to “crypto-assets”.

[iii] From a functional point of view, a virtual currency can be defined as a digital expression of value that can be bought and sold digitally and function as: (1) a medium of exchange; and/or (2) an accounting unit; and/or (3) a means of preserving value but has no legal status in any jurisdiction (that is, it is not, from a normative point of view, a legal means of payment in most developed and developing countries). From an institutional point of view, the virtual currency can be interpreted as a digital expression of value, which is not issued by traditional issuers of modern forms of money – central bank, credit institutions or specialized issuers of electronic money, but can be used as an alternative to the generally recognized forms of money in payments in electronic networks (Kochergin, 2017, p. 120). Despite the fact that from a formal point of view the terms "virtual currency" and "cryptocurrency" are often used in economic research as synonyms, these terms are not identical. The term virtual currencies is broader and may include not only cryptocurrencies that are issued on the basis of DLT, but also currencies that are issued using other emission technologies and that may not be convertible.

[iv] Retail (general purpose) payments are universal payments between individuals and legal entities and banks.

[v] Wholesale (specialized) are payments of limited purpose between central banks or between central bank and commercial banks.

[vi] A digital token in CBDC systems can be a digital form of a national currency (a digital token of value) in the form of an electronic monetary obligation of the Central Bank, which can be used in retail payments by analogy to cash. Tokens can be stored on various electronic value storage devices.

[vii] For more details, see: ‘The Riksbank’s E-Krona Project’. Sveriges Riksbank, Report 2. 2018. p. 23.

[viii] It goes about funds in settlement accounts and accounts of required reserves at central bank.

[ix] For more details, see: ‘The Riksbank’s E-Krona Project’. Sveriges Riksbank, Report 1. 2017. p. 4–5.

[x] For more details, see: ‘Central Banks of Canada and Singapore Conduct Successful Experiment for Cross-Border Payments Using Distributed Ledger Technology’. Monetary Authority of Singapore. Monetary Authority of Singapore [Online], [Retrieved June 15, 2019] http://www.mas.gov.sg/News-and-Publications/Media-Releases/2019/Central-Banks-of-Canada-and-Singapore-conduct-successful-experiment-for-cross-border-payments.aspx.

[xi] Here we refer to the fact that additional cash needs to be backed by additional assets.

References

Ali, R., Barrdear, J., Clews, R. and Southgate, J. (2014), ‘The Economics of Digital Currencies’, *Bank of England Quarterly Bulletin*, 54 (3), 276-286.

Barontini, C., Holden, H. (2019), ‘Proceeding with caution – a survey on central bank digital currency*’, BIS Papers*, 101, 24 p.

Barrdear J., Kumhof M. (2016), ‘The Macroeconomics of Central Bank Issued Digital Currencie’, Bank of England Working Paper, 605, 92 p.

Cœuré B., Loh J. (2018), ‘Central bank digital currencies’, *Committee on Payments and Market Infrastructures BIS Report*, 34 p.

Engert W., Fung B. (2017), ‘Central Bank Digital Currency: Motivations and Implications’, *Bank of Canada Staff Discussion Paper*, 30 p.

Garrat, R. (2016), 'CAD-coin versus Fedcoin’, *R3 Reports*, 9 p.

KOCHERGIN, Dmitry; DOSTOV, Victor; YANGIROVA, Alsu; SHUST, Pavel (2019): Central banks digital currency: prospects for monetary and payment systems, In: 34th International Business Information Management Association Conference (IBIMA), Madrid, Spain, 13-14.11.2019, ISBN 978-0-9998551-3-3, *IBIMA Publishing, King of Prussia*, PA, pp.

Gürtler K., Nielsen S. et all. (2017), 'Central bank digital currency in Denmark?', *Danmarks Nationalbank Analysis Paper*, 28, 24 p.

Hancock M., Vaizey E. (2016), 'Distributed Ledger Technology: beyond block chain', *Report by the UK Government Chief Scientific Adviser*, 98 p.

Ingves S. (2018), 'Going Cashless'. *Finance and Development*. 2, 11-12.

Juks R. (2018), 'When a Central Bank Digital Currency Meets Private Money: The Effects of an E-Krona on Banks', *Sveriges Riksbank Economic Review*, 3, 79–99.

Kochergin, D.A. (2011), 'The electronic money', Biblioteka Tsentra issledovanii platezhnykh sistem i raschetov. Moscow. 424 p.

Kochergin, D.A. (2017), 'The roles of virtual currencies in the modern payment system', *St Petersburg University Journal of Economic Studies,* 33 (1), 119-140.

Kumhof M., Noone C. (2018), 'Central Bank Digital Currencies – Design Principles and Balance Sheet Implications', *Bank of England Working Paper*, 725, 54 p.

Lagarde C. (2018), 'Winds of Change: The Case for New Digital Currency', *IMF Managing Director Singapore Fintech Festival*, [Online], [Retrieved May 15, 2019], https://www.imf.org/en/News/Articles/2018/11/13/sp111418-winds-of-change-the-case-for-new-digital-currency

Lannquist A. (2019), 'Central Banks and Distributed Ledger Technology: How are Central Banks Exploring Blockchain Today?', *World Economic Forum's White Paper,* 14 p.

Licandro G. (2018), 'Uruguayan e-Peso on the context of financial inclusion', *Basel*. [Online], [Retrieved May 01, 2019], https://www.bis.org/events/eopix_1810/licandro_pres.pdf.

Mancini-Griffoli T., Martinez M., Agur I. et all. (2018), 'Casting Light on Central Bank Digital Currency', *IMF Staff Discussion Notes*, 39 p.

Mau, V.A. (2019), 'National goals and model of economic growth: New in the Russian socio-economic policy of 2018—2019', *Voprosy ekonomiki*, 3, 5-28.

Mohanty, S., Sin Ng Nam. (2017), 'The future is here Project Ubin: SGD on Distributed Ledger', *Monetary Authority of Singapore*, 44 p.

Santiprabhob V. (2018), 'Thai Economy: The Current State and the Way Forward', Nomura Investment Forum Asia, [Online], [Retrieved June 23, 2019], https://www.bis.org/review/r180606g.pdf