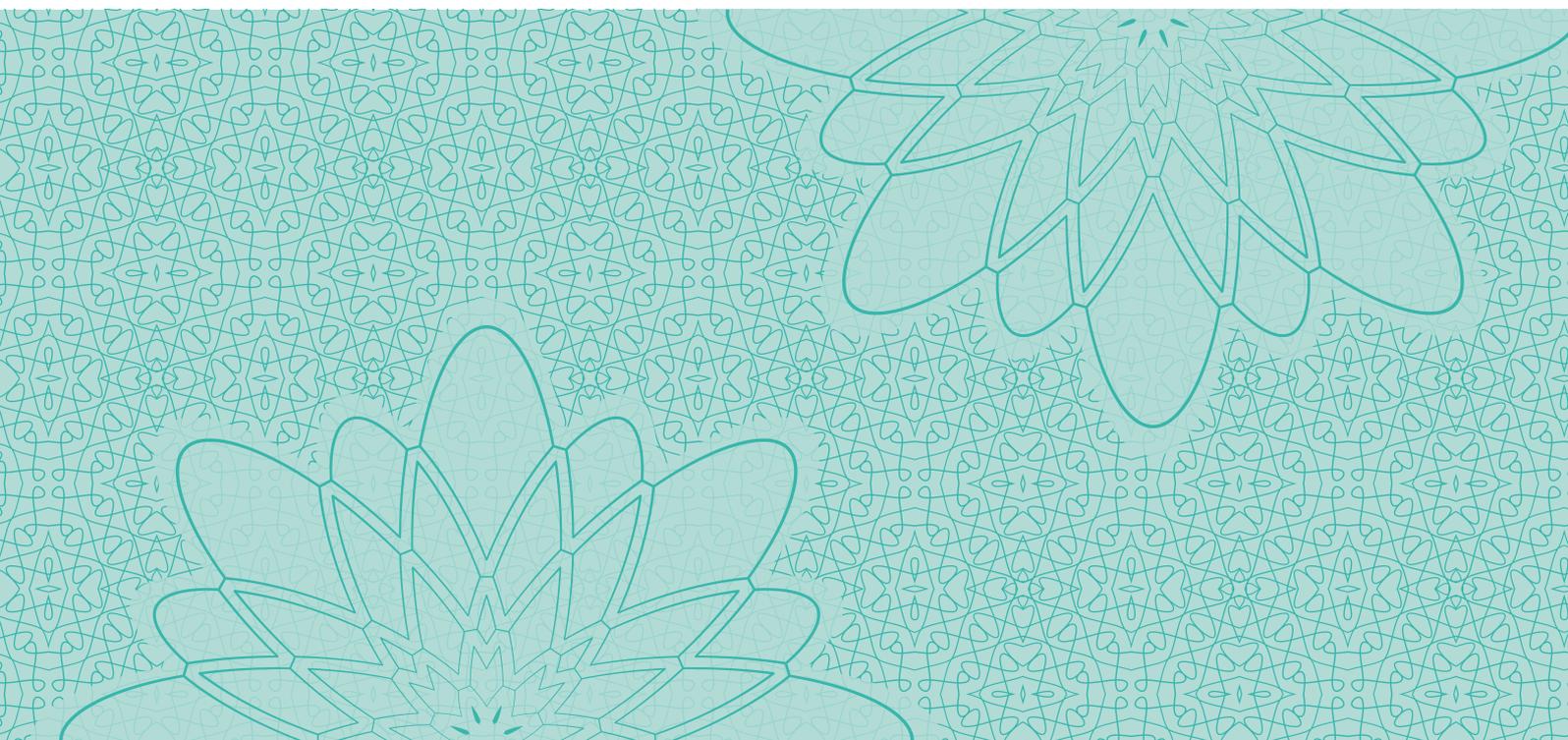


NBP

Narodowy Bank Polski

May 2021

Central Bank Digital Currency



May 2021

Central Bank Digital Currency

Prepared by:
Payment Systems Department

Foreword

Recent years have seen the rapid development of new technologies and related changes in the payment services market. The Covid-19 pandemic we have been confronted with since the first quarter of 2020 is accelerating these processes. The share of payment transactions carried out through non-cash instruments is steadily increasing. However, one cannot ignore the fact that at the same time the value of cash in circulation is increasing, while the share of cash in retail payments in Poland remains relatively high. In accordance with the results of a survey of payment habits conducted by Narodowy Bank Polski among the adult population of Poland, in 2019, 54%¹ of retail transactions were performed using banknotes and coins, and in 2020 this figure reached 46%². The period of the Covid-19 pandemic highlighted the importance of cash as an essential component of the payment infrastructure, ensuring high resilience of the national payment system as well, as a factor stabilising public sentiment. Quantitative public opinion surveys conducted in 2020 on behalf of NBP showed that 9% of respondents withdrew more cash than usual during the Covid-19 pandemic. At the same time, 9% of respondents experienced a refusal to accept cash in their daily transactions.³ Bearing in mind that ensuring undisturbed access to banknotes and coins that have the status of legal tender in Poland and ensuring widespread acceptance of cash payments in retail transactions is necessary for the efficient functioning of the economy and responds to social demand, NBP has undertaken work on the National Cash Security Strategy. The objective of NBP is to ensure the possibility to select and make an independent decision on the form of collecting savings and the method of making payments – cash or cashless – in the territory of the Republic of Poland. In the opinion of NBP, all payment instruments should be supported to an equal extent, and their choice is the exclusive right of consumers.

The year 2020 saw a marked increase in the engagement of central banks worldwide in exploring the possibility of issuing Central Bank Digital Currency (CBDC), mostly as a digital equivalent to cash. Research carried out by the Bank for International Settlements indicates that at the end of 2020, 86% of the 65 central banks surveyed worldwide were involved in exploring the concept of CBDC issuance.⁴ The rapid development of the global digital economy, the imminent prospect of the introduction of global stablecoins and the intensification of analytical, research and pilot (and in individual cases, implementation) work on CBDC are conducive to taking action aimed at solving specific socio-economic problems of individual countries. In international discussions, more and more attention is being paid to the use of new technologies and CBDCs in cross-border

¹ Source: "Payment habits of Poles in 2019", POLASIK Research ordered by the Polska Bezgotówkowa Foundation.

² Source: "Payment habits in Poland in 2020", survey conducted in 2020, ordered by the NBP.

³ Source: Report on quantitative studies. Openfield, ordered by the NBP, September 2020.

⁴ In accordance with the report of January 2021: [Ready, steady, go? - Results of the third BIS survey on central bank digital currency](#)

payments as an opportunity to make them, faster, cheaper, more transparent and universally accessible, especially in the case of remittances.

The premises underlying potential CBDC issuance are shaped by national circumstances. In developing economies, work on CBDC is primarily driven by the low effectiveness of existing payment systems, the occurrence of irregularities (such as tax evasion or money laundering), or financial exclusion of a large part of the population. In developed economies, on the other hand, work on CBDC is often driven by the rapid development of modern technologies and the decline in the use of cash in retail payments, which may consequently lead to various risks, including the formation of private monopolies in the payment services market.

NBP is monitoring closely the progress of work in the field of CBDC issuance worldwide in order to be able to take appropriate action also in Poland, should the need arise. At present, the premises which have driven other central banks to launch pilot tests in the area of CBDC issuance or digital currency implementation are not reflected in the Polish context. Learning from the research of other central banks, NBP is well advanced in its analysis of the key issues related to the issuance of central bank digital currency. In particular, NBP is investigating the potential legal, technological and economic implications of CBDC issuance. Despite this progress, NBP takes a prudent approach to the possibility of introducing digital zloty and does not currently choose to issue it. Given the statutory duty of NBP to organise monetary settlements and to act for the stability of the financial system, any decision concerning CBDC issuance must require particular caution due to the potential risks arising from the introduction of this form of central bank money for the functioning of the banking sector, financial stability, the implementation of monetary policy and the operation of the payment system.

Until now, NBP has not identified the a systemic objective for the issuance of digital zloty or any specific needs of consumers or business entities that could not be satisfied by payment service providers in Poland but only by the central bank through the introduction of CBDC. The restraint of the central bank on this subject also stems from the lack of a legal basis for the introduction of CBDC (contained in the Act of 29 August 1997 on Narodowy Bank Polski). At this stage, there are no clear benefits arising from the introduction of central bank digital currency in Poland versus the identified risks related to its issuance for the economy, cash circulation and the financial system. NBP's current stance on the issuance of CBDC may be modified if factors (domestic or international) justifying such a change emerge. It is not excluded that in the future NBP could also issue, in addition to banknotes and coins, a digital zloty, which would complement the set of payment instruments currently available and would provide the possibility of using central bank money to persons who prefer electronic payment methods.

This paper presents both the general assumptions of the concept of central bank digital currency issuance and the implications of its potential issuance, as well as the results of current analytical,

research and pilot work around the world on publicly available CBDC and CBDC for wholesale payments. It also presents an assessment of the conditions for the potential introduction of digital currency in Poland.

I hope that this study of Narodowy Bank Polski will become not only a source of information on the new form of currency issued by central banks, but also the basis for further analyses and discussions on the future of digital currency worldwide and in Poland.

Adam Glapiński

Governor of Narodowy Bank Polski

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Summary

The concept of Central Bank Digital Currency (CBDC) issuance has been analysed in many countries for several years. The analytical and research work undertaken on this concept was a response of central banks to the rapid development of modern technologies (DLT/blockchain), the increase in popularity of virtual currencies operating with their use, the introduction of innovative payment solutions adapted to the needs of the digital economy, and the decline in the importance of cash in payment transactions in some countries.

The scope of the work carried out in nearly 60 countries around the world, including the implementation of digital currency pilot projects by some central banks and the launch of CBDC implementation in first countries in the world, i.e. the Bahamas and the Union of Eastern Caribbean, with the use of blockchain, demonstrates the great potential of modern technologies and the attempt to use them to address the specific problems affecting the payment systems of these countries (such as the significant and steady decline in the share of cash in retail payments, the cost-related and logistic problems associated with the provision of cash, and the high level of financial exclusion).

The concept of digital currency is also investigated in the context of the announced introduction of so-called global stablecoins linked to the exchange rates of major fiat currencies (the euro, the US dollar, the yen or a basket of these currencies). While the large-scale introduction of these cryptocurrencies is not currently ascertained, it has been indicated that stablecoins could be used for payments, particularly for cross-border payments, on Internet platforms operated by large international technology companies (e.g. Diem, scheduled to be made available, among others, to users of Facebook, initially only as a token linked to the US dollar). The discussion carried out in this context at the international forum (G20, IMF, FSB, BIS, ECB/Eurosystem, Council of the European Union) indicates, among others, the need to regulate the functioning of crypto assets, including stablecoins⁵ and the need for central banks to conduct feasibility and relevance analyses of CBDC issuance, taking into account the domestic and cross-border effects of such issuance. An acceleration of analytical and pilot activities has been recorded since the second half of 2020. Such activities are carried out both by individual central banks and in cooperation with other central banks and the BIS/BIS Innovation Hub. The Covid-19 pandemic, which has intensified the digitisation of the economy and affected the shift in payment habits in favour of cashless instruments, has become another factor that has motivated central banks to undertake or intensify

⁵ In connection with the development of cryptocurrencies, in particular the emergence of so-called “stablecoins”, the European Commission and the Council of the European Union recognised the need to develop a secure framework enabling the operation of crypto-asset markets and a wider use of DLT in the sector of financial services. In September 2020, the draft of *Markets in Crypto-Assets Regulation* (MiCA) was published. In the future, the new regulation is intended to replace national and EU provisions currently regulating the issuance, trading and storage of crypto-assets. The intended aim of the regulation is to encourage innovation while ensuring consumer protection. The main principle will be the harmonisation of the rules consistent with the slogan “same activity, same risk, same rules”. The full text of the draft regulation is available at: https://eur-lex.europa.eu/resource.html?uri=cellar:f69f89bb-fe54-11ea-b44f-01aa75ed71a1.0014.02/DOC_1&format=PDF.

their activities in this area. The analytical and research work in progress is aimed at determining the method of implementing the digital form of central bank money, including assigning the specific features, the choice of the issuance model, as well as the application of adequate technological solutions for the CBDC system. In addition, intensified international cooperation has been observed with the aim of taking the necessary measures to reduce the cost and time of making payments, especially cross-border payments, in the currently operating payment systems. This should be achieved, among others, by introducing ISO 20022 communication standards and by establishing common principles or new international standards to ensure the interoperability of payment systems, including those using CBDC.

CBDC is defined as a central bank liability, expressed in the prevailing unit of account, in digital form, which serves as a means of exchange and as a store of value.⁶ In the framework of the work conducted on the concept of CBDC issuance, two main types of this form of central bank money are analysed: (1) publicly available CBDC (for retail payments) and (2) CBDC for wholesale payments (in payment and securities settlement systems and in cross-border transactions). In the case of CBDC available to the general public, two main options of its issuance are considered: (1) a model based on accounts held for individuals and businesses in the central bank and (2) a model based on the issuance of digital representations of value (tokens). In the case of CBDC for wholesale payments, a model based on the issuance of tokens by the central bank in a distributed ledger is mainly analysed. The aforementioned models can be built on the basis of existing technology used in functioning payment systems (with central settlement) or new technology, mainly distributed ledger technology – DLT (with decentralisation of processes, including settlement).

There is no uniform CBDC issuance scheme. Each of the above models used for introducing digital currency can be designed in a number of ways. Indeed, CBDC can be assigned diversified characteristics, depending on the objective to be achieved through its introduction (different when increasing the effectiveness of existing payment systems and different when replacing cash). The main features of CBDC which can be considered in relation to this form of money include: the subjective scope of access (general public or selected entities), the anonymity of the transaction, both in relation to the issuer and the parties to the transaction in relation to each other (almost complete or limited), the mechanism of the transfer of funds (directly between the parties involved or via a third party), the interest rate (positive, negative or no interest rate), and the limits on the amount or other restrictions on its convertibility, availability or functionality.

While presenting the arguments supporting the introduction of CBDC, a possibility of reducing financial exclusion is indicated. Moreover, insofar as it would lead to an increase in the share of non-anonymous and monitorable cashless transactions in the economy, the CBDC could contribute to the reduction of negative phenomena such as conducting unregistered and therefore untaxed economic activity, corruption, money laundering or terrorist financing. However, the issuance of digital money by a central bank, especially a publicly available CBDC, would have serious legal,

⁶ Central bank digital currencies, CPMI (BIS, 2018)

economic, social and operational implications for the central bank. The impact of the introduction of CBDC on individual impact areas would vary depending on the choice of the specific CBDC issue option and the characteristics assigned to it.

It should be expected that widely available digital currency (especially interest-bearing CBDC) would provide an alternative to commercial bank deposits. It would therefore affect the size of the deposit base in the banking sector, which is the main source of acquiring cheap and stable funds to finance lending activities. The issuance of a publicly available CBDC would lead to increased operating costs of commercial banks. The large scale use of such CBDC could lead to structural change in the financial intermediation model through infringing the two-tier banking system, where the central bank is the bank of banks (and also the lender of last resort) and does not compete with banking sector entities. The introduction of a publicly available and interest-bearing CBDC would also lead to significant changes in liquidity and activity in the interbank market. The issuance of CBDC could have an impact on increasing short-term money market interest rates. Moreover, in crisis situations, even interest-free CBDC, as a credit-risk-free means of hoarding, could pose a threat to financial stability. Should confidence in the banking sector decline, one would expect a rapid and large-scale transfer of deposits from commercial banks towards CBDC. This could threaten the functioning of individual banks and even the entire traditional banking system. As a consequence, it could become necessary for the central bank to grant refinancing loans to some banks.

In the case of countries with a declining share of cash in retail payments, the issuance of a new form of central bank money, i.e. a safe and credit-risk-free asset, could be used for maintaining confidence in the monetary and banking system of the country. It is assumed that the introduction of CBDC would not change the general principles of conducting monetary policy by the central bank. The issuance of CBDC would rather mean making available a new form of central bank money, the demand for which would require undertaking stabilisation measures (e.g. provision of liquidity or extending the range of collaterals available for the needs of central bank borrowing). CBDC could become an additional monetary policy tool of the central bank which, under certain conditions, could increase the effectiveness of the transmission of monetary impulses to the economy (although it should be stressed that at present this mechanism is generally effective). In a sustained low interest rate environment, a widely available and potentially negative interest-bearing CBDC could theoretically lead to a lower effective bound for nominal interest rates. However, it should be stressed that CBDC issuance itself (i.e. provided that it is not associated with the disappearance of cash in the economy) will not affect the level of the effective bound for nominal interest rates.

The issuance of digital currency by a central bank would entail a number of legal implications, varying depending on the CBDC issuance model adopted. It is accepted that, as with the issuance of banknotes and coins, the issuing activity of central banks in relation to CBDC would also need

to be regulated by law. The significance of this issue would increase if CBDC were assigned the status of legal tender, with universal debt cancellation power. It should also be assumed that the issuance of CBDC in the model based on central bank accounts for non-bank customers would require the establishment of an appropriate legal basis for such activity of the central bank. An important legal aspect associated with the introduction of digital currency in this model would also be the issue of potential settlement finality in CBDC-based payment systems.

Similar to cash, widely accessible CBDC would be a liability component in the balance sheet of the central bank. Its issuance, especially of a widely accessible CBDC in the model based on accounts held with the central bank, would have an impact on the balance sheet as well as on the profit and loss account of the central bank. In the event of a significant reduction in cash demand, a decline in the cost of issuing and handling cash could occur. However, this does not mean that simultaneously a decline in the central bank's total cost of issuing money (both digital and cash) would occur. CBDC issuance could affect the size of the central bank's seigniorage. The change in this respect would depend on the CBDC model (interest-bearing or not) and the size of the total demand for central bank money, i.e. the demand for both CBDC and cash. At the same time, the potential outflow of deposits from the banking sector following the introduction of CBDC and the consequent need for the central bank to refinance banks (against the collateral) would create a potential risk of financial loss for the central bank.

The issuance of CBDC would result in incurring additional one-off costs for the central bank related to the construction of a new system for CBDC payments and fixed costs arising from its maintenance. Expenditure on ensuring the cyber-security of the created payment infrastructure solutions would also increase. In the case of the introduction of CBDC in the model based on accounts in the central bank, additional costs would be incurred for opening and maintaining accounts for non-bank participants of economic transactions. In addition, the issuance of widely accessible CBDC would have an impact on the organisation of central bank operations. The introduction of an additional form of central bank money would entail changes in, among others, the organisational structure, in the substantive scope of analyses and research carried out in the central bank, as well as in the scope of statistical data collected.

In September 2017, the Management Board of NBP expressed a negative stance with regard to the proposal of the Council of Depository Banks to issue virtual currency by NBP for the purposes of monetary settlements in electronic transactions conducted using DLT. The position of NBP was reflected in the "Report on the work of the Working Group on the development of financial innovation (FinTech)" (the group established in 2016 at the UKNF). It reads as follows: "At this stage NBP has a negative opinion on the proposal to issue virtual currency and at the moment does not envisage any possibility of issuing such currency. In the opinion of NBP, neither the legal requirements, i.e. the provisions of the Constitution of the Republic of Poland and the Act of 29 August 1997 on Narodowy Bank Polski concerning the issuance of currency in the form of

banknotes and coins, nor the security considerations related to the immaturity of distributed ledger technology, which could be used in the issuance of virtual currency, allow to address the proposal indicated in a positive manner.”

The immaturity of DLT and the ambiguous balance of costs and benefits of CBDC issuance support a prudent approach to the concept of central bank digital currency. So far, the premises underlying other central banks’ in-depth analytical and research work and pilot tests on CBDC issuance have not been reflected in Polish conditions. However, due to the considerable and constantly growing interest in the concept of digital currency issuance on the part of central banks, governments and international financial institutions, NBP has been monitoring the activities of other central banks in this area for many years. Analytical work on the concept of CBDC issuance is also conducted with the aim of assessing the demand for the introduction of digital currency in a form other than offered by the central bank so far. This issue is becoming increasingly important, not so much in connection with the development of the virtual currency market, but rather due to the efforts to introduce stablecoins, including the Diem token proposed by Facebook, and the need to guarantee universal access to central bank money under the conditions of a dynamically developing digital economy. The launch of CBDC issuance in other countries, especially those that are important trading partners of Poland (such as the euro area), will be of significant importance, including in the international dimension. Furthermore, the progress of work on improving cross-border transfers, including transfers with the use of CBDC systems, will require special attention.

Introduction

The discussion on the possibility of digital currency issuance by the central bank was initiated several years ago. It was a response to the growing interest in virtual currencies which, although they do not operate as legal tender and have not become commonly used in the execution of retail payments, highlighted technological opportunities that could serve to improve digital payments. The technological progress which accompanied their emergence and the increased importance of the digitalisation of the economy and of cashless transactions themselves have, in many countries, challenged the future of payment methods used so far and the long-term effectiveness of operating payment and securities settlement systems. The attributes of virtual currencies, such as the anonymous nature of the transfer of value carried out in a decentralised manner or performing P2P (peer-to-peer) transfers, have triggered discussions and work on the introduction of modern payment solutions that are better adapted to the needs of the contemporary world. However, the volatility of the purchasing power of virtual currencies and the relatively long transaction time (longer than payments under instant payment systems) as well as the limited security of transactions and hoarding, have hindered their development as a means of payment and consequently, they act mainly as speculative assets. The issue of the announced introduction of global virtual currencies (stablecoins) whose exchange rate would be linked to the exchange rate of the most important fiat currencies (the euro, the US dollar, the yen or a basket of these currencies), once the legal framework for their safe functioning is established, will further stimulate discussions on the future of payment solutions.

Against this backdrop, the discussion on the possibility of introducing digital assets that constitute a liability of the central bank and are equivalent to banknotes and coins is gaining considerable momentum. This issue is becoming more important in the light of the long-term change in the demographic structure of society and the payment habits of individual age groups. The role of the so-called Millennial generation is growing, who are familiar with modern technological solutions and for whom P2P payments, micropayments and easy-to-use interfaces integrated with e-commerce platforms or social networks are important. Different age groups attribute slightly different importance to the basic features of various payment methods, i.e. among others, security, speed, convenience or transaction costs. The shift in payment habits observed globally as a result of the Covid-19 pandemic, towards an increased share of cashless payments in retail transactions may encourage the spread of innovative payment solutions. At the same time, the growing role of cross-border trade, including retail trade, facilitated by the development of digital technologies, increases the importance of efficient cross-border payments.

CBDC may be the next step in the evolution of the monetary system.⁷ The impact of CBDC issuance on this system will depend on a number of factors, including mainly on the objective of introducing

⁷ IMF Staff Discussion Note, SDN/18/08 (2018), p. 6

CBDC, confidence in the issuer, the method of CBDC design in the given country and the characteristics of the specific market. The demand for CBDC will depend on its attractiveness in relation to other forms of money as well as in relation to other accepted means/methods of payment.

The material prepared by NBP presents selected issues raised in the discussion on the concept of CBDC issuance. The analysis covers studies of other central banks, international financial institutions and research centres, available as at the end of March 2021.

Assessments of the potential impact of the introduction of central bank digital currency were presented by NBP primarily to report on the current status of the discussion conducted by central banks. They are only hypothetical. These assessments cannot be treated as universal since they usually result from the specific nature of the economies of the countries analysed (in particular, in terms of potential implications for the payment system and monetary policy). They cannot therefore be directly applied to the situation of Poland and NBP.

The paper consists of 5 chapters discussing the following issues:

- 1) general assumptions of the concept of central bank digital currency issuance,
- 2) implications of CBDC issuance,
- 3) analytical, research and pilot work on CBDC issuance worldwide,
- 4) conditions for the introduction of digital zloty in Poland,
- 5) summary and conclusions.

1. General assumptions of the concept of central bank digital currency issuance

1.1. CBDC definition

For the purpose of defining digital currency issued by the central bank, the acronym that is commonly used in the English-language literature on the subject, i.e. CBDC – Central Bank Digital Currency, will be used in this paper.

The Bank for International Settlements (BIS) defines central bank digital currency, CBDC, as a liability of a central bank, expressed in the prevailing unit of account, which serves as a medium of exchange and as a store of value.⁸ CBDC is a form of central bank money which takes the form of an electronic record, different from the money available to banks and selected other entities (financial institutions involved in the implementation of monetary policy) on accounts maintained by the central bank where required reserves are held or where the settlement of payment orders takes place.

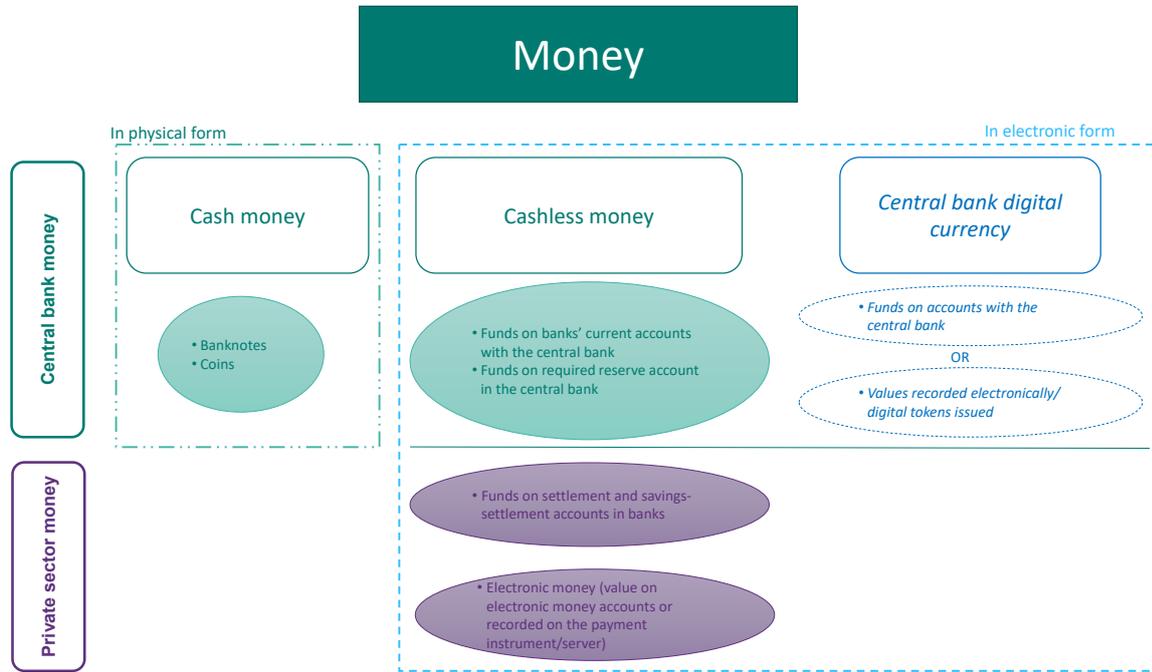
On the other hand, the International Monetary Fund defines CBDC as a new form of money, issued in digital form by the central bank, to be used as legal tender.⁹

The classification of the forms of currency according to the issuing entity and the features of the currency, respectively, is presented in Figures 1 and 2.

⁸ BIS (2018)

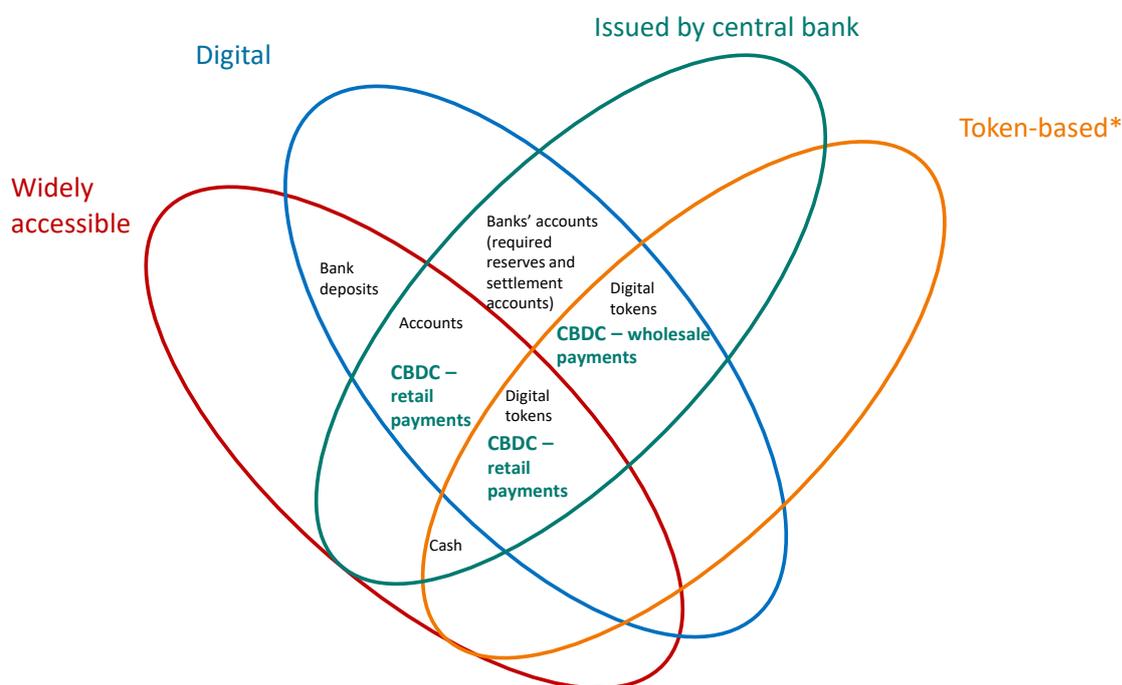
⁹ IMF Staff Discussion Note, SDN/18/08 (2018), p. 7

Figure 1 Forms of currency broken down by issuing entity



Source: NBP own study

Figure 2 CBDC versus other forms of money



Source: according to BIS (2018, p. 5), based on M.Bech and R.Garratt (2017)

[* - a token is understood by the authors as a representation of value, whether in physical or digital form]

1.2. Basic types of CBDC

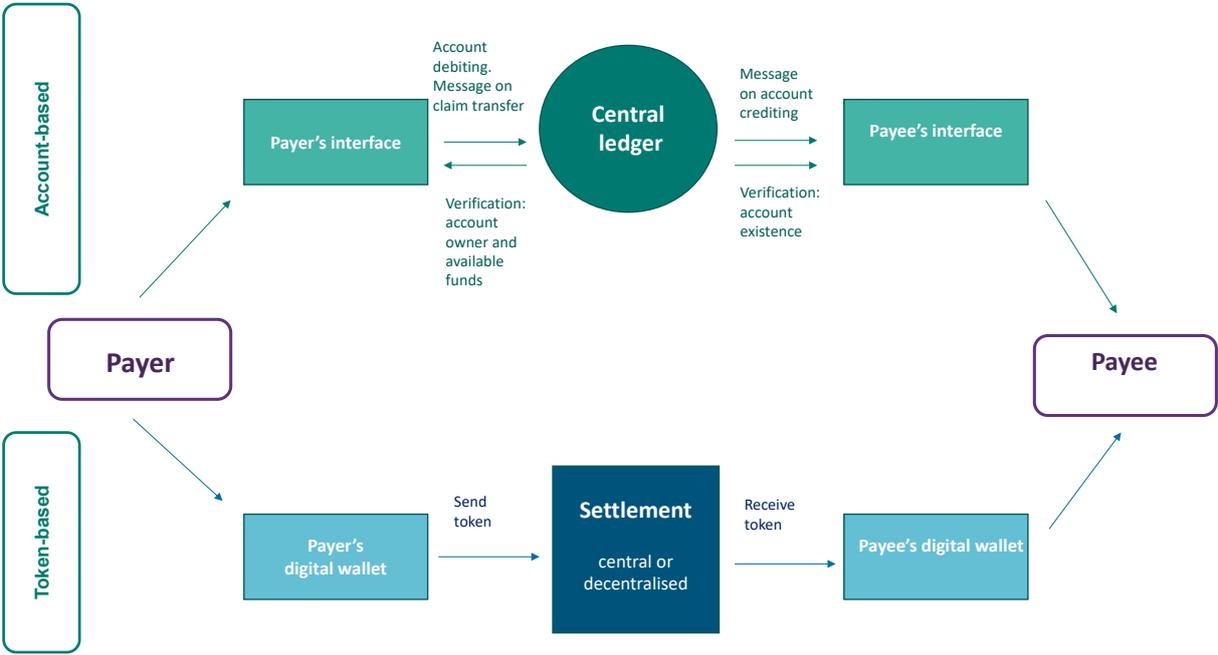
CBDC could be available to selected financial institutions and used for wholesale payments, i.e. for interbank settlements, as a substitute for cash on banks' current accounts in the central bank. CBDC could also be widely available and used for retail payments or general purpose payments, representing a substitute for cash and deposits in commercial banks. The central bank already offers access to digital money to banks and other selected financial institutions in connection with the monetary policy pursued or the operation of wholesale payment systems. However, this access could be extended to other entities, such as other types of financial institutions or other payment service providers. In the CBDC issuance model for retail payments, CBDC would represent an innovation unknown so far for individuals and economic operators other than those currently holding accounts with the central bank.

From the point of view of the place and type of electronic recording, two models of issuance are distinguished where CBDC could take the form of:

- (1) electronic accounting records on accounts held with the central bank for individuals and economic operators (account-based – the CBDC model based on accounts held with the central bank),
- (2) tokens – digital representations of value which can be stored on an electronic instrument issued by or on behalf of the central bank, such as a prepaid card, a SIM card or a phone application, or stored in a distributed ledger (token-based – the CBDC model based on issuance of tokens).

There are fundamental differences between the aforementioned CBDC models. In the CBDC model based on a system of accounts held with a central bank, direct changes to the account balances of the parties to the transaction take place (simultaneous debiting of the payer’s account and crediting of the payment beneficiary’s account). On the other hand, in the second case, i.e. during the execution of a payment using CBDC stored in the distributed ledger or locally on a payment instrument or device, it is necessary to transfer the digital representation of the transaction value between the payer and the payee. A simplified mechanism of operation of various CBDC models is shown in Figure 3.

Figure 3 Mechanism of CBDC operation in the models under analysis



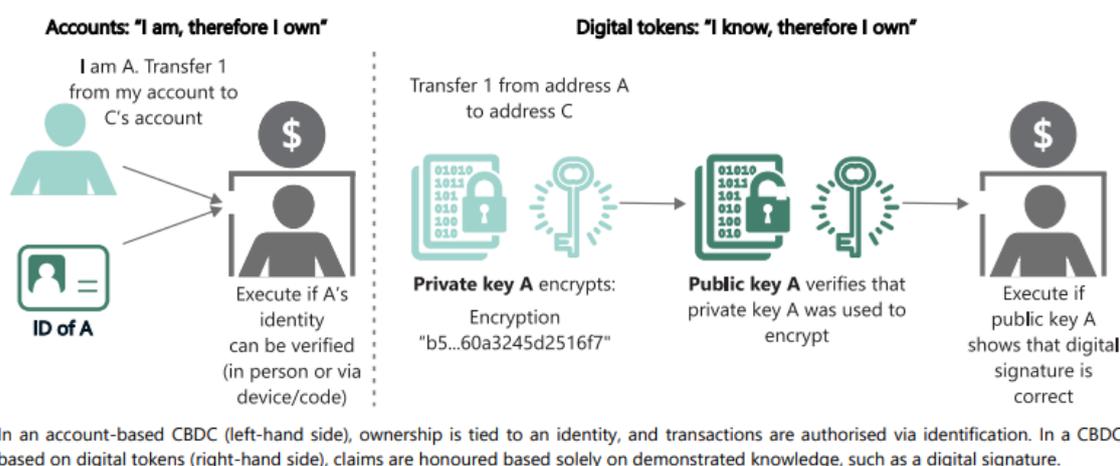
Source: IMF Staff Discussion Note, SDN/18/08 (2018, p. 8),

In addition, the CBDC issuance models mentioned above differ in terms of the scope of information required for conducting the transaction. The model of introducing digital money through the issuance of tokens by the central bank (token-based money) should enable the payee to verify the validity of the particular means of payment, i.e. whether the digital representation of value (token) is genuine and not digitally counterfeit (forged) and whether it has not been issued before in connection with the execution of another payment transaction. Due to the complex nature of token verification, this process could not be carried out by the direct parties to the transaction but must

be performed “externally”. Therefore, the transaction cannot be completely anonymous.¹⁰ The scope of anonymity will depend on whether digital wallets are registered and whether information on transactions executed is permanently recorded. Token verification and settlement will take place in a decentralised manner using distributed ledger technology (e.g. in the closed (permissioned) network managed by the central bank). A token-based solution can also assume central settlement of payments. In this case, it is possible to check the validity of, for example, token serial numbers, and then reassign such numbers when tokens change wallets to avoid the risk of double spending.¹¹

In the case of digital currency issued on the basis of the balance of an account held with the central bank, on the other hand, the exchange of information in the system is crucial. The execution of transactions would take place along the lines of those currently performed between accounts in commercial banks. The settlement would be performed following the prior verification of the identity of the account holder (in order to mitigate the risk of theft of funds deposited on the account), the amount of available funds, and the payee’s account (whether it exists and belongs to the designated person). The differences in the scope of information required to perform the transaction in both models are shown in Figure 4.

Figure 4 Determinants of access to CBDC in the models under analysis



Source: Auer, R. and Böhme, R. (2020, p. 10)

Considering the fact that CBDC is a direct liability of the central bank, it is assumed that three CBDC models exist for retail payments, differing in terms of the role played by the central bank and in the scope of the data they collect:¹²

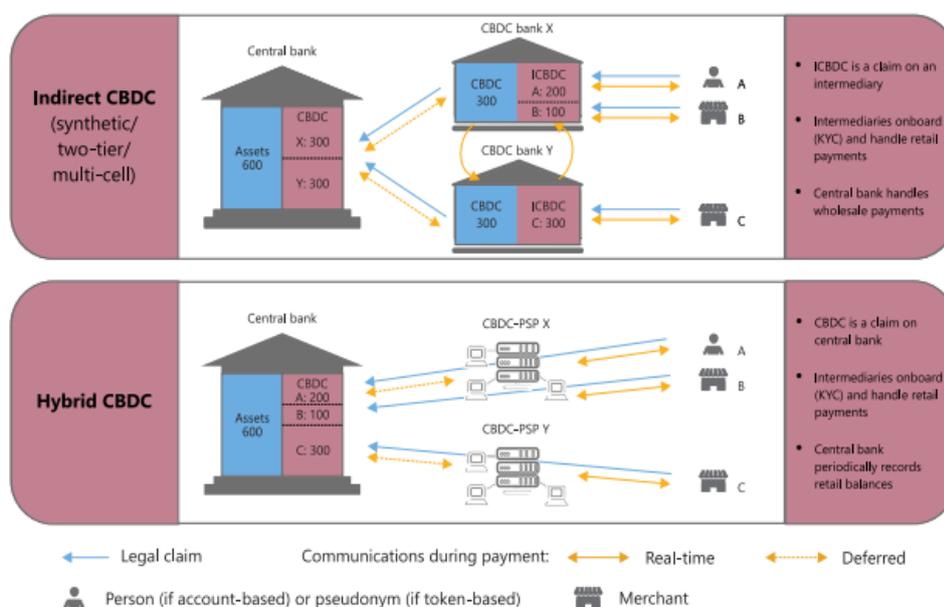
¹⁰ The scope of anonymity would depend on the details of the solution design. Chaum, D., Ch. Grothoff and T. Moser (2021) propose a design of a token-based CBDC ensuring anonymity of the payer vis-à-vis the merchant and the central bank.

¹¹ IMF Staff Discussion Note, SDN/18/08 (2018, p. 9)

¹² Auer, Raphael, Giulio Cornelli and Jon Frost (2020)

- 1) direct CBDC – a model based on the assumption that the payment system is operated by the central bank which provides retail services itself. The central bank keeps a record of all transactions and processes retail payments;
- 2) hybrid CBDC – a solution in which the central bank is responsible for the issuance and redemption of CBDC while intermediaries make retail payments. The central bank keeps the central ledger of all transactions and maintains the back-up technical infrastructure which enables activation of the backup payment system in the event of a breakdown, should intermediaries fail or in other types of emergency;
- 3) intermediated CBDC – a solution similar to the aforementioned CBDC issued in the hybrid model, i.e. with the participation of intermediaries executing retail payments, with the difference that the central bank only keeps a ledger of wholesale transactions.¹³

Figure 5 Basic CBDC issuance and distribution models



Source: Auer, R. and Böhme, R. (2020, p. 5)

In all the aforementioned models of CBDC operation, it would be possible to introduce account-based or token-based digital currency.

¹³ The report omits the model referred to by the authors as “indirect (synthetic) CBDC”, which is based on the assumption that the issuance and distribution of digital currency takes place through financial institutions. In this model, however, digital money is not the liability of the central bank, but the liability of financial intermediaries. This model was proposed by the IMF in 2019. (Adrian, Tobias and Tommaso Mancini Griffoli (2019)).

1.3. CBDC functioning in its individual issuance models

It is assumed that from the point of view of the CBDC holder, whether an individual or an economic operator, the process of executing a transaction with the use of CBDC should correspond to the use of existing cashless payment methods and should be similar both in stationary retail outlets, in e-commerce and m-commerce and, where possible, in P2P payments. It is further assumed that CBDC – as legal tender – would be guaranteed universal acceptability in retail payments.

Simplified schemes for settlement in the models under analysis (Figures 6-8) and basic information concerning the payment transaction process is presented below.

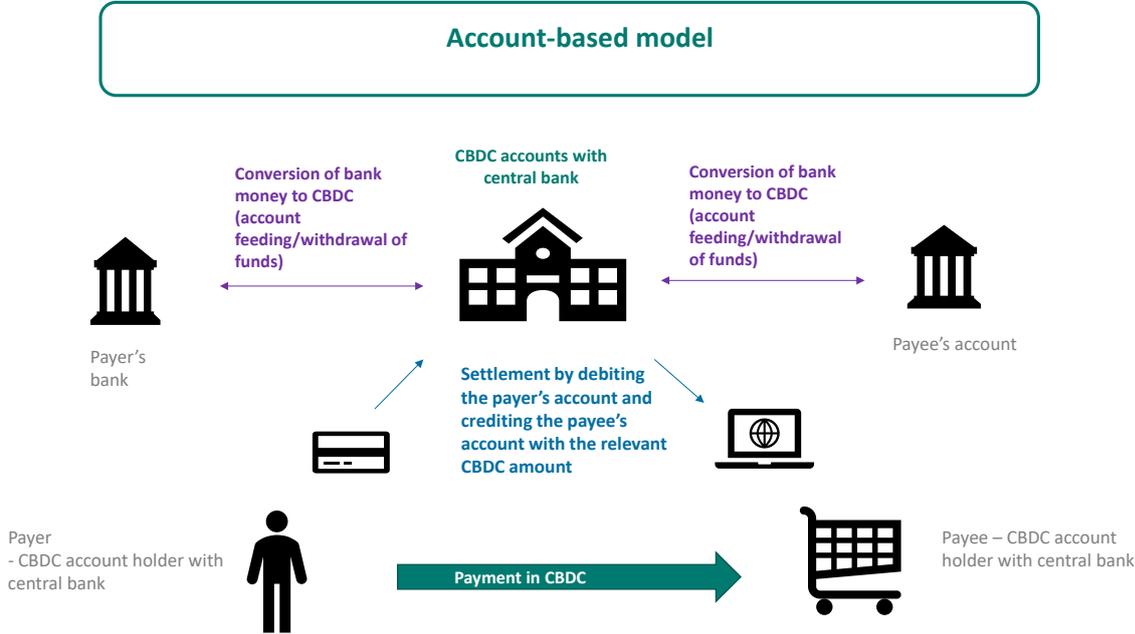
1.3.1. Model based on central bank accounts

This model assumes widespread acceptance of CBDC payments in retail transactions and thus also holding a CBDC account with the central bank by both payers and payees.¹⁴ CBDC accounts would be credited through a transfer of bank (scriptural) money from a payment account in a commercial bank to a CBDC account in the central bank. It would also be possible to de-credit this account (e.g. in connection with the payment of obligations to private entities without a CBDC account). Payments would be initiated at a payment terminal (e.g. by card or phone), in a phone application or via a website and performed in real time. Settlement of a payment made between CBDC account holders would occur in a closed system, as is currently the case for transfers between customers with accounts in the same bank, i.e. by debiting the relevant CBDC amount from the payer's account and crediting the payee's account held with the central bank.

The central bank would – on its own, or through a subsidiary or a third party – open CBDC accounts (taking into account all legal obligations, including those arising from anti-money laundering and counter-terrorist financing, consumer protection and personal data protection), provide account maintenance services, and perform statistical and reporting obligations for monetary and issuance policy purposes and for the needs of other entities (including international financial institutions).

¹⁴ In the analyses of the Central Bank of Norway, an additional distinction was introduced within the CBDC issuance model based on accounts in the central bank. Norges Bank has taken into account the closed account system discussed in this paper and the open system in which CBDC accounts in the central bank can substitute accounts in commercial banks. Bank money and CBDC may flow between accounts. The central bank opens accounts for individuals and businesses and provides related services. For the needs of clearing retail payments performed, the central bank participates directly in existing retail payment systems. (Norges Bank 2019)

Figure 6 Retail payment settlement in a model assuming operation of CBDC accounts by the central bank



Source: NBP own study

In this model, making offline payments would be possible. It should be assumed that these payments would be executed within certain limits in terms of their number and amount (for a single transaction or an aggregate amount limit for offline transactions). This solution would be particularly relevant in the event of technical problems in the payment systems or lack of Internet access (as a fall-back solution).

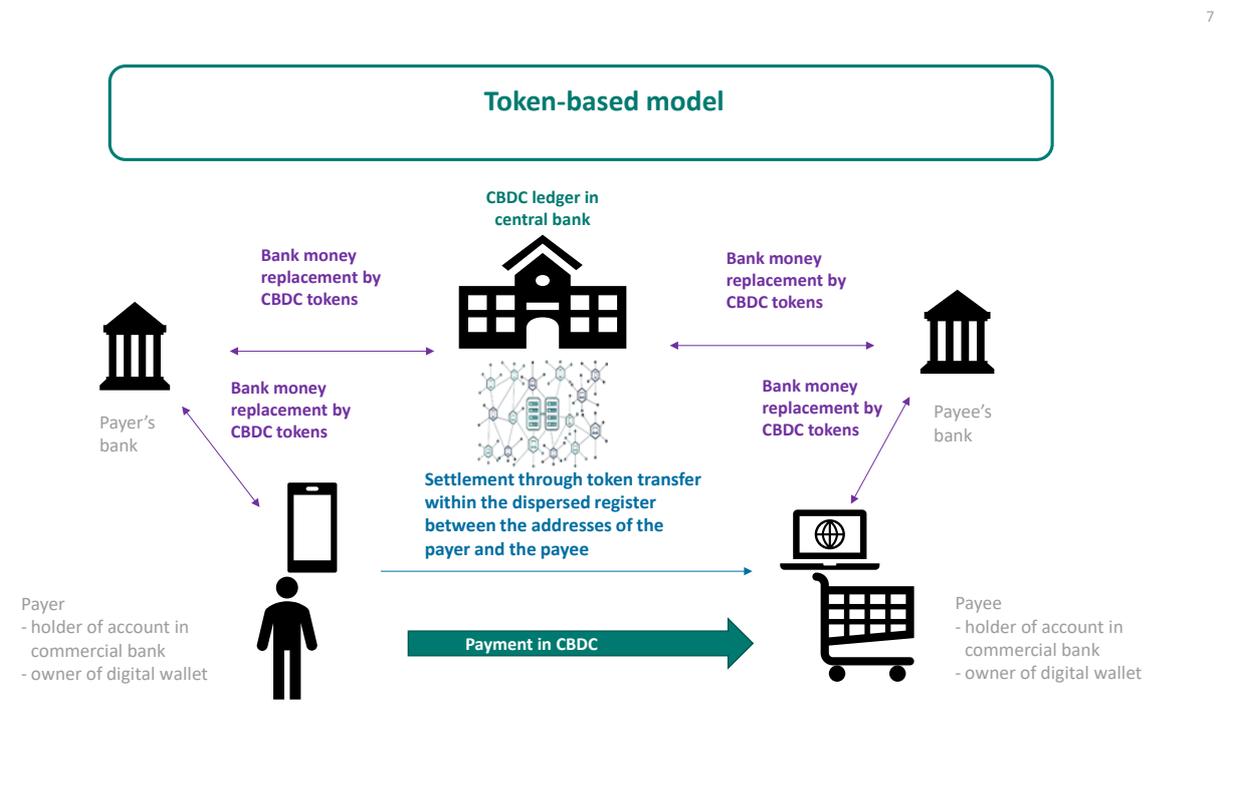
In the case of a model based on accounts in the central bank, there would be the possibility of setting interest rates and using CBDC as an instrument of the monetary policy pursued. Making an API interface available to third parties would allow an expansion of the scope of available CBDC-based payment services and possibilities. It is assumed that the central bank could offer the core range of services associated with the account, while other functionalities and various types of CBDC-based payment solutions would be built and made available by other entities providing payment services (payment service providers, including Third Party Providers).

1.3.2. Token-based model for retail payments

In the model involving the issuance of tokens as digital representations of value, it is assumed that commercial banks would act as distributors of CBDC tokens issued by the central bank. CBDC

would be issued in exchange for funds deposited in banks' accounts held with the central bank. It would be possible to manage the tokens held using the digital wallets of its holders (offline wallets, e.g. stored on desktop computers, wallets with access via a web browser or mobile wallets). Depending on the way of concluding the sales agreement, i.e. at a stationary point of sale, via a website (e-commerce), mobile application (m-commerce) or P2P, the payment would be initiated via the interface on the relevant device (enabling access to the digital wallet) and performed in real time (or close to real time). The settlement of a retail payment would be performed within a distributed ledger (it should be assumed that it would most likely be private). Tokens would be sent directly from the relevant address assigned to the payer in the distributed ledger to the dedicated address of the payee in that ledger. The entire transaction would be authenticated using public and private key cryptography. The settlement would be decentralised.

Figure 7 Retail payment settlement in a model assuming issuance of CBDC tokens by the central bank within the distributed ledger



Source: NBP own study

The central bank would have to maintain, either itself or through a supervised entity, a dedicated ledger of the issuance volume of CBDC tokens. In this system, the central bank would act as the entity which determines the “rules of the game” and implements the applicable standards. Depending on the technological solution adopted, it could also act as a validator/notary.

This system could be extended by making the source code available to third parties, which would allow the creation of various payment solutions based on CBDC dedicated to the needs of specific social groups, particular institutions or the implementation of social programmes.

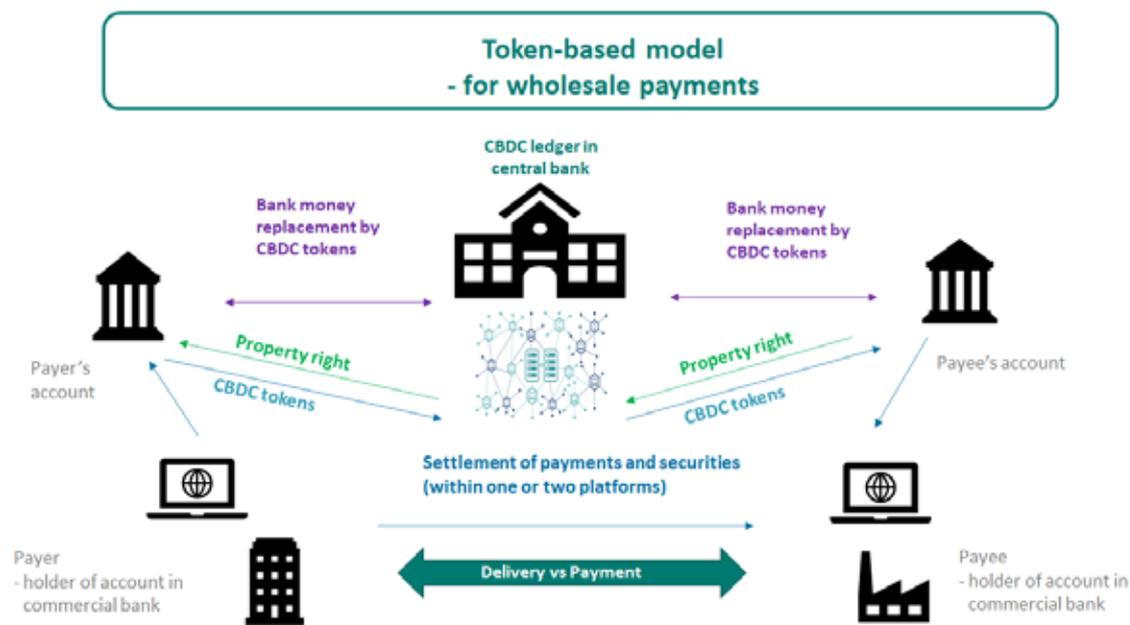
The use of tokens would also be possible in the case of the use of conventional technology enabling the digital record of values locally, i.e. using physical instruments/devices (hardware) or software. This would mean CBDC recorded locally on a prepaid card – an electronic purse (in the card’s microprocessor), on a smartphone SIM card or in a dedicated mobile application – a digital wallet.¹⁵ It is assumed that this system would be mainly dedicated – like cash – to payments made under the conditions of the physical presence of the CBDC holder and the CBDC recipient, i.e. at stationary points of sale. Payments would be initiated on the terminal (or other dedicated device) accepting CBDC or through the dedicated application on the seller’s phone. It would also be possible to make payments offline within legally defined limits (amount, quantity and time). The payment would be settled by transferring digital representations of value directly between payment instruments or CBDC storage devices of the parties involved, i.e. the payer and the payee. In the case of this type of solution, it would be possible to provide a near-anonymous version of digital currency (within legally defined limits), i.e. issued without the need to maintain legally defined customer due diligence measures. However, the loss of the payment instrument/smartphone could mean the loss of CBDC funds stored on it. In the model described, no interest rate is foreseen. For the needs of the monetary and issuance policy pursued as well as for statistical and reporting purposes, it would be necessary to collect at least the data on the volume of CBDC issued and transactions carried out with its use.

1.3.3. Token-based model for wholesale payments

In the case of the CBDC issuance model for wholesale payments, it is assumed that it can be used for interbank and securities settlement in accordance with the DvP (delivery versus payment) principle in order to reduce the time and costs of settlement execution (among others, due to the modification of the liquidity management system for the purposes of the settlement performed). This model could also be used for cross-border payments. If this CBDC issuance model were to be applied only to settlement in the interbank market, i.e. only for wholesale payment systems, according to pilot tests carried out in some countries, there would be no significant advantages of such a solution over the currently existing RTGS systems. It appears that a change in efficiency and costs could only be observed if outdated and inefficient systems are in place or if no RTGS systems are in place (when, for example, netting of payment orders is used in settlement). Therefore, pilot projects have been exploring the possibility of using CBDC tokens rather for securities settlement and for cross-border payment settlement.

¹⁵ The possibility of using a software-only token-based CBDC mobile application with the use of FLOSS (Free/Libre and Open Source Software) has been proposed by Chaum, D., Ch. Grothoff and T. Moser (2021).

Figure 8 Settlement of payments and securities in the model of issuance of CBDC tokens for wholesale payments by the central bank



Source: NBP own study

CBDC tokens would be issued in exchange for funds deposited by commercial banks in an account with the central bank. As in the previous model, the central bank would have to maintain, either itself or through a supervised entity, a special register of tokens issued. In this system, the central bank would act as the entity which determines the “rules of the game” and implements the applicable standards. It could also, depending on the technological solution adopted, act as the institution which validates transactions within the system (validator/notary).

It is envisaged that one or two different but interconnected platforms would settle payments and securities instantaneously and in accordance with the DvP (delivery vs. payment) principle. It would also be possible to introduce so-called smart contracts (mechanisms of automated execution of transactions), which would guarantee the automatic conclusion of transactions under strictly defined conditions (e.g. after reaching an acceptable price by shares). In this model, it would be possible to allow settlement in the CBDC of entities other than banks which are direct participants of existing RTGS systems.

For individuals and economic operators – parties to a retail transaction and providers of specific payment solutions – such a model would be technologically neutral, which is a frequently requested requirement indicated internationally. Payment transactions and the acquisition of securities would be carried out in the same way as before. However, a revised settlement process could lead to faster execution times for the whole transaction (including crediting the payee's account and transferring ownership of the securities to the acquirer) and lower costs (although probably only in the long-term).

1.4. Basic CBDC features

The CBDC is supposed to serve as a digital representation of central bank currency. For this reason, existing forms of central bank money should be mutually convertible (in a 1:1 ratio). Depending on the purpose to be achieved by issuing the CBDC, digital money can be designed in a number of ways. Different characteristics will be attributed to a CBDC that would be introduced in response to a decline in cash in circulation, and other features would be assigned to the CBDC introduced in order to increase the effectiveness of payment systems.

The key features of the CBDC, relevant to the development of its issuance concept, are as follows:

- **Availability:** the CBDC could be available 24 hours a day, 7 days a week, or at specified times, e.g. during the business hours of wholesale payment systems as well as offline. Its creation, issuance and redemption could take place continuously or in periods determined during the day.
- **Anonymity:** the CBDC in the form of digital tokens could be designed so as to ensure a high degree of anonymity of persons/entities and the transactions carried out therewith, along the lines of privately issued tokens (e.g. bitcoin).
- **Fund transfer mechanism:** the CBDC can be designed in such a way that the transfer of digital money takes place directly between the two parties to the transaction (P2P) or through some entity – a central bank, a commercial bank or another third party.
- **Interest rate:** it is technically possible to set an interest rate (positive or negative) both for the token-based CBDC model and the model based on the balance of an account held with the central bank. The interest rate applicable to the CBDC can be fixed at a level equal to the monetary policy reference rate or at a different level in order to increase or reduce the demand for the CBDC.
- **Limits and restrictions:** different types of restrictions on the use or holding of CBDC may be put in place (e.g. as regards the number of transactions or the amount of the CBDC held) as a means to prevent potential adverse effects on the financial system (e.g. in the event of an economic crisis) or to manage the use of the CBDC (e.g. mainly for retail payments). Fees could also be introduced to counteract adverse effects, e.g. an excessive outflow of bank deposits towards the CBDC (a fee could then be levied, e.g. on bank-to-CBDC swaps).

The following table summarises the key features of central bank currency forms – the existing forms and the form contemplated for introduction.

Table 1.1. CBDC compared to existing forms of central bank currency

Feature	Existing forms of central bank money		CBDC		
	Cash	Funds on required reserve accounts and on accounts maintained for settlement needs	Widely accessible		For wholesale payments
			Token - based	Account-based	In the form of token issuance
Continuous availability (24/7)	√	x	√	(√)	(√)
Anonymity in relation to the central bank	√	x	(√)	x	(√)
Possibility of direct fund transfer	√	x	(√)	x	(√)
Interest rate	x	(√)	(√)	(√)	(√)
Limits and restrictions	x	x	(√)	(√)	(√)

Legend: √ - existing or likely feature, (√) – applicable feature, x – non-standard or non-applicable feature

Source: BIS (2018, p. 6)

The demand for the CBDC would mainly depend on the characteristics assigned to it. It should be expected that this demand may not be very high in countries with highly developed economies, characterised by a high level of digitisation of the economy and effectively functioning payment systems.¹⁶ Although the undoubted advantage of CBDC over funds deposited in banks would be the absence of credit risk for the issuer, the CBDC (interest-free) would not have many other advantages from the point of view of the user over funds deposited in bank accounts by which payments can already be made instantly, cheaply and using convenient payment instruments (e.g. payment card or telephone) in many developed countries. If the CBDC enables low-value payments to be made anonymously, such money could be an attractive alternative to cash for some users.

The CBDC could be particularly attractive to users in economies with low banking penetration rates and settlement systems that are inefficient and unreliable and expensive for the user, in particular in conditions of no or limited access to stored value facilities.¹⁷

It is assumed that the CBDC could reduce the social costs of using cash and could increase the level of financial inclusion, provided that no infrastructural measures are put in place to improve the

¹⁶ Except in countries where it would be introduced as if as a replacement for the disappearing cash (such as in Sweden).

¹⁷ IMF Staff Discussion Note, 2018, p.15

efficiency of payments or socio-economic policy measures are taken that would achieve the same objective by other means. In addition, the CBDC could, under certain circumstances, increase security and confidence in the payment system and strengthen consumer protection; however, this would require building a secure system that simultaneously provides a choice between different forms of payment (CBDC or cash). It should be assumed, however, that in many cases the same objectives can be achieved through adequate regulatory changes and the introduction of instant payment systems without the launching the CBDC.¹⁸

1.5. Rationale for working on the CBDC concept

Motivations for potential CBDC issuance are shaped by national or regional circumstances. The key premises, as indicated in publicly available material, that have guided central banks or national governments in initiating analytical work and pilot projects related to the CBDC concept are presented below.

1) CBDC as a method to improve the efficiency of existing payment systems

Outdated technologically, often inefficient infrastructure of existing wholesale or retail payment systems in some countries, forces central banks to decide on the way forward. The main aspects that are taken into account when deciding on future action are the costs of operating the systems and the costs and time of processing payment transactions. In many cases, what is at stake is not so much an upgrade, but the creation of new systems to meet the challenges of the modern world and to ensure operational efficiency and interoperability in the longer term. Therefore, it is quite common to analyse and explore the possibility of applying DLT to payment systems (and securities settlement systems). Changes are also introduced in existing RTGS payment systems to enable interoperability of modernised systems with systems built in the DLT/blockchain technology (e.g. the United Kingdom).

For retail payment systems, central banks have been considering the possibility of improving the efficiency of payment execution in stationary points of sale, in e-commerce, and in payments made directly between the payer and the payee (P2P). When analysing the relevance of introducing CBDC for wholesale payment systems (interbank, cross-border), central banks consider, among others, the possibility of accelerating the settlement and increasing its time availability (e.g. for payments between entities from various time zones).

2) The CBDC as a way to improve the transfer of funds, especially cross-border transactions

The problem that has not been effectively addressed in the wider payment service market for many years is the cost and time of cross-border transfers and the lack of transparency with regard to the conditions under which they take place and the difficulty in ensuring the compliance with national regulations (e.g. AML/CFT). Actions are undertaken within various monetary unions and

¹⁸ Ibid. p. 20

regionally (e.g. Buna Payment Platform). Globally, however, it is not possible to introduce uniform standards on costs, execution times for fund transfers and uniform procedures for AML/CFT and for claiming rights for the execution of transactions (e.g. filing complaints). It is assumed that the issuance of the CBDC acceptable internationally or within the jurisdictions concerned could address at least some of the current problems. Efforts to ensure interoperability between CBDC systems of different jurisdictions are also seriously considered, including the introduction of common standards for such systems (e.g. ISO 20022 communication standards).

3) CBDC as a tool in the process of reducing financial exclusion

In the case of developing countries, with a limited network of accessibility to credit institutions' branches as well as a low level of banking penetration in the society and, at the same time, the widespread use of smartphones by the population, the introduction of a widely available CBDC is seen as a potential way to reduce the phenomenon of financial exclusion. These measures are often linked to a strategy to counteract other problems deeply affecting countries' economies, such as money laundering and terrorist financing, the existence of a shadow economy and corruption, which may in some situations be facilitated by the existence of cash in circulation as a means of payment that guarantees the anonymity of transactions.

4) CBDC facilitating the transformation of the digital economy

In the era of development of the Internet of Things (IoT), and in particular, of trade based on ordering goods or services and making payments directly through a device (refrigerator, coffee maker or car) with funds made available by its owner, there seems to be a real risk that manufacturers of such devices in cooperation with payment service providers may introduce dedicated payment solutions available only to a limited group of stakeholders. It also cannot be excluded that one payment service provider may monopolise the market for this type of payment. In such a situation, a desirable solution could be for the central bank to provide a form of money – a legal tender that would be universally available in a non-discriminatory manner to all those interested in using modern e-commerce channels. a CBDC enabling the performance of P2P payments would be of particular importance.

5) CBDC as a way to reduce costs of production and management of cash resources

Issuance of a widely available CBDC is considered by developing countries facing cost-related logistic difficulties in cash supply (e.g. China, India). The growing demand for cash resulting from strong economic growth, a geographically large area for cash supply and low bank penetration rates often cause the time and cost of producing, distributing, verifying banknotes and costs for authenticity or consumption to exceed the capacity of central banks.

Measures to increase the efficiency of production and management of cash resources are also embedded in the plans of central banks in developed countries. After introducing changes in

production technology, changing raw materials for the production of banknotes and coins, improving security features, modifying various logistical elements related to cash processing and switching to outsourcing in the case of, for example, cash distribution, the issuance of the CBDC is one of the options considered in this respect also in developed countries.¹⁹

6) CBDC as a new means of payment in response to the decline in importance of cash transactions

A change in payment attitudes can be observed in all markets. However, the form and intensity of this change varies between countries. In the Nordic countries, especially in Sweden and Norway, the importance of cash in retail payments has been declining significantly. This means that the availability of means of payment that was previously widely used for making payments, discharging liabilities, was free of credit risk, was autonomous from existing payment systems and was also used during economic downturns as a safe asset to store value is subject to limitations. The downgrading of cash raises questions about the smooth functioning of the economy and confidence in the existing monetary system, the maintenance of access to central bank money, the possibility of anonymity in connection with a transaction, the possibility of avoiding intermediation in making payments, the possibility of restricting access to personal data or the risk of financial exclusion of people who are not familiar with modern technological solutions. At the same time, the disappearance of cash may create risks associated with the formation of private monopolies in the payment system.

7) CBDC as a system to facilitate the direct distribution of state aid

For some countries, the Covid-19 pandemic highlighted weaknesses in the existing payment systems and social and humanitarian assistance systems. For a number of reasons it proved difficult to quickly reach specific individuals or businesses with financial aid, particularly in countries with a high share of individuals who do not use bank services. One of the reasons was the predominance of payment instruments that were inefficient under pandemic conditions (e.g. cheques). However, in the majority of cases, the lack of a digital identification/digital proof of identity system proved to be a fundamental problem. It is assumed that the CBDC system, combined with an effective system of digital identity confirmation of customers²⁰, could ensure efficient distribution of public aid funds at least in situations of higher necessity (pandemic, natural disasters).

8) CBDC as an alternative to traditional cashless payment systems

The circulation of the CBDC independently of the existing payment systems would be of particular importance in the case of the inability to use traditional payment systems, e.g. in the case of a cyber-

¹⁹ Such an option is considered in its analysis by, for example, the Bank of Canada (2016, p. 2)

²⁰ CBDC users would be screened against customer knowledge requirements (KYC and AML/CFT) at the stage of joining the scheme.

attack, problems with the payment infrastructure, system failures or a banking crisis leading to a freeze of interbank settlements. In this case, it is assumed that the CBDC would guarantee a high level of cyber-security, would be a substitute for existing electronic means of payment (for e-commerce and for wholesale P2P, C2B, B2C and B2B transfers), and would be transferred via an alternative payment system that would not be subject to the same type of technical problems (it would be the so-called fall-back option).

9) CBDC as the competition to volatile virtual currencies and the response to plans of introducing the so-called *stablecoins*

So far, virtual currencies (such as Bitcoin, Ether or XRP) have not become widespread as a means of payment, mainly due to the very high volatility of their value, as well as the relatively long payment processing times (compared to transfers in instant payment systems) and limited security of payment and storage. However, it remains to be seen whether further technological improvements, market regulation and stabilisation of the value of virtual currencies will not increase their popularity in the future. This applies, for example, to the potential introduction of special virtual currencies (stablecoins) as part of the available means of payment on platforms operated by large technology companies whose rates would be linked to the rates of stable fiat currencies, such as the euro, the US dollar, the yen or a basket of these currencies. It is worth noting, however, that if such a formula were applied, stablecoins would have to “import” stability from traditional currencies issued by credible central banks, which would automatically make them a less attractive, somehow “secondary”, asset.

Threats posed by the possibility of virtual currencies being offered on a large scale by still unregulated entities operating in one or more jurisdictions would support the need to consider the issuance of a widely available CBDC. However, it should be stressed that the issuance of the CBDC as a competitor to virtual currencies or stablecoins could entail the need for the CBDC to guarantee a high degree of transaction anonymity, with the possibility of P2P and cross-border payments. The flow of such CBDC could be difficult to trace and the scale of issuance could result in the central bank losing control over the creation of traditional money or the ability to properly analyse the effectiveness of its monetary policy and assess risks to financial stability. However, the potential risks associated with the introduction of CBDC would be clearly lower than those associated with the widespread use of virtual currencies (in particular, private global stablecoins), the functioning of which could remain completely outside the control of central banks. At the same time, it should be borne in mind that real competition for global stablecoins could only come from CBDC issued in the framework of an international initiative or from domestic CBDC with secured interoperability of systems and made available to non-residents.

10) CBDC as a response to potential CBDC issuance by another central bank

This situation may be particularly relevant in the case of CBDC issuance by a central bank whose currency plays an important role in international trade. The key issue in this case would be whether the CBDC would be available to persons and entities outside the jurisdiction concerned and could be used for international payments and at what transaction costs. Indeed, the low cost of obtaining such CBDC and executing cross-border transactions with its use could over time lead to widespread use of the CBDC in domestic payment transactions, especially in countries where the local currency has low credibility. This could pose a risk to the stability and security of national payment systems. It could also affect the effectiveness and transmission channels of monetary policy (as a new version of the phenomenon of “dollarization”²¹ of the economy).

11) The CBDC as a way to improve the effectiveness of monetary policy

The issuance of CBDC could hypothetically be relevant for monetary policy in a persistently low interest rate environment, where a constraint exists on the lowering of interest rates clearly below zero, due to the existence of a large stock of safe and non-interest-bearing assets such as cash in circulation. The replacement of an important part of the cash stock by CBDC, for which the central bank could also apply negative interest rates, could become a tool contributing to lowering of the effective lower bound on nominal interest rates. However, it should be noted that the elimination of this constraint would only be possible in the case of a virtually complete disappearance of cash. Otherwise, non-banking entities would continue to be able to convert negative interest-bearing deposits or the CBDC into cash.

In addition, it is pointed out that the introduction of the CBDC could increase the efficiency and reduce the transmission time of monetary impulses in the economy, although the transmission of monetary policy impulses by central banks to economies is already generally efficient.

12) CBDC as a response to international sanctions

An example of a country that has undertaken issuance of digital currency in response to international sanctions is Venezuela. The country has been experiencing a deep economic crisis since 2013. The introduction of international restrictive measures against Venezuela in 2017 due to the deteriorating state of democracy, rule of law and human rights meant, among others, the freezing of funds and economic resources owned or held by, in effective possession or control of natural or legal persons, entities or bodies linked to the ruling regime. The sanctions imposed result in Venezuela’s economic isolation from the outside world and a deep internal crisis. To ensure monetary circulation and stabilise the economy continuously struggling with hyperinflation, President Maduro’s government decided to introduce government-guaranteed digital currency backed by deposits of natural resources (e.g. oil, gold, iron and diamonds) in August 2018. However, the reform of the monetary system, involving the introduction of digital currency – the

²¹ A term used only in the general sense of the high role of foreign currency in domestic economic circulation, without indicating a specific currency.

Petro, pegged to a fiat currency (Bolivar Soberano²²) – did not yield the expected results in Venezuela. North Korea and Iran also announced the issuance of CBDC in response to international sanctions.

The reasons described above for the in-depth studies and pilot projects conducted by central banks and governments of different countries worldwide on the feasibility of CBDC issuance in combination with the basic CBDC issuance models under analysis are presented in Table 3.1.

Table 1.2. Premises for introducing CBDC in relation to basic issuance models

Premises	CBDC for wholesale payments	CBDC for retail payments
improving the efficiency of existing payment systems	√	√
improving the cross-border transfer of funds	√	√
increasing financial inclusion	-	√
supporting the digital transformation of the economy	-	√
reducing production and cash management costs and reducing the risk of illegal activities	-	√
new means of payment - an alternative to cash	-	√
alternative to cashless payments	-	√
direct distribution of public aid in cases of force majeure		√
competition for virtual currencies and potential introduction of <i>stablecoins</i>	-	√
response to CBDC issuance by another central bank	-	√
improving the efficiency of monetary policy	-	√
response to the current difficult economic situation and the economic sanctions imposed	-	√

Source: NBP own study

1.6. Desired features of the CBDC payment system and technologies considered

The payment system built for the needs of issuance of publicly available CBDC should display the following features²³:

²² In this case, international sanctions were intended to lead to the abandonment of support for terrorist organisations, the withdrawal of military aid to the regime in Syria, and the abandonment of its nuclear programme and ballistic missile development.

²³ Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors Federal Reserve System, Bank for International Settlements (2020)

- **versatility** – the system should enable the use of different types of solutions currently used by consumers to make payments in all channels of customer interaction (in stationary points of sale, e-commerce or P2P payments) such as smartphones, prepaid cards, proximity (provided by NFC technology) or QR codes,
- **high security and resilience** – both the infrastructure of the system and its participants should be highly resistant to cyber-attacks; the system should ensure business continuity under conditions of operational errors, technical problems, blackouts or natural disasters. To this end, cryptographic techniques, principles of information access/data protection management or back-up data centres (in centralised systems) should be used,
- **speed of settlement** – the system should provide immediate (real-time or near real-time) settlement of payments,
- **high performance and scalability** – the system should be capable of processing a very large number of transactions; the system should be able to expand further taking into account the potential for future large volumes in use,
- **interoperability** – in order to ensure a smooth flow of funds, the system should have appropriate mechanisms for interaction with private payment systems or payment schemes (platforms enabling building of business models by third parties using API communication interfaces as well as the use of data communication standards – ISO 20022),
- **flexibility and adaptability** – the system should be able to adapt to changing economic (e.g. dominance of micropayments, development of automated payments within the “Internet of Things”), legal or technological (including cryptographic techniques) conditions.

In the case of widely accessible CBDC, issued for the purpose of retail payments, analytical work and pilot projects are carried out using the existing technology, assuming the role of the central bank in the CBDC system (in issuance, settlement, record keeping and redemption) as well as taking into account the use of DLT/blockchain technology, in which the basic principle is the organisational decentralisation of processes.²⁴ In the work on the issuance of such a type of CBDC, the possibility of using permissioned DLT is most often examined, i.e. implying the need to obtain permission to participate in the system and the existence of a single entity (a central bank or a narrow bank subordinate to it) or a limited number (usually several) of entities approving transactions and holding an up-to-date record of all transactions. Given the existence of a trusted entity (central bank), the desired efficiency of the system (high speed and low cost of transaction execution) and the reputational/operational risks involved in running a payment system, the use of public blockchains, at this stage, is purely hypothetical.²⁵

In order to make the CBDC available for retail payments by persons who do not use banking services, socially excluded, living in areas remote from payment infrastructure, or those who particularly appreciate privacy, solutions using tokenization and the ability to locally store a digital

²⁴ More information on the analytical and design work carried out is included in Chapter 3.

²⁵ An additional argument against the use of public blockchains is the high energy intensity of the proof-of-work consensus algorithm used by the most popular networks.

value on an instrument or device, such as a prepaid card or mobile applications are being considered. These would be available by omitting standard procedures or the application of simplified Know Your Customer (KYC) procedures. Such a solution makes offline payments possible, i.e. without access to the Internet or the need to connect to a central ledger. However, bearing in mind the need to prevent money laundering and terrorist financing, the amounts of payments performed using these solutions should not be high.

It should be stressed that in the case of publicly available CBDC, the technological solution is the result of decisions taken concerning the purpose of issuing the CBDC, the specific characteristics assigned to digital currency and the assumptions made about the future development of the project (e.g. in terms of cross-border use). It can be assumed that the use of DLT will be desirable under the circumstances of a country where there is no trusted third party (e.g. a central bank, such as in the Marshall Islands²⁶) or problems related to compliance with the law exist.²⁷ Key decisions on the use of specific technological solutions will be driven by the relative priorities assigned to issues such as: (i) the extent of privacy of transacting parties and the ability to combat illegal activity, (ii) the security of the system (cyber security as well as other aspects) and the resilience of the system to disruptions in operation, (iii) interoperability with other systems, (iv) the range of CBDC users, (v) the provision of advanced features such as programmability of digital currency, (vi) the performance of the system, (vii) the cost of operating the system.²⁸

In the case of CBDC issuance for wholesale payments, i.e. performed on the interbank market in the settlement of payments and securities and in cross-border payments, the possibility of using DLT is mainly being explored, due to its three main features: the possibility to conclude transactions directly by the stakeholders (without the involvement of a trusted third party), public key cryptography (guaranteeing the verification of digital identity and the confidentiality of information) as well as the consensus mechanism (necessary to authenticate data and ensure their immutability, including counteracting the problem of double spending). It is important to highlight the existence of various technological solutions that are built under pilot projects, including those related to CBDC issuance as well as the continuous development that takes place in this field. For example, tests concerning the potential introduction of CBDC in the form of token issuance used, among others, the following DLT platforms: Ethereum, Corda (belonging to the R3 consortium), Hyperledger Fabric, Quorum (created by ConsenSys), Azure Blockchain (built by Microsoft) and Stellar. Each platform offers different types of solutions for issues such as transaction validation. Their capabilities are also different with regard to issues such as access to information (confidentiality), scalability and flexibility, and the estimated cost-effectiveness in its use in the execution and settlement of transactions based on the DvP (delivery versus payment) and PVP (especially cross-border payment versus payment) principles.

²⁶ Chaum, D., Ch. Grothoff and T. Moser (2021).

²⁷ Casterns A. (2021).

²⁸ See for example Bank of Canada, European Central Bank, Bank of Japan, Sveriges Riksbank, Swiss National Bank, Bank of England, Board of Governors Federal Reserve System, Bank for International Settlements (2020)

At this stage, there is no clear indication of the suitability of any particular technological solution. Even before choosing a specific technology, one should consider, among others, the question related to the preferred way of acquiring it. One of the options is to use software supplied and managed by a specific company, while another is to use open source software (modification of existing solutions or development of new software). The advantages of the latter solution include, above all, the lack of dependence of the system on a commercial entity (or entities) and the transparency of system operation for all its users (the central bank, financial institutions, entrepreneurs, the public).²⁹

²⁹ The advantages of freely licensed software are described by Chaum, D., Ch. Grothoff and T. Moser (2021).

2. Implications of CBDC issuance

Central banks conducting analyses concerning CBDC issuance present various arguments that could justify the introduction of the digital currency. The focus is on issues that create a fundamental problem for their economies.

On the one hand, for example, the possibility of mitigating negative phenomena for the functioning of the economy as a whole, such as financial exclusion, is mentioned. On the other hand, the possibility of reducing unlawful activities, such as pursuing entirely or partly unregistered economic activities that avoid taxation, the occurrence of corruption, theft, and money laundering and terrorist financing which can be counteracted by increasing the share of non-anonymous and traceable cashless transactions in the economy, is also highlighted.

On the other hand, it is indicated that CBDC issuance may counteract the decreasing importance of central bank money in economic transactions. This refers especially to economies where the share of cash in retail payments is significantly decreasing (e.g. Sweden, Norway). In the case of these countries, the issuance of a new form of central bank money, an asset which is safe because it is free of credit risk, may serve to maintain confidence in the monetary system and the banking system of the state as well as to reduce risks to the payment system associated with the concentration of payment services among private operators.

Below, the most important issues of concern relating to the activity of the central bank in the context of CBDC issuance are signalled. This information has been prepared on the basis of an analysis of the available surveys of other central banks, international financial institutions and research centres. The conclusions presented in the analysed studies in relation to the potential effects of the introduction of the central bank digital currency are not always unambiguous. Most often they result from the specific nature of the economies of particular countries. The material presents only summary information of an introductory nature, concerning the potential effects of issuing mainly widely accessible CBDC. It should be borne in mind that the potential effects of the introduction of CBDC may significantly differ depending on the choice of a specific variant of CBDC issuance and the features assigned to it.

2.1. Impact on the banking system and financial stability

One of the most important aspects concerning the concept of issuing widely accessible CBDC is the potential impact on the functioning of the banking system and on financial stability.³⁰ It should be

³⁰ It is assumed that in the case of CBDC issuance for high-value payments (in the domestic interbank and cross-border markets), the impact on banks' activities and financial stability will not be large, given the current access of banks to central bank money. However, the possible increase in competition, should non-banks also have access to such CBDC, should be highlighted (Bank of Israel 2018).

assumed that the implications of CBDC issuance will depend on the issuance model and the basic characteristics of the CBDC, which could determine the stronger competitive position of the CBDC compared to bank deposits or cash. It seems that these implications will largely depend on the potential interest rate of CBDC, the scope of anonymity attributed to its holders and the transactions carried out with its use, as well as on whether the CBDC will be issued in a model based on accounts held with the central bank, in which the involvement of traditional financial institutions in the process of distributing digital currency and performing transactions with its use would be in fact impossible. In addition, the existence of potential limits on the amount (such solutions are considered by Sveriges Riksbank in the context of e-krona and by the ECB in relation to the digital euro) or fees for CBDC (e.g. fees for conversion into bank money) should not be disregarded.

The impact of widely accessible CBDC on the stability of the financial system can be best described by analysing the behaviour of market participants under usual market conditions and in a crisis situation characterised by a general decline in confidence in the banking sector. Under usual market conditions, the central bank digital currency will be a substitute for bank deposits rather than cash for its holders. If it is non-interest bearing, the CBDC will mainly be used as a means of payment and will serve as an alternative to payment services provided, among others, by banks using cashless payment instruments to access bank (scriptural) money.

If interest rates are set for the CBDC, digital money will compete with interest-bearing commercial bank deposits (and to a lesser extent, other methods of saving). It will therefore affect the size and cost of the deposit base in the banking sector, which is the main source of cheap and stable funds for financing banking activities. Under such circumstances, the issuance of interest-bearing CBDC could lead to an increase in the cost of raising funds for commercial banks. In order to maintain an adequate volume of deposits, banks would have to raise deposit rates to make them more attractive relative to CBDC,³¹ or increase the scale of funding raised in the wholesale market (in practice, mainly through debt issuance). This would either result in an increase in lending rates to maintain the current net interest margin, or in an increase in exposure to higher-yielding and thus higher-risk assets (this trend could, however, be mitigated by the need to increase the portfolio of securities that could serve as collateral for repo transactions in the wholesale market or in the central bank liquidity operations) or in a significant reduction of banks' profits and, consequently, marked reduction in lending.

The introduction of widely accessible interest-bearing CBDC could also lead to significant changes in liquidity and activity in the interbank money market. Interest-bearing central bank digital currency as a fully liquid and reliable asset would be an alternative to investing funds in short-term debt securities and reverse repo operations. Available analyses indicate the possibility of an

³¹ This situation may pose a greater challenge for commercial banks that finance themselves largely with household deposits, which are already often exposed to competition from lending companies. IMF (2018).

increase in short-term interest rates, which could in turn lead to an increase in funding costs for banks and other entities (e.g. the Treasury).³²

The widespread use of CBDC, especially if issued under a model that does not involve traditional financial sector institutions, and at attractive interest rates relative to bank deposits, could result in a structural change in the financial intermediation model by increasing the central bank's participation and simultaneously reducing the existing role of commercial banks. Should banks be unable to raise market funding to replace the deposits that flowed to the CBDC, they would have to acquire funding from the central bank. The collateral for such funding would be the assets held by the banks, i.e. mainly loans granted to the private sector. Consequently, there would be a transfer of credit risk to the central bank, potentially creating the risk of loss. Thus, there would be incentives for the central bank to intervene in the credit process. In the case of such a scenario, the central bank would be more responsible than now for the efficient allocation of money and credit in the economy. This would, in fact, mean a change in the formerly functioning two-tier model of the banking system, where the central bank is the bank of banks (lender of last resort) and does not conduct competitive activities with respect to entities in the banking sector.

Competition from CBDC for bank deposits would be particularly dangerous in periods of crisis, characterised by reduced public confidence in the banking sector. The CBDC would be free of credit risk and would be a safe way to store value (its interest rate would be of secondary importance). Furthermore, CBDC would be much more attractive than cash due to the speed of the transaction and the convenience of storage. In the event of a decline in confidence in an individual bank, these factors would significantly limit the time for public authorities to take appropriate action (e.g. the provision of appropriate liquidity support by the central bank to a distressed credit institution). The ease in which bank deposits can be converted into CBDC could also increase the risk of a widespread loss of confidence in banks (systemic bank run). In such a situation, a massive conversion of bank deposits into central bank digital currency would pose a significant risk to financial stability. In an extreme situation, this conversion, despite the central bank feeding operations, could pose a threat to the functioning of individual banks or even the entire traditional banking system.

The uncontrolled flow of funds to the central bank could be prevented by establishing limits on the amount of transactions carried out or on the balance of CBDC accounts for individuals and economic operators, respectively³³ as well as by limiting the possibility of converting bank deposits into CBDC or imposing a fee on this account. The use of CBDC as a stable investment could be

³² This issue is addressed, among others by the BIS (2018), Norges Bank (2018), Danmarks Nationalbank (2017) and Sveriges Riksbank (2018).

³³ The analyses so far on the digital euro assume the possibility of introducing, for example, an absolute limit on transactions; payments exceeding such a limit would be automatically rejected. If a maximum amount of balances is set, automatic transfers of surpluses from CBDC wallets to a traditional bank account could be introduced. A report on the digital euro is available at: https://www.ecb.europa.eu/pub/pdf/other/Report_on_a_digital_euro~4d7268b458.en.pdf

prevented by establishing diversified interest rates. For individuals who would use CBDC as a means of payment, the interest rate on the funds collected would be 0% as for cash up to a maximum amount³⁴ and could be negative above this amount.³⁵

2.2. Impact on monetary policy

In the discussion on the issuance of digital money by central banks, the absence of a uniform model for the introduction of new solutions, and therefore the difficulty in assessing the impact of their implementation, is raised. The effectiveness of the solution adopted by a given central bank may be determined by the following parameters: the issuance model (account-based vs. value-based), the scope of availability of CBDC (for non-financial entities and the general public), the degree of anonymity of CBDC, interest rates, the specific time of performing the settlement and introduction of individual quantitative limits.

Central banks working on the CBDC generally communicate that the rationale for this work is not driven by issues related to the conduct of monetary policy.³⁶ It is assumed that the introduction of CBDC would not change the way central banks conduct monetary policy, including the use of open market operations by central banks. The issuance of CBDC would rather mean the provision of a new form of central bank money.³⁷

The CBDC would probably not interfere with the freedom of choosing the method of monetary policy implementation (e.g. through the purchase of securities or credit and deposit operations with banks), nor would it normally affect the maturity, liquidity and credit risk of assets held by central banks. However, serious challenges could arise in the situation of financial market stress, resulting in a considerable increase in demand for CBDC, resulting in a flow of funds from commercial banks to CBDC accounts in the central bank. Some available analyses suggest that in such a case, considerable central bank intervention and lending to commercial banks of potentially significant magnitude would probably be required. This would not exclude the need to extend the collateral available to enable commercial banks to access central bank lending, thereby increasing the risk in the central bank's balance sheet (if it materialised, the central bank could suffer financial losses).³⁸

Some studies present the position that CBDC could become an additional tool of the central bank's monetary policy, which could – under certain conditions concerning the availability of CBDC, interest rates and demand – increase the effectiveness of the transmission of monetary impulses to

³⁴ For the digital euro, an amount of €3000 is proposed, i.e. higher than the amount of cash most citizens currently hold and above the average monthly salary in most euro area countries. Panetta, F. (2021)

³⁵ Bindseil, U. (2020)

³⁶ Bank of Canada et al. (2020)

³⁷ BIS (2018)

³⁸ BIS (2017), BIS (2018), Juks, R. (2020)

the economy. The central bank, due to the absence of complete anonymity of digital money, unlike cash, could monitor the holdings of CBDC and the directions of its flow.³⁹ Some studies suggest that access to central bank liabilities in the form of CBDC for the general public could further enhance the transmission of interest rate impulses to the money and credit markets, although already, in general, changes in central bank interest rates are effectively transmitted to deposit and lending rates in the banking sector. Indeed, the central bank could directly shape the interest rate on some household funds (those collected in the form of CBDC).⁴⁰ The implications for monetary policy would be greater, the greater the attractiveness of the CBDC as a store of value, but for this to happen, the central bank would have to incur higher costs (if the interest rate on the CBDC were above zero), which would adversely affect the central bank's financial result. On the other hand, the greater the attractiveness of the CBDC, the greater the risks to financial stability described in the previous section (2.1 *Impact on the banking system and financial stability*).

From the point of view of the possibility of using CBDC as a new monetary policy instrument, its difference in relation to cash, i.e. the possibility to set a negative interest rate, is highlighted. In a sustained low interest rate environment, a widely accessible and potentially negative interest-bearing CBDC could contribute to lowering the effective floor for nominal interest rates. However, it should be stressed that CBDC issuance in itself (i.e. unless it involves an explicit reduction in the role of cash in the economy) may not affect the level of the effective lower bound for nominal interest rates.

The issuance of the CBDC in a given jurisdiction, especially by a country with a strong position in the global market, assuming interoperability of the CBDC system with other payment systems, may have implications for the functioning of other countries' economies, limiting the autonomy of their monetary policies. Simulations indicate that the existence of the CBDC (an internationally liquid asset) may lead to greater volatility in capital flows between countries and, through this, increase the volatility of exchange rates and market interest rates, which may pose challenges to the monetary policy pursued. It is also worth noting that even if a jurisdiction does not introduce CBDC, under the conditions of widespread cross-border use of other CBDC, its economy may become more vulnerable to international spillovers⁴¹, which may trigger capital outflow from the domestic market towards foreign CBDC. The magnitude of these shocks would depend on the specific characteristics of the CBDC abroad (including, for example, the presence of transaction limits for non-residents or negative interest rates on funds held in CBDC by tourists and other non-residents in excess of a certain amount) or the credibility of the domestic currency.

³⁹ Bank of Canada (2016)

⁴⁰ Nuño, G. (2018)

⁴¹ Ferrari, M. M., A. Mehl and L. Stracca (2020)

2.3. Impact on the payment system

The impact of the introduction of CBDC on the functioning of the payment system may vary, above all, depending on the degree of development of the payment system in a particular country and on the characteristics assigned to the CBDC itself. When assessing the impact of CBDC, it is important to bear in mind the role of the state in the monetary system and the statutory obligation of the central bank to issue banknotes and coins, which are generally the legal tender in the territory of the particular state. Under the conditions of progressive digitisation of the economy, the introduction of CBDC may not only meet the consumer demand but, above all, represent the way to ensure common access to safe and risk-free central bank money. The CBDC would thus enable central bank money to retain its role as a public benefit. This is particularly true in countries experiencing a decline in the importance of cash and a strong and sustained reduction in the share of cash in retail transactions (such as Sweden).⁴² CBDC could also be a safe alternative to stablecoins (such as Diem), which are planned to be introduced by private entities and which, for example, under the conditions of limited access to non-cash payment instruments or market stress, could theoretically become a widely used means of payment for online payments.

The introduction by a central bank of money that represents a digital reflection of cash, which has characteristics such as widespread acceptability in retail transactions, widespread availability, ease of use, low or even zero cost of acquisition and use, almost complete anonymity of transactions and no interest rate, under normal economic conditions can complement cash resources and act as an alternative payment instrument for use in cashless transactions, such as those performed online or P2P. Under the conditions of market stress, on the other hand, it can compete with cash in terms of its precautionary function. Depending on the existence of interest rates, balance limits, maximum transaction amounts and other restrictions, it can also be expected to compete with cash as a means of hoarding. This phenomenon may be more widespread and thus more relevant in countries with a declining share of cash in retail transactions or with logistic problems related to the production and distribution of cash or with high cash handling costs. It will furthermore be relevant in emergency situations, such as pandemics or natural disasters.

In the case of countries with underdeveloped payment systems or highly concentrated systems, with a prevailing role of one entity or a small group of entities – payment service providers or payment infrastructures, which generate significant market entry barriers – the introduction of CBDC may lead to increased market competition.⁴³ As a consequence, the efficiency of the market of payment services may increase. This may be manifested by extending the catalogue of electronic payment instruments, increasing their availability (also for persons who do not use banking services and socially excluded individuals), reducing transaction costs, and speeding up the time of payment execution, among others, due to the introduction of instant payments (e.g. by the CBDC

⁴² Armelius H., G. Guibourg, A.T. Levin and G. Söderberg (2020)

⁴³ Bergman M. (2020)

itself). CBDC issuance may also be a driving force for increased innovation in payment systems. Providing an open system code or communication interface (API) to the CBDC platform may encourage banks, other payment service providers, or FinTech entities to create innovative payment solutions based on CBDC.

As a competitor to privately offered products (e.g. cheaper, faster, safer payment instrument), the CBDC, unless properly designed, may lead to reduced demand for, or even the displacement of existing cashless payment instruments. It may also reduce the demand for clearing and transaction processing services. If the interoperability of the CBDC system with other payment systems is ensured, including with other CBDC systems, the scale of this process may go beyond the boundaries of a single jurisdiction. In particular, this may be the case for the use of cashless payment instruments in cross-border e-commerce or for cross-border remittances.⁴⁴ As a result of the CBDC issuance in many countries worldwide, a decrease in the cost and execution time of cross-border transfers may occur.

It should be stressed, however, that there is also a possibility of occurrence of potentially adverse phenomena linked to the cross-border use of CBDC, in particular the digital representation of currencies that are most relevant to international trade, such as the US dollar or the euro. The reason this is that in the case of economically unstable developing countries (experiencing high inflation and exchange rate instability), countries with limited trust in public institutions or countries with strong links to the euro area or the US economy, the substitution of local currencies by more stable digital currencies of other countries (e.g. the US dollar or the euro) may occur.

The introduction of CBDC in a system built in a technology different than the technology used so far (e.g. DLT/blockchain), independent from the existing payment systems and payment infrastructure, may lead to an increase in the resilience of the entire payment system to hacking attacks, network failures or other technical problems. The construction of a new system, including the possibility of making offline payments (limited in terms of time and amount), may lead to the establishment of a fall-back solution alternative to cash.⁴⁵

In the case of the introduction of CBDC for wholesale payments, an increase in the efficiency of the functioning of the systems should be expected, in particular due to the link between payment and securities settlement systems. In this case, the main benefit could arise from the use of programmability and automation (smart contracts) in transactions, especially on a cross-border basis under DvP (delivery vs. payment) and PvP (payment vs. payment) rules, for which atomic

⁴⁴ Panetta, F. (2021)

⁴⁵ Sveriges Riksbank (2018)

swaps⁴⁶ could be used. Potential benefits could include transaction times, costs (including those related to liquidity management) and simplification of the settlement process itself.

2.4. Impact on the central bank balance sheet and profit and loss account

Like cash, widely accessible CBDC would be a liability of the central bank. A simplified central bank balance sheet, taking into account the issuance of the CBDC, is shown in Table 2.1.

Table 2.1. Simplified central bank balance sheet

Assets	Liabilities
Receivables from banks	Cash in circulation
Other receivables	CBDC
Other assets	Liabilities to banks
	(reserve requirements, current account balances and term deposits)
	Other liabilities
	Funds and reserves
	Other liabilities

Source: based on Iwańczuk-Kaliska, Anna, 2014 p. 266

Irrespective of the issuance model, i.e. based on accounts with the central bank or based on digital recording of value, CBDC would be recorded on the liabilities side of the central bank’s balance sheet. In the account-based model, any conversion of bank (scriptural) money into CBDC (e.g. as a result of an individual/economic entity renouncing a bank deposit to acquire the CBDC) would require the bank to transfer funds from its current account in the central bank to the CBDC account held for the individual/entity by the central bank.⁴⁷ This would result in a change in the liability structure of the central bank’s balance sheet, with the balance sheet total remaining unchanged. In a situation of significant deposit outflows and inability to obtain market funding, a commercial bank would have to borrow funds from the central bank.⁴⁸ This, in turn, would result in the central bank’s balance sheet total increasing: on the liability side, the amount of liabilities due to CBDC issuance would increase, while on the asset side, receivables from banks (due to credit extended) would increase. The magnitude of this change would depend on the existence or otherwise of limits

⁴⁶ An *atomic swap* is a transaction in which two different tokens are simultaneously transferred in opposite directions between the parties to the transaction. The transaction is validated as a single entity. For tokens representing money or securities, such a transaction ensures that the PvP/DvP principle is met.

⁴⁷ Norges Bank (2018)

⁴⁸ Liquidity-supplying central bank operations could be an alternative solution.

on the amount of CBDC held on the account with the central bank.⁴⁹ In the case of CBDC tokens recorded on a payment instrument/device, the situation would be similar due to the fact that each purchase and recording of CBDC on the instrument/device would be performed with the use of bank (scriptural) money, i.e. by decreasing the amount of funds in the account with the commercial bank.⁵⁰

If the CBDC issued were primarily an attractive alternative to cash for users, the changes in the central bank's balance sheet would consist primarily of a change in the liability structure (i.e. an increase in the value of the CBDC and a decrease in the value of cash in circulation), with the balance sheet total remaining unchanged.

The CBDC issuance would have an impact on the central bank's profit and loss account. At the same time, the scale of the changes would depend on the model of widely accessible CBDC chosen, the real demand for digital money and the impact of CBDC issuance on the demand for cash. Therefore, at this stage, it is not possible to estimate the exact magnitude of changes in the individual items of the profit and loss account. However, on the basis of available analyses it is possible to make an attempt and determine their direction.⁵¹ It should be assumed that the issuance of digital currency which would be available to the general public, could contribute to a decrease in the volume of demand for cash (but not to its withdrawal, as cash should be widely accepted and available as a basic and equal means of payment). In the event of a significant reduction in the stock of cash in circulation, there could be a decrease in the costs of issuing and handling cash. However, this does not mean that simultaneously a decline in the central bank's total cost of issuing money (both digital and cash) would occur.

The issuance of widely accessible CBDC may also have an impact on the size of seigniorage. Available studies indicate⁵² that in the conditions of observed demographic changes and the related payment attitudes as well as a decline in the importance of cash transactions, the introduction of widely available CBDC could translate into an increase or at least maintenance of the size of revenues from seigniorage. The scale of any change will depend on the model of CBDC (interest-bearing or not) and the size of the total demand for publicly available central bank money, i.e. both CBDC and cash. The payment attitudes of individuals and economic operators, in

⁴⁹ The existence of quota limits would have a direct importance for the volume of bank money flowing into the central bank. However, it would also influence the volume of loans granted to commercial banks as well as the quality of securities accepted by the central bank as a collateral for these loans. Such a situation could generate an additional source of risk for the central bank.

⁵⁰ However, it is not excluded that the demand for CBDC could be financed by cash. In such a situation, there would be a change in the liability structure (a decrease in cash liabilities and an increase in CBDC liabilities) without affecting the level of the balance sheet total.

⁵¹ Bank of Israel (2018)

⁵² Danmarks Nationalbank (2017), Gustafsson, P. and Lagerwall B. (2020).

particular their openness to switching to innovative payment solutions based on bank money, e-money or the issuance of stablecoins, will be important in this regard.

A decision taken by the central bank to issue CBDC would result in additional costs of a one-off nature, related to the construction of a new system for CBDC payments and recurring costs resulting from its maintenance. Such scope of financing would apply if the CBDC was introduced in a model based on digital recording of value on a payment instrument/device where CBDC accounts and all services related to their servicing would be ceded to commercial banks. However, in the case of the introduction of a widely accessible CBDC in a model based on accounts maintained by the central bank, the variable costs of operating the CBDC payment clearing and settlement system would also be added to the costs of building and operating the accounts, including: customer verification while maintaining the customer due diligence measures (to prevent money laundering and terrorist financing), personal data protection, consumer protection, collection of statistical and reporting data, and provision of access to accounts for so-called third parties (TPPs). The issuance of CBDC will also result in increased IT investment, including in particular in the area of cyber security.

Notwithstanding the foregoing, as indicated in Section 2.1 *Impact on the banking system and financial stability*, the potential outflow of deposits from the banking sector following the introduction of CBDC and the resulting need for the central bank to refinance banks (against a collateral), would potentially create a risk of financial losses for the central bank. Moreover, under the circumstances of market stress or crisis, the outflow of deposits to CBDC would most likely increase significantly, requiring the central bank to increase its refinancing volume considerably at a time when the counterparty credit risk is rising strongly and the value of the collateral may become questionable.⁵³

It must be stressed that the issuance of widely accessible CBDC would have an impact on the organisation of central bank operations. The introduction of an additional form of central bank money would entail changes in the organisational structure, in the scope of analyses and research conducted in the central bank, as well as in the scope of statistical data collected.

It is worth noting that the above information signalling the impact of CBDC issuance on various areas of central bank activity assumes the availability of CBDC to individuals and businesses resident or doing business in the country. When the CBDC is made available to non-residents, the impact assessment becomes respectively more difficult. This is because it involves, among others, cross-border capital flows and the verification of customers residing or doing business in another

⁵³ In such a situation, the central bank does not have a good choice – either it will restrict refinancing and lead to losses or even bankruptcy in the banking system, or it will itself accept high losses (or at least the risk of incurring them), or it will restrict access to the CBDC, undermining confidence in the monetary system and potentially intensifying risk perception and perhaps even triggering panic. In this way, the introduction of CBDC raises the risk of pro-cyclical crisis propagation.

country in order to fulfil the obligations related to counteracting money laundering and combating terrorist financing.

2.5. Legal issues related to CBDC issuance

The issuance of digital currency by the central bank entails a number of legal implications that cannot be fully anticipated at this stage of the analytical work. Based on the available analyses, only some of them are highlighted below.⁵⁴ It should be emphasised that the choice of the CBDC issuance model for the implementation of a specific objective will be of key importance in this regard because it will determine the future powers and obligations not only for the central bank but also for the entire financial market, including the users of the new form of money.

Within their basic tasks, central banks perform the function of a bank of issue and a bank of banks. The issuing activity of central banks is legally regulated with regard to banknotes and coins. However, it seems necessary to examine also the formal and legal possibility of issuing publicly available digital currency by the central bank. In the case of the introduction of CBDC tokens (e.g. stored on a payment instrument/device) as e-money, an in-depth legal analysis will be required of the possibility of its issuance on the basis of existing regulations in this respect (EMDII⁵⁵). It should be assumed that the issuance of CBDC based on accounts held by individuals and businesses with the central bank would in turn require the creation of a new legal basis.

One of the important aspects raised in the context of the issuance of digital currency by central banks is the possibility of assigning the status of legal tender to the CBDC, with the general power to redeem monetary obligations.⁵⁶ Putting this into practice would require amendments to existing legislation in order to legally guarantee the universality of acceptance in making settlements of both cash and CBDC.

Another legal aspect that central banks pay attention to in the context of a potential decision to issue the CBDC are issues related to anti-money laundering and terrorist financing. In order for central banks to mitigate reputational and operational risks, it would also be important to regulate issues related to the prevention of fraudulent transactions. It should be assumed that the implementation of CBDC issuance in the model based on accounts maintained by the central bank may have significantly greater legal consequences than the issuance of digital currency in a model that includes the intermediation of commercial banks in access to CBDC by individuals and economic operators.

⁵⁴ Norges Bank (2018), Norges Bank (2019), Danmarks Nationalbank (2017), Sveriges Riksbank (2017), Sveriges Riksbank (2018)

⁵⁵ Directive 2009/110/EC of the European Parliament and of the Council of 16 September 2009 on the taking up, pursuit and prudential supervision of the business of electronic money institutions amending Directives 2005/60/EC and 2006/48/EC and repealing Directive 2000/46/EC (OJ L 267, 10.10.2009, as amended)

⁵⁶ Bossu, W., M. Itatani, C. Margulis, A. Rossi, H. Weenink and A. Yoshinaga (2020)

It should be assumed that the issuance of the CBDC in a central bank account-based model, in particular a widely accessible CBDC, would require the introduction of an appropriate legal basis for the opening and maintenance of accounts for individuals and businesses by the central bank (or another entity established for this purpose and supervised by the central bank). However, it is not clear at this stage whether, for example, the provisions of the PSD2 would apply to these accounts.⁵⁷ Recognition of the central bank as a payment service provider in connection with the issuance of CBDC would lead, among others, to the need of fulfilment of information obligations, application of complaint procedures, or providing access to the accounts to third parties (TPPs). In addition, the central bank would have to comply with the relevant requirements regarding the secure processing and storage of personal data. Ensuring the security of personal data could be more challenging for the central bank in a situation where the CBDC is issued under an account-based model, which would provide for the outsourcing of competences to a supervised entity (e.g. an institution set up for this task) for opening accounts and providing various services within the accounts. In view of potential reputational risks, it might be necessary to legally guarantee the security of payment solutions that would be created by payment service providers based on CBDC.

It should be noted that the issuance of CBDC would furthermore require a corresponding modification of the existing settlement finality rules. The issue of settlement finality in CBDC-based systems is relevant in relation to so-called designated systems to which the settlement finality rules apply. It would become more relevant if transfers were possible between accounts holding bank money and central bank digital currency accounts, and the central bank, as the operator of these accounts, were a participant in “standard” payment systems.

2.6. Social aspects of CBDC introduction

Significant benefits stemming from the introduction of CBDC may be gained by consumers, with the attractiveness of CBDC to consumers depending to a large extent on how it would be designed, including the technology on which it would be based (and the resulting security of funds storage and transactions), functionality, cost, limits on funds storage and maximum transaction value, interest rate, scale of anonymity, etc. With the proper CBDC design, consumers could gain access to an alternative form of central bank money that meets the challenges of the digital economy while being secure, credit risk-free, cheap, easy to use and more widely available than bank (scriptural) money, also for people who do not use banking services, people with various disabilities, socially excluded people (immigrants, homeless) or people living in remote, sparsely populated areas (as long as they have the physical possibility to access the solution (smartphone, Internet access)). Importantly, with the right design of the CBDC system, digital currency could also prove attractive

⁵⁷ Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC, 2013/36/EU and Regulation (EU) No 1093/2010 and repealing Directive 2007/64/EC.

to people who use cash for privacy reasons, fearing the use of their personal and transaction data for marketing/commercial purposes by private entities.

The introduction of the CBDC for retail payments, due to social aspects, such as reducing financial exclusion and providing access to central bank money in the face of declining cash use and difficult access to cash, presents various challenges. The issuance of the CBDC as a tool in the process of reducing financial exclusion is more relevant in developing countries⁵⁸ or countries where access to financial services is more difficult due to natural conditions (island countries like the Bahamas or Jamaica, countries with a very large territory like China or Canada). When designing the solutions of the future CBDC, among others, the following reasons of financial exclusion will have to be taken into account:

- lack of motivation (willingness, perceived benefits) to use banking infrastructure,
- insufficient accessibility of existing financial infrastructure,
- social exclusion (e.g. lack of work, lack of income) and digital exclusion (lack of internet access or digital literacy).

The success of the issue will depend on the design of the CBDC in such a way that the users will see the benefits of using the new system, will have the physical possibility of accessing it regardless of their wealth (smartphone, Internet access), affluence (no fees for using the system and carrying out transactions) or place of residence (universal accessibility from anywhere, at any time, universal acceptability in transactions), and are able to use it as easily as they currently use cash, even in the absence of identity documents (which is quite common in developing countries). The issuance of CBDC must guarantee maximum security in the execution of transactions and ensure full convertibility of CBDC into cash. It can be expected that the acceptance of CBDC distributed by payment service providers will also depend on the speed (or even instant nature) and convenience of the transaction, as well as linkage to already existing financial systems and services. The use of data on user preferences⁵⁹ while designing future digital currency solutions by a public trust institution, such as the central bank, should increase user confidence in the new solution and influence its easier adoption.

Another social aspect related to the CBDC issuance will be the need to prepare the public to accept the new payment instrument by implementing an appropriate communication strategy. The need for intensive educational activities is emphasised, among others, by the only country that is at the stage of introducing digital currency – the Bahamas.⁶⁰ It should be noted that the educational and

⁵⁸ Where the percentage of people using banking infrastructure is the lowest: [World's Most Unbanked Countries 2021 | Global Finance Magazine \(gfmag.com\)](#)

⁵⁹ According to the 2020 survey of 13 countries around the world, the most important features a payment instrument should meet are to provide “security against fraud and theft” and “privacy protection”. This was followed by features such as “ease of use” and “universal acceptability”. Official Monetary and Financial Institutions Forum (2020), *Digital currencies: A question of trust*, p. 13.

⁶⁰ According to information published on the official website of the project: [Public Update - The Bahamas Digital Currency Rollout \(sanddollar.bs\)](#)

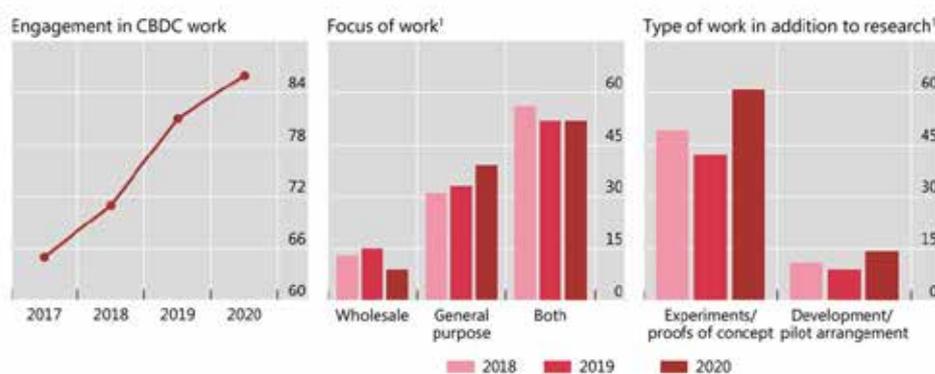
popularisation element must also be adapted to the purpose of introducing CBDC in a given country and its main potential recipients. A different communication strategy needs to be prepared when trying to reach non-users of financial services (including, in particular, people with primary education or no education or some of the elderly who may feel the lack of digital literacy) and a different one for those proficient in using modern infrastructure who generally include people with secondary and higher education as well as younger people who have been using digital technologies throughout their lives.

3. Analytical, research and pilot work related to CBDC issuance worldwide

3.1. Status of work related to CBDC introduction

The BIS survey⁶¹ on central banks’ engagement in analytical and research work related to CBDC issuance indicates that at the end of 2020, 86% of the 65 central banks surveyed worldwide were in the process of conducting work on the concept of CBDC issuance (80% in 2019). Within this group, half of the central banks were exploring the introduction of CBDC for both retail and wholesale payments, 40% were analysing publicly available CBDC only and 9% – CBDC for wholesale payments only.

Chart 3.1. Involvement of central banks in work on CBDC issuance



¹ Share of respondents conducting work on CBDC.
Source: BIS central bank survey on CBDCs.

Source: Boar, C. and A. Wehrli (2021)

More than 60% of central banks (compared to less than 40% in 2019) have moved from theoretical analysis to the experimental or proof-of-concept development stage for the application of a new

⁶¹ Boar, C. and A. Wehrli (2021)

technology, which is in most cases the distributed ledger technology (DLT). Only 14% of central banks have decided to take the next step, i.e. to start pilot testing. However, this does not prejudice a central bank's decision to issue CBDC. So far, only the central bank of the Bahamas started implementing CBDC for retail payments on 20 October 2020. 60% of central banks surveyed do not expect to issue CBDC in the foreseeable future. The possibility of introducing a widely accessible CBDC in the next 3 years was declared by only a few banks; however, they represent 1/5 of the world's population. Among the central banks surveyed, 20% declared the possibility of issuing CBDC in the medium term (within 6 years). In the case of CBDC for wholesale payments, the possible introduction of this form of central bank money was considered by the banks concerned mainly in the medium term.

As at the end of March 2021, the level of progress in the issuance of the publicly available CBDC carried out in the countries⁶² for which NBP has verified the reliability of the information, can be assessed as follows:

- 1) Stage 1 – conducting analyses of implications (legal, economic) of issuing digital currency and exploring potential technological opportunities – euro area countries and 20 other countries (Australia, Brazil, the Czech Republic, Denmark, Eswatini, India, Indonesia, Iceland, Israel, Japan, Canada, Malaysia, Mauritius, Norway, New Zealand, Poland, Russia, the United States, Switzerland and the United Kingdom),
- 2) Phase 2 - development of assumptions for a prototype system – 2 countries (Jamaica and the Marshall Islands),
- 3) Phase 3 – pilot testing – 7 countries (China, Philippines, South Korea, Sweden, Turkey, Ukraine, Uruguay),
- 4) Phase 4 – implementation of the production version of the CBDC system – 4 countries (2 unsuccessful – Ecuador and Venezuela and currently under implementation – Bahamas and the Organisation of Eastern Caribbean States).

Media reports indicate that at least 15 more countries are working on the CBDC issuance concept for retail payments, namely [Bahrain](#), [Chile](#), [Curaçao and St. Maarten](#), [Egypt](#), [Ghana](#), [Haiti](#), [Kazakhstan](#), [Kenya](#), [Lebanon](#), [Madagascar](#), [Morocco](#), [Pakistan](#), [South Africa](#), [Rwanda](#) and [Trinidad and Tobago](#). However, the current status of work on these projects is unknown. No reliable information is available (e.g. on central bank websites).

In the case of CBDC for wholesale payments, the central banks publishing on-going work in this area have not progressed beyond the research and testing stage. This includes Saudi Arabia in cooperation with the United Arab Emirates, Australia, France, Hong Kong in cooperation with Thailand, Canada, South Africa, Singapore, and the euro area in cooperation with Japan and Switzerland.

⁶² The euro area is treated as a single entity.

Detailed information in the above scope is provided in the tables in the Appendix.

3.2. Examples of actions related to the introduction of CBDC for retail payments

The results of the analytical and pilot central bank work of the Bahamas, China and Sweden on publicly available CBDC are presented below. These projects were selected by NBP due to the progress of the work, the results achieved to date and the availability of information on the status of the project. Given the strong economic links and the potential for direct effects of issuing widely accessible CBDC in the euro area, the basic assumptions of the digital euro and the European Central Bank's action plan for the near future with regard to its possible issuance in the euro area are also presented.

3.2.1. Commonwealth of the Bahamas

The Sand Dollar issued by the Central Bank of the Bahamas is recognised as the first permanent implementation of central bank digital currency in the world. The nationwide CBDC implementation process was launched on 20 October 2020.⁶³ Earlier, in 2019, the Central Bank of the Bahamas decided to select a technology partner for the introduction of central bank digital currency and conducted a pilot study on the islands of Exuma and Abaco. The Central Bank of the Bahamas decided to accelerate the implementation of digital currency across the country, among others, due to the impact of the Covid-19 pandemic.⁶⁴ The introduction of CBDC is intended as a response to the limited availability of electronic payment infrastructure and banking services for many residents, so primarily to increase financial inclusion.⁶⁵ It is assumed that the system should reduce the cost of providing payment services, increase transaction efficiency and improve the overall level of financial inclusion.

The Sand Dollar digital currency is exchanged at a ratio of 1:1 for the traditional Bahamian dollar, whose exchange rate is fixed against the US dollar. Concluding transactions using CBDC between individuals (P2P) or businesses, including offline, is performed through a mobile application. Six financial institutions have been approved to operate CBDC accounts: Cash N 'Go, Kanoo, MobileAssist, MoneyMaxx, Omni Financial and SunCash. Prior to the launch of the pilot phase on Exuma Island, the central bank verified each institution to ensure that it had stringent standards in place in the areas of cyber security, risk management and consumer data protection. Currently, only the aforementioned institutions allow 393,000 islanders to register with the Sand Dollar

⁶³ The official website for the Sand Dollar project provides basic information on the Bahamian Payments Systems Modernisation Initiative, of which the introduction of the CBDC is a component. The page outlines the following: the entities involved in the project; the basic assumptions regarding the purpose of the CBDC issue; the security issues of the system, including the strong customer authentication measures established, and the detailed terms and conditions of access to the CBDC for individuals and businesses. Link to official site: <https://www.sanddollar.bs/>

⁶⁴Based on information of 23 November 2020, *The world's first retail CBDC tiptoes into existence*, available at: <https://www.centralbanking.com/fintech/cbdc/7713961/the-worlds-first-retail-cbdc-tiptoes-into-existence>

⁶⁵ The Bahamas is a country consisting of approximately 700 islands. On many of them, especially the less populated ones, access to banking services and ATMs is limited.

system and obtain a digital wallet (a dedicated smartphone application). However, the central bank envisages including other commercial banks, cooperative credit unions and some government agencies in the system, at a later stage of the project and after a verification process. Each authorised institution can introduce users to the digital wallet platforms; each institution is also responsible for conducting a customer knowledge check (KYC). Sand Dollar's implementation process is staggered in order to include as many users as possible. In the context of a national deployment, only a sufficiently large critical mass will allow each CBDC scenario and use case to be tested. The central bank allocated the first three months after the launch of CBDC implementation to assess the direction of the system evolution in the future. The central bank has also been closely monitoring the number of transactions taking place as well as the number of users, in order to understand what types of transactions take place in the CBDC. Some users use digital currency for everyday transactions, while others use it only for P2P transfers. The application provided on IOS and Android phones uses QR codes to carry out payment transactions. It is assumed that fees will only be charged for additional innovative services offered from the user interface by payment service providers. Users will also have the option of using a smart card with embedded QR functions instead of a smart device.

There are three types of digital wallets at Sand Dollar: basic, standard and advanced. The basic wallet allows users to hold funds equivalent to a maximum of USD 500 and includes a monthly spending limit equivalent to USD 1,500. Customers who access this type of wallet are not subject to KYC criteria and are only asked to provide their name, phone number and email address, similar to what is required when withdrawing high amounts of cash from a bank.

The standard digital wallet option, where the central bank expects to generate the highest number of users, requires consumers to confirm their identity. Customer verification will allow current bank accounts to be linked to Sand Dollar wallets and funds to be moved seamlessly between them. Limits also apply in this case. Consumers can hold funds worth up to USD 5,000 within the digital wallet at each time and incur expenditure of up to USD 10,000 per month.

Advanced wallets, on the other hand, are reserved exclusively for companies and individuals with high transaction needs. Consumers who wish to use such wallets are required to submit additional documentation and undergo due diligence checks to justify setting higher transaction and balance limits. In addition, to allow for higher value transactions, advanced digital wallets will need to be linked to deposit accounts held by national financial institutions where any excess CBDC can be deposited.

Currently, the role of the central bank is to oversee the system and capture cases of fraudulent transactions or other types of illegal and unauthorised activities. The central bank also keeps a close eye on the possible consequences of the system for monetary policy and financial stability. To mitigate some of the risks, limits on specific types of digital wallets and real-time monitoring of

transaction volumes have been introduced. Currently, the Sand Dollar can only be used within the borders of the Bahamas, but the central bank plans to create an international payment network in the future that would make the Sand Dollar convertible into other digital currencies. However, this will only be possible if central banks start issuing their own CBDC and accepting other central banks' CBDC.

The first quarter of 2021 is designated for the integration of digital currency into financial institutions' digital wallet platforms.⁶⁶ All authorised wallet providers are expected to offer interoperable Sand Dollar services. The execution of transactions in the CBDC between parties will take place through any digital wallet. For some payment providers, a two-step product implementation plan has been adopted, i.e. ensuring CBDC availability within their own network and then ensuring interoperability with third-party wallets. The Central Bank of the Bahamas recommends that such cross-platform interoperability should be ensured in the first months of 2021.

Public consultation is held from February to March 2021 on Proposed Legislation for the Regulation of the provision and use of Central Bank issued Bahamian Dollars as well as for proposed amendments to the Payment Systems Act and to the Computer Misuse Act.⁶⁷

On 17 February 2021, a collaboration between Mastercard, the Central Bank of the Bahamas and Island Pay made available a prepaid card that enables payments for purchased goods and services wherever Mastercard cards are accepted on the islands and worldwide.⁶⁸ Payments are made in traditional currency as a result of the instant conversion of the Sand Dollar digital currency into Bahamian dollars.

In 2021, the central bank also intends to intensify its educational activities on digital financial services. The campaign will be accelerated in the first quarter of 2021 with the inclusion of interoperable access to CBDC on mobile wallet platforms.

3.2.2. China

The People's Bank of China started its analytical work on digital currency in 2014. In 2016, the Digital Currency Research Institute of the People's Bank of China became the first official institution in the world to engage in research and development of central bank digital currency. In

⁶⁶ Based on information available at:

<https://www.sanddollar.bs/publicupdates/public-update-the-bahamas-digital-currency-rollout>

⁶⁷ The official information on the public consultation launched is published at:

<https://www.centralbankbahamas.com/viewPDF/documents/2021-02-15-11-24-12-Central-Bank-Electronic-Bahamian-Dollars-Regulations-2021.pdf>

⁶⁸ The official announcement on the matter has been published at:

<https://www.mastercard.com/news/press/2021/february/mastercard-and-island-pay-launch-world-s-first-central-bank-digital-currency-linked-card/d-and-IslandPayLaunchWorld'sFirst-Central-Bank-Digital-Currency-Linked-Card>

2017, the State Council confirmed the competence of the People's Bank of China to conduct work on the development of the digital renminbi (digital yuan, e-yuan, e-RNB, e-CNY), also with the participation of commercial institutions.⁶⁹ In the same year, the Digital Currency/Electronic Payments (DC/EP) research project was established. Tests of the digital yuan have been conducted since April 2020. The digital yuan may be in general circulation as early as 2022.⁷⁰

Information on the project is drawn from a small number of official communications (e.g. speeches by Chinese delegates at international fora) and mostly from unofficial communications (e.g. information from test users). Precise data on the state of progress of works or technological specifications of the adopted solutions are not officially published.

According to official information⁷¹, the main objectives of the introduction of CBDC are as follows:

1. defending the sovereignty of the Chinese currency and the stability of the payment system against the emergence of bitcoin, stablecoins and other crypto-assets;
2. increasing the presence of central bank money in circulation: China is already an almost cashless society, and in 2018, 83% of transactions were conducted via mobile payments (only 17% were card or cash transactions);⁷²
3. counteracting the dominance of two commercial mobile payment systems in China, Alipay and WeChat Pay, to enable commercial banks' involvement in the market of payment services and to create a back-up system that could be used in the event of any future disruption due to financial or technical difficulties in the operation of the above private sector entities. A disruption or failure of one of two dominant systems could potentially disrupt the entire payment system in China;
4. reducing the costs and inconvenience of issuing and distributing coins and banknotes in a country with such a large territory and population;
5. financial inclusion of those unable to use commercial mobile payments (the digital yuan will also be available to persons without electronic devices such as a smartphone);
6. maintaining the anonymity of payments to private mobile payment operators;
7. improving the security and efficiency of the payment system and ensuring that offline and low-value payments can be made;
8. prevention of crime and fraud, corruption, money laundering, terrorist financing;
9. possibility of transferring funds (e.g. subsidies) directly to citizens.

⁶⁹Based on information of 8 June 2020, available at

<https://finance.sina.com.cn/blockchain/roll/2020-06-08/doc-iirczymk5806799.shtml>

⁷⁰Based on information available at

<https://www.atlanticcouncil.org/blogs/econographics/the-rise-of-central-bank-digital-currencies/>

⁷¹Based on information of 8 June 2020 posted on the website of the Central Commission for Discipline Inspection

<https://finance.sina.com.cn/blockchain/roll/2020-06-08/doc-iirczymk5806799.shtml>

⁷²Based on information of 22 February 2021, <https://daxueconsulting.com/payment-methods-in-china/>

Other arguments mentioned in press reports and studies concerning the DC/EP project:

1. creation of an international payment system which allows to bypass global players such as SWIFT and others linked to the US sphere of influence and frees China from the domination of the US dollar;
2. ability to bypass sanctions imposed by other countries by transferring digital currency abroad without going through a US dollar-based international payment system such as SWIFT;
3. increasing China's sphere of political and economic influence by strengthening the potential for the use of the yuan in international transactions as well as reducing the cost of such transactions;
4. acquisition of data influencing cash circulation and hoarding, the implementation of monetary policy, macroeconomic surveillance and activities related to analysing the stability of the state financial system;
5. ability to trace the flow of all payments in the country – both for purposes of improving, for example, the lending economy and for surveillance of the population;⁷³
6. possibility of conducting unconventional monetary policy, such as the introduction of negative interest rates.⁷⁴

Central bank digital currency will be a digital form of legal tender issued by the People's Bank of China (renminbi) and forming a part of its liabilities.⁷⁵ It is intended to replace cash in circulation rather than bank deposits. It will be a widely accessible digital currency of the central bank, dedicated to retail payments. On 23 October 2020, the People's Bank of China published a draft law to provide the legal basis for a sovereign digital currency. The draft law assigns the same legal status to the digital yuan as to the physical yuan.⁷⁶

The DC/EP shall operate in a two-tier system based on centralised issuance and dispersed distribution.⁷⁷ The first tier of the system will be the People's Bank of China, which will issue and distribute the digital yuan to second-tier institutions in exchange for transferred money or deposits with the central bank. Such a system is intended to ensure that competition can exist and various payment instruments can be developed, adapted to the needs of the Chinese people. In

⁷³Items 1-5 based on ASPI publication, *The flipside of China's central bank digital currency*, publication available at <https://www.aspi.org.au/index.php/report/flipside-chinas-central-bank-digital-currency>.

⁷⁴Based on information of 7 December 2020, available at: <https://www.china-briefing.com/news/chinas-digital-yuan-status-roll-out-impact-businesses/>.

⁷⁵Based on information available at: <https://finance.sina.com.cn/blockchain/roll/2020-06-08/doc-iirczymk5806799.shtml>. A slightly different assumption regarding the basis for issuing digital currency is presented in an article of 13 December 2020, available at: http://www.cf40.com/en/news_detail/11481.html.

⁷⁶Based on information of 7 December 2020, available at <https://www.china-briefing.com/news/chinas-digital-yuan-status-roll-out-impact-businesses/>.

⁷⁷Information based on the article "Understanding China's Digital Currency" of 13 December 2021, available at http://www.cf40.com/en/news_detail/11481.html.

technological terms, the digital yuan system will be hybrid, based on token issuance (token based), accounts (account based) and digital currency sub-accounts (semi-account based).⁷⁸

The People's Bank of China as the first-tier institution has the following responsibilities:

- to ensure the stability of the system, e.g. by imposing reserve capital requirements on participating second-tier institutions;
- to build and maintain the infrastructure enabling settlement of system participants;
- to promote the interoperability of individual payment instruments in order to maximise their usefulness for the public;
- to prepare action plans in case of breakdowns, malfunctions or the need to update the system.

Second tier institutions of the DC/EP system can include commercial banks, telecommunication companies or mobile payment platforms that provide access to digital currency to the public. Entities acting as distributors must meet the following assumptions:

- hold sufficient capital to mitigate operational risk;
- comply with the Know Your Customer (KYC) principles;
- ensure the protection of transaction data;
- invest in technology and equipment that will ensure the secure functioning of their payment instruments.

The use of digital currency is to be voluntary, at least for individual consumers. However, economic operators will be required to accept the digital yuan as a means of payment.⁷⁹

The assumption of the DC/EP system is controlled anonymity. The digital yuan is linked to the banking system but does not require a bank account (which will make it possible, for example, for tourists to use it). It allows limited anonymous payments, with legitimate transactions for small amounts. For payments of larger amounts, identification is required to set up a digital yuan account. The account can be linked directly to a person, but digital wallets can also be linked to a phone number or, for example, a car licence plate, which of course indirectly links them to the owner.⁸⁰ It is intended that the information about the people conducting the transactions will not be available to commercial operators of the system (banks and other payment operators); however, all this information will be available and collected by the People's Bank of China.

⁷⁸ Based on a speech by Changchun Mu, Director of the Digital Currency Research Institute of the People's Bank of China, at the BIS Innovation Summit, delivered on 25 March 2021.

⁷⁹ Based on information of June 2020, available at: <https://www.ledgerinsights.com/china-digital-currency-head-market-adoption/>.

⁸⁰ Based on information of June 2020, available at: <https://www.ledgerinsights.com/china-digital-currency-head-market-adoption/>.

The practical aspects of the public use of digital currency can be inferred from the tests conducted.⁸¹ The main method of using the digital yuan is a mobile application for payments and transfers using various payment methods: QR codes, barcodes, or facial recognition, and comparable methods to Alipay and WeChat Pay applications dominating the market. During the tests, users, after registering their phone number, could use the application to top up their digital yuan accounts and withdraw money (using ATMs), make payments (in online shops as well as stationary shops using NFC technology, including offline). A feature called sub-wallet allows users to create a sub-account within the digital yuan application for use on e-commerce platforms (it ensures anonymity with the operators of these platforms). Contactless electronic purses (which resemble a traditional payment card, with an embedded screen that allows users to view the card balance and a record of payments made) and wearable devices (e.g. watches, bracelets, gloves, ID badges) were also used for payments.⁸²

The leading centre of the work on the DC/EP system is the Digital Currency Research Institute of the People's Bank of China. In addition, at least three stakeholder groups are involved in the work:

1. second-tier institutions in the DC/EP system: state-controlled commercial banks: Agricultural Bank of China, Bank of China, Bank of Communications, China Construction Bank, Industrial and Commercial Bank of China and Postal Savings Bank of China⁸³, telecommunications companies: China Mobile, China Telecom, China Unicom and payment system operators: Alipay (Ant Group) and WeChat Pay (Tencent);⁸⁴
2. local authorities, so far in the following cities, among others: Shenzhen, Suzhou, Xiong'an, Beijing, Chengdu and localities associated with hosting the 2022 Olympic Games,
3. selected entrepreneurs, both Chinese, e.g. Didi Chuxing (passenger transport company), Meituan Dianping (service and goods provider), Bilibili (streaming platform), JD.com (one of the largest e-commerce shops), and international, e.g. McDonald's, Starbucks, Subway.⁸⁵

For China, the international aspect of digital currency operation is important.⁸⁶ In October 2020, at the Sibos conference, Fan Yi Fei, the deputy governor of the People's Bank of China, expressed the view that central banks should form an "alliance" of digital currencies whose issuance could be

⁸¹ Based on a press release of 19 October 2020 available at: <https://cointelegraph.com/news/95-of-winners-in-china-s-cbdc-lottery-spent-digital-yuan-prizes> and of 7 December 2020 available at <https://www.china-briefing.com/news/chinas-digital-yuan-status-roll-out-impact-businesses/>

⁸² Based on information of 8 January 2021 available at: <https://www.nfcw.com/2021/01/08/369942/pboc-pilots-contactless-cards-and-wearables-that-let-consumers-make-payments-with-chinas-digital-currency/>.

⁸³ Based on information of 14 December 2020 <https://www.centralbanking.com/fintech/cbdc/7723266/chinas-digital-yuan-kicks-off-test-on-e-commerce-platforms>.

⁸⁴ Information based on the article "Understanding China's Digital Currency" of 13 December 2021, available at http://www.cf40.com/en/news_detail/11481.html

⁸⁵ Based on information of 7 December 2020, available at <https://www.china-briefing.com/news/chinas-digital-yuan-status-roll-out-impact-businesses/>.

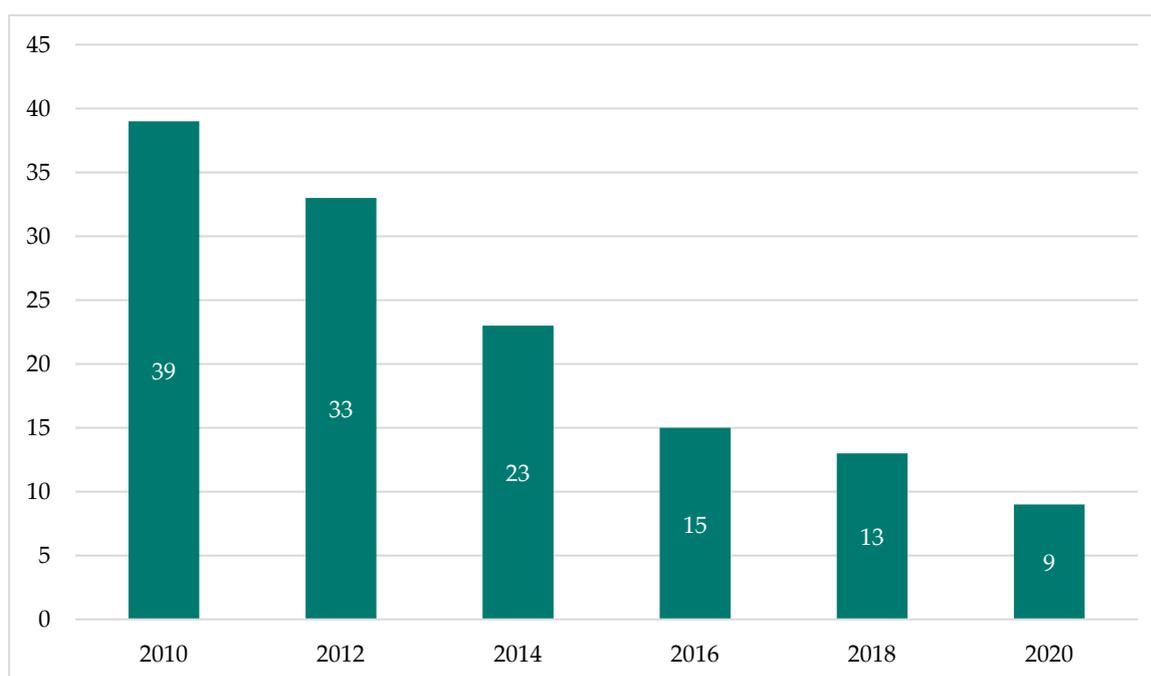
⁸⁶ The People's Bank of China has also joined the Multiple CBDC (m-CBDC) Bridge initiative led by the BIS Innovation Hub together with the central banks of Hong Kong and Thailand. This project aims to develop a proof-of-concept system for real-time cross-border foreign exchange payments using DLT.

based on common standards⁸⁷ to ensure their interoperability. An alliance of CBDC issuers would have to assume compliance with regulations in different jurisdictions and full compliance with international standards, such as the Financial Market Infrastructure (PFMI) rules.

3.2.3. Sweden

Since March 2017, the central bank of Sweden (Sveriges Riksbank) has been implementing a project to explore the possibility of issuing money to the general public that is a digital reflection of legal tender (referred to as “e-krona”). Digital currency would be issued to supplement available cash resources. In Sweden, a particularly strong and steady decline in the volume of cash in circulation has been recorded. According to Sveriges Riksbank data, the share of people who paid cash for their most recent purchases dropped from 39% in 2010 to 9% in 2020, while when asked about payment instruments used in the last 30 days, 92% of Swedes indicated payment cards, 75% Swish payments,⁸⁸ 50% cash and 8% other mobile payments.

Chart 3.2 Percentage of individuals in Sweden who pay in cash for their shopping



Source: Sveriges Riksbank, 2020⁸⁹

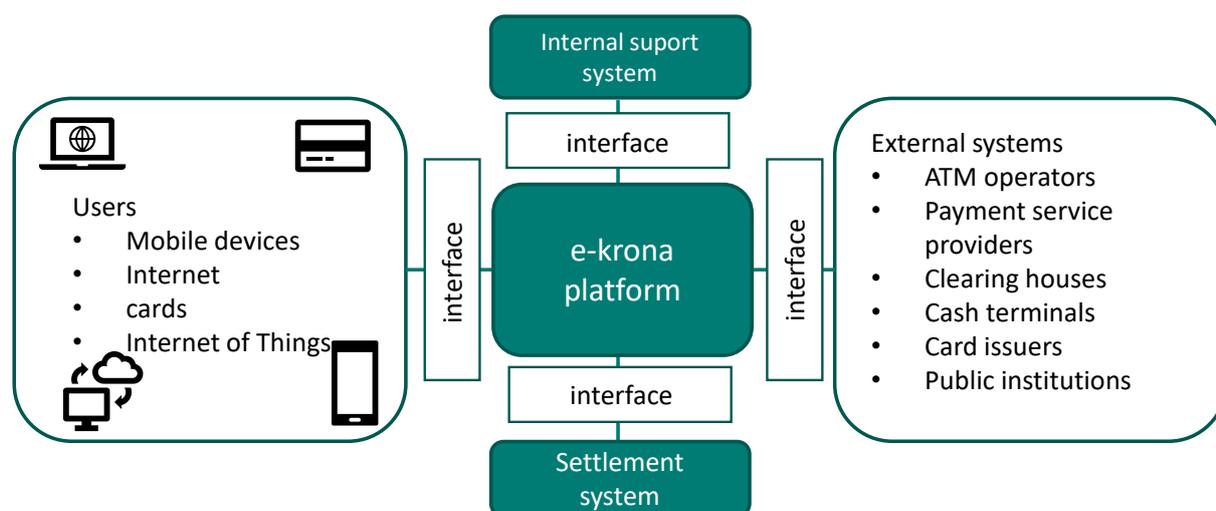
⁸⁷ Based on press release of 6 October 2020, *People’s Bank of China deputy governor: Digital, not crypto currency*, available at: <https://www.paymenteye.com/2020/10/06/peoples-bank-of-china-deputy-governor-digital-not-crypto-currency/>

⁸⁸ Swish – a Swedish mobile payment system launched in 2012 by six large commercial banks, Bankgirot and Sveriges Riksbank.

⁸⁹ Based on information of 29 October 2020 available at: <https://www.riksbank.se/en-gb/payments--cash/payments-in-sweden/payments-in-sweden-2020/1.-the-payment-market-is-being-digitalised/cash-is-losing-ground/>

In view of Swedes’ growing interest in electronic payments and the high costs of obtaining and withdrawing cash in commercial and service activities, private sector operators increasingly restrict consumers’ access to central bank money and refuse to accept banknotes and coins in retail transactions.⁹⁰ To a growing extent, only payment instruments issued and controlled by private entities are accepted. In the opinion of the Sveriges Riksbank, the lack of an alternative offer from the central bank may lead to a decrease in competition in the highly concentrated market for payment services, limited operation of payment systems to a few major international operators (also from the BigTech area), financial exclusion of certain social groups, weaken the stability of the payment system (also in terms of cross-border payments), and consequently also reduce confidence in the Swedish monetary system. The analytical work on the e-krona project has been undertaken by the Riksbank in view of the legal obligation of the central bank to provide cash, and also in light of the statutory task of maintaining price stability and promoting a secure and efficient payment system in the developing digital economy.⁹¹ In April 2019, the Vice President of Sveriges Riksbank, Cecilia Skingsley, estimated the chances of introducing e-krona in the next 10 years at more than 50%.⁹²

Figure 9 Simplified diagram of the e-krona system



Source: Sveriges Riksbank (2018, p. 18)

⁹⁰ Research conducted in 2017 by Sveriges Riksbank shows that 50% of retailers believe that by 2025 at the latest, they will stop accepting cash for payment processing in retail transactions due to costs.

⁹¹ The results of the research work and plans for further stages of the e-krona project are continuously published on the Sveriges Riksbank website. The most important results are available at: <https://www.riksbank.se/en-gb/payments--cash/e-krona/>

⁹² Press release on this topic available at: <https://news.bitcoin.com/central-bank-digital-currencies-take-center-stage-at-imf-spring-meetings/>

The assumptions for the e-krona issuance, developed in 2017-2018⁹³, are as follows:

- the purpose of introducing the e-krona is not to replace cash or any other payment solution, but to supplement the stock of cash in circulation;
- the e-krona would be a direct liability of the central bank, available to the public where cash is not widely accepted;
- the e-krona would function as a means of payment and a store of value;
- the e-krona would be used for payments by consumers, companies and public institutions, but would not be used for wholesale payments and would not be a monetary policy instrument;
- the e-krona would be used to make payments both on a stationary basis, at points of sale, and remotely (e.g. in e-commerce) at a relatively low cost;
- the e-krona would be electronically accessible 24/7/365, and for small retail payments, also offline;
- the e-krona would not be interest bearing but should have a built-in feature that would technically enable the introduction of an interest rate;
- the central bank will be responsible for issuance, redemption and settlement of the e-krona;
- the e-krona will be used to transfer funds directly between the payer and the payee (P2P) in real time (settlement will be immediate);
- the e-krona should be convenient and fast (almost intuitive), taking into account adapting to specific needs (e.g. the elderly or visually impaired persons);
- contact with e-krona users will be carried out entirely or partly through private or public agents authorised to act as intermediaries in payments but Sveriges Riksbank does not exclude assuming the responsibility for providing a well-defined range of basic services that would be tailored to the needs of specific social groups;
- the e-krona issued under the e-money regime could potentially be used to make anonymous payments – within the limits legally defined (including the amount) under the regulations on counteracting money laundering and combating terrorist financing;
- it should be built using technology offering a high degree of flexibility and compatibility with modern solutions emerging in the market of payment services;
- future project work will take into account a special solution in the event of a serious threat to the payment system of Sweden (e.g. in case of the war).

Sveriges Riksbank has been considering two models for issuing e-krona. The first one would be based on the digital recording of value on a prepaid card or in a mobile application (value-based e-krona). The second model would be based on a system of accounts held with the central bank (account-based e-krona).

⁹³ Sveriges Riksbank 2017, Sveriges Riksbank 2018, *The Riksbank's e-krona project*, materials available at: <https://www.riksbank.se/en-gb/payments--cash/e-krona/>

Table 3.1. Properties of e-currency compared to cash and scriptural money

Properties	Cash	Value- based e-krona	Account-based e-krona	Commercial bank money (scriptural)
Credit risk	-	-	-	√*
Store of value	√	√	√	√
Real-time payments	√	√	√	-**
Offline payments	√	√	-	-***
Anonymous payments	√	√ (in the case of pre-paid cards)	-	-
Physical presence	√	√ (for prepaid cards, not for applications)	-	-
Usefulness	-			√

*- limitation due to amount of guaranteed funds (up to EUR 100 thousand)

**- except for payments made between customers of the same bank or using Swish

***- some cards may have this kind of functionality

Source: *The Riksbank e-krona project*, Sveriges Riksbank, September 2017, p. 19.

Table 3.2. Basic differences between the analysed e-krona issuance models

Properties	Value- based e-krona	Account-based e-krona
Immediate payments	√	√
Central ledger	√	√
Legal form	electronic money (prepaid value)	cash held in the account (account balance)
Interest rate	not as a rule	√
Anonymous payments	√ (for the amount lower than EUR 150)	-
Traceability of transactions	√ (if prepaid cards are used, unless there is a change of user)	√
Offline payments	√	√

Source: Sveriges Riksbank (2018, p. 17)

The activities carried out in Sweden, starting in 2019, comprise both legal issues, an analysis of the economic impact of the introduction of the e-krona and a study on possible technological solutions for CBDC issuance.⁹⁴ It is assumed that it will be necessary to prepare proposals for relevant legal amendments that will clarify the mandate of the central bank of Sweden and define the legal status

⁹⁴ Sveriges Riksbank 2018, *The Riksbank e-krona project*, materials available at: <https://www.riksbank.se/en-gb/payments--cash/e-krona/>

of the e-krona. If it is decided to issue a digital representation of the currency which would be held in accounts with the central bank (account-based e-krona), an amendment to the Sveriges Riksbank Act would be required.

In March 2019, Sveriges Riksbank published the results of public consultations on proposals for e-krona issuance.⁹⁵ Public administration entities, banks, business associations and consumer associations participated in the consultation. Most entities supported the central bank's actions and the consultation resulted, among others, in a list of problematic issues to be clarified by the Swedish parliament (e.g. whether the Riksbank has the right to issue digital currency and what the legal status of the CBDC would be).

In June 2019, Sveriges Riksbank requested the Swedish Parliament to set up a special committee with experts from various fields to analyse the role of the state in the operation of the payment system, among others, also in the context of the issuance of central bank digital currency.⁹⁶ Stefan Ingves, the Governor of the central bank, stressed that the decision on whether to issue digital currency must be taken at the political level.⁹⁷ In December 2020, the Swedish government started work on the review of the role of the state in the payment market. The review will be based on an in-depth analysis of: (1) the current and historical role of the state in the monetary system, (2) changes in the financial and payment market resulting from technological developments and digitisation, (3) reasons for the increasing use of new payment methods and the less frequent use of banknotes and coins in Sweden, (4) directions for the future development of the payment market. It is assumed that work on the review report will continue until November 2022. The report will outline a vision for the future role of the state in the Swedish monetary system.⁹⁸

In June 2020, the Bank of Sweden published a study entitled *The rationale for issuing e-krona in the digital era*.⁹⁹ According to the publication, a well-functioning and trustworthy means of payment should be seen as a public benefit that is guaranteed by continuous direct involvement of the public sector. A properly designed e-krona could be an important tool for the Swedish government to ensure the smooth functioning of the monetary system in the future. Moreover, in June 2020, the results of the Sveriges Riksbank economic analysis were published, which aimed at answering the

⁹⁵ A brief summary of the views presented is available at: <https://www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/notices/2019/most-referral-bodies-positive-to-the-riksbanks-e-krona-investigation/>

All opinions submitted by 20 different institutions are published only in Swedish (<https://www.riksbank.se/globalassets/media/rapporter/e-krona/2019/remissvar-riksbankens-e-kronaprojekt-rapport-2.pdf>)

⁹⁶ Based on information posted at: <https://www.riksbank.se/globalassets/media/rapporter/ekonomiska-kommentarer/engelska/2019/the-e-krona--now-and-for-the-future.pdf>

⁹⁷ Based on the press release of 11 December 2020, available at: <https://www.bloomberg.com/news/articles/2020-12-11/sweden-explores-the-feasibility-of-moving-to-a-digital-currency>

⁹⁸ Based on the press release available at: <https://cashessentials.org/sweden-plans-expansion-of-its-cash-infrastructure/>

⁹⁹ H. Armelius, G. Guibourg, A. T. Levin, G. Söderberg, *The rationale for issuing e-krona in the digital era*, Sveriges Riksbank Economic Review, 2020:2 June 2020, available at: https://www.riksbank.se/globalassets/media/rapporter/pov/artiklar/engelska/2020/200618/2020_2-the-rationale-for-issuing-e-krona-in-the-digital-era.pdf

questions regarding: (1) the possibility of maintaining confidence in money and the banking system by issuing publicly available central bank digital currency, (2) financial stability (in particular, providing liquidity to banks), (3) CBDC sources of funding, (4) competitiveness in the market for payment services, and (5) the impact of CBDC issuance on seigniorage income.¹⁰⁰

In 2020, Sveriges Riksbank launched the e-krona pilot project in cooperation with Accenture.¹⁰¹ The project is expected to continue at least until 2022 (with the possibility of an extension), but at this stage no binding decision has yet been made on the CBDC issuance, its features, or the use of specific technology.¹⁰² The objective of the pilot study currently in progress is:

- to create a simple and user-friendly digital krona design in a test environment, while meeting the security and performance requirements of the system;
- to design a digital wallet from which, via a mobile application (and to some extent, wearable devices and cards), it will be possible to make transfers as well as to make and receive payments;
- to provide access to the digital krona on a 24/7/365 basis and allow instant payment; the possibility of making payments without an Internet connection will be also explored.

The technical assumptions of the pilot study are as follows:

- the system is based on the DLT Corda platform; it is operated by the central bank, which admits only selected users to the network; each participant controls one or more nodes within the network;
- the system is a two-tier system: the central bank issues the digital krona to participants in the system (e.g. banks), while at the second level, participants in the system distribute digital krona to end-users;
- the digital krona take the form of tokens that cannot be counterfeit or double-issued, and enable instant and easy-to-use payment transactions; they are obtained by network participants in exchange for deposits or reserves held with the central bank, through the RIX payment system;
- all transactions within the network take place independently of existing systems;
- the system architecture is flexible and expandable.

The Sveriges Riksbank research paper published in February 2021 shows that regardless of whether the e-krona is based on individual accounts or token issuance, a central ledger will need to be maintained, tracking the CBDC holdings of participants in the system. The link to such a ledger means that none of the aforementioned forms of digital currency will provide the same level

¹⁰⁰ The economic analyses were made available at: [EconomicReview2, 2020 \(riksbank.se\)](https://www.riksbank.se/ekonomiska-analyser/2020/ekonomisk-analyse-2020)

¹⁰¹ Sveriges Riksbank (2020), *The Riksbank e-krona pilot*, study available at: <https://www.riksbank.se/globalassets/media/rapporter/e-krona/2019/the-riksbanks-e-krona-pilot.pdf>

¹⁰² Based on the press release of 12 February 2021, available at: <https://www.riksbank.se/en-gb/press-and-published/notices-and-press-releases/notices/2021/riksbank-extends-test-of-technical-solution-for-the-e-krona/>

of anonymity as cash. At the same time, due to the need to link to the ledger, it will not be possible to carry out larger scale transactions offline.¹⁰³

3.2.4. The euro area

So far, the Eurosystem has not decided whether the digital euro should be introduced. However, a document of December 2019 concluded that the desirable design features of the CBDC and its economic and financial implications justify further analysis.¹⁰⁴ A comprehensive report on the digital euro was published on the ECB website on 2 October 2020.¹⁰⁵ It presents the findings of the *Eurosystem High-Level Task Force on Central Bank Digital Currency (CBDC)*, which was established in January 2020. The report was endorsed by the ECB Governing Council.

In accordance with the above analysis and in the opinion of Christine Lagarde, the President of the ECB Executive Board¹⁰⁶, the digital euro could be issued:

- to support the digitisation and strategic autonomy of the European Union;
- to maintain public access to central bank money in response to the significant decline in the role of cash as a means of payment;
- amid a significant increase in the share of foreign digital payment instruments (CBDC or stablecoins) in retail transactions;
- as a new channel for monetary policy transmission;
- to reduce the risks associated with the provision of payment services;
- to strengthen the international position of the euro;
- to reduce the ecological footprint of the operation of monetary and payment systems.

The report analyses various scenarios, depending on the main reasons and objectives for introducing the digital euro. It identifies the most important features that the digital euro should fulfil:

1) Basic principles:

- full convertibility of the euro at a par value;
- the nature of the central bank liability for which the Eurosystem is responsible;
- universal accessibility on equal terms in all euro area countries;
- market neutrality (it should not favour any private solution);
- confidence among society from the outset.

¹⁰³ Sveriges Riksbank Staff Memo (2021), material available at: <https://www.riksbank.se/globalassets/media/rapporter/staff-memo/engelska/2021/on-the-possibility-of-a-cash-like-cbdc.pdf>

¹⁰⁴ European Central Bank (2019). The report is available at: <https://www.ecb.europa.eu/pub/pdf/other/ecb.other191204~f6a84c14a7.en.pdf>

¹⁰⁵ European Central Bank (2020). The report is available at: https://www.ecb.europa.eu/pub/pdf/other/Report_on_a_digital_euro~4d7268b458.en.pdf

¹⁰⁶ The text of the speech by Christine Lagarde, President of the Executive Board of the ECB, at the conference organised by the Deutsche Bundesbank on *Banking and Payments in the digital world*, 10 September 2020, is available at: <https://www.bis.org/review/r200911a.pdf>

2) Assumptions depending on the solution scenario adopted:

- pro-innovation and digital efficiency: the digital euro should use state-of-the-art technology to ensure maximum convenience, speed and cost-effectiveness; it should be made available through standard interoperable front-end solutions and enable interoperability with private payment solutions;
- analogous solutions compared to cash: among others, availability offline, availability for vulnerable and excluded groups, free of charge, preservation of the privacy of transactions, ensuring a strong brand equivalent to the euro brand;
- competitiveness in the market of payment instruments: the digital euro should enable the provision of functionalities at least as attractive as payment solutions available in foreign currencies or through unregulated entities;
- the option of using the digital euro as a means of conducting monetary policy: the digital euro should be able to bear interest at the current central bank rate;
- function as a back-up system: the digital euro should be widely available and accessible via resilient systems, independent of currently functioning payment systems, to be able to mitigate the consequences of extreme events, such as natural disasters or pandemics, when traditional payment services may not be available to consumers;
- international use: the digital euro should potentially be available outside the euro area in line with current Eurosystem policy;
- savings compared to the cost of the current payment ecosystem;
- environmental friendliness: it should be based on technological solutions that minimise its ecological footprint.

The report also analyses the legal aspects of issuing the digital euro: the European Union legal system does not exclude the possibility of issuing the digital euro, but the exact legal implications of issuing the digital euro will also depend on the solution finally chosen. The report does not prejudge the choice of technology. The most appropriate technology will be selected once the functional requirements have been defined and the technical feasibility of the project has been checked.¹⁰⁷ It is expected that the decision on this issue will not be taken in 2021.

The ECB authorities¹⁰⁸ also stress that the digital euro would have to be designed so as to minimise the risk of changing the way the banking system works and crowding out private payment solutions. It would need to take into account the strengths of both the Eurosystem and the private sector to ensure a competitive and innovative payment ecosystem. To avoid abandoning the intermediation of banks in the financing of the economy or to avoid bank runs in times of financial market stress, analyses of the digital euro so far have taken into account, among others, the possibility of setting limits on the size of transactions or on the balances held by individuals and

¹⁰⁷ Potential technological solutions are described in the *Report on digital euro*, European Central Bank (2020), available at: https://www.ecb.europa.eu/pub/pdf/other/Report_on_a_digital_euro-4d7268b458.en.pdf

¹⁰⁸ The text of the speech by Christine Lagarde, President of the ECB, at the conference organised by the Deutsche Bundesbank on *Banking and Payments in the digital world*, 10 September 2020, is available at: <https://www.bis.org/review/r200911a.pdf>

non-banks, different for each group of the digital euro users. In turn, the use of the digital euro as a stable investment could be prevented by setting diversified interest rates.¹⁰⁹

In January 2021, the ECB concluded a 3-month consultation on a widely accessible CBDC.¹¹⁰ The aim was to understand the actual needs and the expected benefits and challenges of issuing the digital euro. Preliminary analysis of the raw data showed that among the desired features of a potential digital euro, privacy of payment transactions carried out ranked highest (41% of responses), followed by security (17%) and pan-European coverage (10%). The detailed report of the survey was presented in April 2021.¹¹¹ According to Christine Lagarde, the President of the ECB, there is demand for the digital euro. Its introduction, due to the need to guarantee the security and adequate resilience of the system, requires time. However, it should not take more than 5 years.¹¹²

The ECB and the Eurosystem national central banks started initial CBDC experiments for retail payments in October 2020 across four work streams. First, compatibility between the digital euro and existing central bank settlement services (such as TIPS) will be tested. Second, the interplay between decentralised technology solutions and centralised systems will be explored. Third, the use of blockchains for payments with digital identity proofing will be analysed. Fourth, the functionality of devices that can enable offline payment transactions while maintaining user privacy will be assessed.

On 19 January 2021, the European Commission and the ECB issued a joint communication on cooperation on the issue of digital euro¹¹³, which could respond to new payment needs in Europe. In mid-2021, the Eurosystem (ECB Governing Council) will decide on the potential launch of the digital euro project. This will be followed by a phase to study the requirements of users and service providers for one or more CBDC issuance models, the most optimal in view of the objectives and specific requirements identified in the report. The decision on the potential issuance of the digital euro will also be preceded by an analysis of the costs of such a project in comparison with alternative solutions.

¹⁰⁹ Interview with Ulrich Bindseil, Director General at the ECB, on the digital euro, published on Central Banking on 1 February 2021, is available at:

<https://www.centralbanking.com/fintech/cbdc/7739951/ulrich-bindseil-on-the-launch-of-the-digital-euro>

¹¹⁰ Information on the results of the consultation is available at:

<https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210113-ec9929f446.en.html>

¹¹¹ The report is available at:

https://www.ecb.europa.eu/pub/pdf/other/Eurosystem_report_on_the_public_consultation_on_a_digital_euro-539fa8cd8d.en.pdf

¹¹² Information based on press reports of a virtual forum held on 13 January 2021 by Reuters:

<https://techxplore.com/news/2021-01-digital-euro-years-lagarde.html>

¹¹³ Communication available at:

https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/210119-ec-ecb-joint-statement-digital-euro_en.pdf

The Eurosystem will further develop the concept of digital euro issuance in consultation with a number of EU institutions (European Parliament, EU Council, European Commission, supervisory authorities: EBA, ESMA and ESRB), other central banks (e.g. Canada, UK, Japan, Sweden and Switzerland) as well as international bodies and actors (BIS, IMF, *Financial Stability Board* or *Financial Action Task Force*).

3.3. Examples of actions related to the introduction of CBDC for wholesale payments

The results of analytical and pilot work carried out (alone or in cooperation with others) by the ECB and the central banks of Japan, Canada, Singapore, Switzerland, Hong Kong and Thailand on CBDC for wholesale payments are presented below. These projects were selected by NBP due to the progress of the work, the results achieved so far and the availability of information on the status of the project.

3.3.1. Bank of Japan and European Central Bank – Stella project

The Stella research project has been jointly carried out by the Bank of Japan and the ECB since February 2017. Its main objective is to analyse the feasibility of using DLT in building financial market infrastructure. The project included concept development as well as testing of solutions based on distributed ledger technology. However, its aim was not to create solutions that would replace the currently existing systems. So far, four stages of pilot tests have been performed. The report presenting the results of the first phase was officially published in September 2017 on the ECB website.¹¹⁴ The analytical activities of the project group focused on testing the efficiency and security of functioning of payment systems built using DLT. Although the results of the work were satisfactory, it was concluded that DLT was too immature to be used for the construction of wholesale payment systems.

The next stage of the project group's work involved securities settlement systems.¹¹⁵ The objective was to develop concepts and build prototypes of DLT-based solutions in which the DvP (delivery versus payment – cash) principle could be applied. Within the project, prototypes of securities settlement systems were built on three different DLT platforms: Corda, Elements and Hyperledger Fabric. The results of the tests showed that in each of the tested solutions it is possible to carry out operations effectively in accordance with the DvP principle, both in the case of building one common distributed ledger for the payment system and the securities settlement system (Single Ledger DvP), and in the situation of the existence of two different distributed ledgers (Cross Ledger DvP). The second version considered two variants of solutions, i.e. the interconnection of ledgers (with connection between ledgers) and only the cooperation of the parties involved in a transaction

¹¹⁴ https://www.ecb.europa.eu/pub/pdf/other/ecb.stella_project_report_september_2017.pdf

¹¹⁵ https://www.ecb.europa.eu/pub/pdf/other/stella_project_report_march_2018.pdf

(without connection between ledgers), which participate in two different ledgers. The specific characteristics of each type of DLT platform (e.g. the scope of information exchanged by system users, data structure or the method of blocking delivered securities) affected the functionalities of the constructed solution. As in the case of the first stage of testing, the conclusion of the second stage was also positive, but pointed to a number of technological limitations and the need for further analysis (including legal implications) before deciding on the possibility of using these solutions in practice.

The third stage of testing within the Stella project was devoted to the possibility of increasing the efficiency and security of making cross-border payments by using modern technological solutions. The results of the experiment presented in the report on *Synchronised cross-border payment*¹¹⁶ indicate a real potential in this respect, also in the case of payment settlement which takes place between a system built on a distributed ledger (DLT) and a payment system with a central register of orders. Cost reductions and faster execution of transactions could be achieved assuming the use of payment methods that synchronise payment and blocking of funds in the payment chain.

The final, fourth phase of the Stella project was devoted to conceptual studies and practical experiments analysing whether the use of privacy-enhancing technologies/techniques (PETs) will enable transaction auditing in a DLT-based financial market infrastructure, including determining the conditions. The results of the experiments are presented in the report on *Balancing confidentiality and auditability in a distributed ledger environment*¹¹⁷, published in February 2020.

3.3.2. Bank of Canada – Jasper project

The Jasper project was launched in March 2016 as an analytical and research joint venture led by Payments Canada (the entity responsible for running the clearing and settlement system), the Bank of Canada (the entity responsible for macroprudential oversight of the system), TMX Group, Accenture, the R3 consortium (developer of the Corda platform) and 7 commercial banks. The aim of the project was to build and test a high value payment system for the interbank market, operating on the basis of DLT. The digital currency used in the project was the “DDR” (digital depository receipt).

So far, four stages of testing have been conducted¹¹⁸ (the first on a system built on the Ethereum platform, and the next on the Corda platform). The first two phases were devoted to analysing the way the wholesale payment system (RTGS) works, changes in the roles of individual entities –

¹¹⁶ <https://www.ecb.europa.eu/paym/intro/publications/pdf/ecb.miptopical190604.en.pdf>

¹¹⁷ https://www.boj.or.jp/en/announcements/release_2020/data/rel200212a1.pdf

¹¹⁸ The results of the experiments carried out in all stages of the project have been published at: <https://www.bankofcanada.ca/research/digital-currencies-and-fintech/projects/#Phase-4>

participants of the system¹¹⁹, compliance of the system with international standards for systemically important payment systems (core international principles, PFMI) and potential benefits for individual participants of the system. The results of the tests indicated the feasibility of the wholesale payment system built on DLT which, however, at that stage of development, did not take into account the possibility of implementing all required international standards for financial market infrastructure. Improvements were made to the liquidity management mechanism as an experiment (by allowing some payments to be netted within the order queue). Savings were achieved in back-office services, mainly as a result of the automation of many processes. However, the results were not satisfactory, mainly in terms of the privacy of transactions processed (improvements in this respect reduced the security of the system), the scalability of the system (processing more transactions degraded the system's resilience to disruption and increased the cost of operation) and the increase in efficiency and the size of the actual net gains from the operation of the system compared with the existing centralised wholesale payment system.

In the third phase, conducted in 2018, instant securities settlement was analysed. The test results showed its feasibility within the system built as well as the possibility of tokenization of money and assets and their mutual exchange. At this stage, it was possible to solve the problem related to the lack of privacy of executed transactions. Only the parties involved had access to the transaction history. However, there is no evidence that this type of settlement would be carried out at a significantly lower cost for the parties involved (dealers and banks).

The fourth phase, in turn, invited the Monetary Authority of Singapore (MAS) and the Bank of England to work together to test the feasibility of cross-border multi-currency payment settlement. The joint experiments helped to explore how DLT can lead to increased safety and efficiency of such cross-border payments using different types of DLT platforms.

3.3.3. Central Bank of Singapore (Monetary Authority of Singapore) – Ubin project

The Ubin project was launched in November 2016 by the Monetary Authority of Singapore (MAS). The venture was conducted in cooperation with payment services market players and technology companies as well as central banks. The main objective was to build a payment and securities clearing and settlement system based on DLT technology and then to explore, through a practical experiment, what the potential of the DLT technology is in terms of making financial transactions and financial market processes more transparent, resilient and cheaper.

The project was completed in 2020, after five phases of experiments which helped to understand the potential of the distributed ledger technology in the payment clearing and settlement system. The payment network prototype, developed in collaboration with J.P. Morgan and Temasek

¹¹⁹ It was pointed out, among others, that the operator of a system built with DLT is no longer a provider of IT infrastructure, but is primarily a rule maker, introducing standards. Bank of Canada (2017, p. 9)

Holding, will continue to serve as a test network to facilitate collaboration with other central banks and the financial sector to develop cross-border payments infrastructure. The technical specifications developed under the project have been made publicly available. Six stage-by-stage reports are available.¹²⁰

The first stage of the work involved the creation of a tokenized form of currency (SGD-on-ledger), which was issued by the MAS against the pledge of funds held by participating entities in custody accounts with the central bank. The practical aspects of executing payments between national banks within a system built on a distributed ledger were analysed. A prototype of the system was created using the private Ethereum distributed ledger. Its interface was able to connect to the Singapore RTGS system operated by the MAS. Banks made payments among themselves and to the MAS. The prototype also included smart contracts, which allowed transactions to take place when certain conditions were met (e.g. a stock reaching a designated price level). The system allowed payments to be made 24 hours a day, which could be used in situations where transactions involved entities operating in different time zones.

The second stage of testing was devoted to verifying the operation of the system built on DLT from the point of view of the possibility to increase the efficiency of the liquidity management mechanism, while maintaining the privacy of information on transactions performed. Tests were conducted on three different types of DLT platforms: Corda, Hyperledger Fabric and Quorum. Three different variants of systems, built on the above mentioned platforms, were analysed from the point of view of scalability, performance and resilience to operational disturbances. All DLT-based RTGS prototypes were built and managed on a cloud-based infrastructure (Microsoft Azure cloud platform).

The third phase of the project involved investigating the feasibility of settlement in the delivery versus payment (DvP) model using multiple DLT platforms. Three companies were appointed as technology partners in this project: Anquan, Deloitte and Nasdaq, and the tests used, among others, the DLT solutions developed at earlier stages of the project (five different blockchain solutions were used – Quorum, Ethereum, Hyperledger Fabric, Anquan permissioned blockchain and Chain Inc.). The project demonstrated that with the technologies used, transactions can be performed using Singapore Government Securities (SGS) and central bank-issued cash-depository receipts (CDRs) across different types of DLT solutions. The settlement of such transactions occurs much faster than in traditional systems (T+1, and potentially even in real time). The ability to incorporate smart contract-based entries into transactions allows for regulatory compliance and increases investor confidence. The solutions used allow for arbitrage, ensuring anonymity by the parties to the transaction, while also maintaining an overarching role by the designated regulator.

¹²⁰ All reports are available at: <https://www.mas.gov.sg/schemes-and-initiatives/Project-Ubin>

The fourth phase of the project was devoted to international payments and settlements. It involved two separate survey phases. The first phase was carried out with the participation of the central banks of Canada and the UK, in addition to the MAS. It identified the biggest impediments to cross-border payments and developed assumptions that cross-border payment systems should meet in the future (e.g. extended availability of systems, traceability of transaction stages, consistency and transparency of standards, modernisation of technical infrastructure). The report discusses five potential models for action, two of which involve improving the existing infrastructure and three of which involve setting up new systems using CBDC for wholesale payments and the distributed ledger technology. The report also outlines further issues to be analysed: legal and regulatory requirements, the need for a cross-border supervisory network, the impact on monetary policy, the legal changes required, the criteria for designating institutions which can be direct participants in the network, and the adaptation of the network among market participants. In the second phase, the MAS and the Central Bank of Canada merged their experimental DLT-based payment systems (the Ubin project and the Jasper project) and conducted a successful experiment of cross-border payment settlement using different CBDC.

The final, fifth phase of the project was dedicated to analysing the potential for extensive collaboration within the multi-currency payment ecosystem. The network developed provided connectivity interfaces for other blockchain networks as well as additional functionality, e.g. conditional payments and escrow accounts. During this phase, a successful experiment of a cross-border transaction (Canada-Singapore), in different currencies (CAD and SGD), using separate DLT systems (Quorum and Corda) and HTLC (Hashed Time-Locked Contracts) solutions was carried out, which enable the atomic swap model implementing the PvP principle, even though the constituent transactions were carried out in two different systems. In addition to the technical experiments, this phase also aimed to investigate the business viability of building and using a blockchain-based payment network. Workshops and discussions were held with over 40 financial and non-financial companies to assess the potential benefits. The report examines the use of the blockchain technology in commercial applications across a range of industries.

3.3.4. Swiss Central Bank – Project Helvetia

Project Helvetia was carried out jointly by the BIS Innovation Hub, the Swiss National Bank and SIX, the Swiss financial market infrastructure operator. The report presenting the results of the work was published on 3 December 2020.¹²¹ The project investigated how central bank money can be used to settle securities and other financial assets migrated from today's centralised financial market infrastructure to new, so-called decentralised or tokenized platforms designated for trading and post-trade execution. Project Helvetia involved conducting two proof-of-concept experiments and comparing the results of both experiments. The first one was based on the introduction of the

¹²¹ The report *Project Helvetia: Settling tokenised assets in central bank money* is available at: <https://www.bis.org/publ/othp35.pdf>

central bank's tokenized digital currency for wholesale payments (w-CBDC) within the decentralised digital asset platform, while the second one was based on linking the decentralised digital asset platform to an existing settlement system for wholesale payments operated by the central bank.

The experiments confirmed the technological and legal feasibility of settlement of tokenized assets in central bank money. No solution has proven to be perfect. Each can bring benefits and raise challenges. CBDC for wholesale payments has potential advantages for the settlement of digital assets. However, its introduction would create significant difficulties in the governance of the system (e.g. requiring significant changes in central bank business processes) and in the monetary or payment system policies implemented (e.g. requiring new criteria for participation in the system or conditions for liquidity support). On the other hand, merging the existing settlement system with the new DLT platform would allow to avoid many of these problems, but the solution would be deprived of the potential benefits of full integration of the systems (e.g. it would prevent the use of atomic multilateral settlement and limit the use of automation (e.g. in the form of smart contracts)).

The Swiss National Bank did not take any decision on the potential CBDC issuance. Andréa M. Maechler, member of the SNB Governing Board, stressed that it was crucial to preserve the safety and reliability of the financial infrastructure of Switzerland. If DLT technology can bring significant improvements to securities trading and the settlement process, the SNB wants to be prepared to use it. However, further work is needed on this topic. Further steps will be taken to better understand the implications of CBDC introduction for wholesale payments, both the practical aspects of the issue and its implications for policy implementation. It is planned to both deepen the research to analyse the effects of CBDC issuance on the banking sector and the payments ecosystem as a whole and to broaden the scope of the research to analyse the cross-border use of CBDC and the inclusion of other types of entities in the system. Different design options for CBDC issuance that balance risks and benefits will be carefully examined. Further work should help to define precisely the role of the central bank in any future system.

3.3.5. Hong Kong Monetary Authority and Bank of Thailand – Project Inthanon-Lion Rock

On 22 January 2020, the Hong Kong Monetary Authority (HKMA) and the Bank of Thailand announced the results and published a report¹²² on a joint research project called Project Inthanon-Lion Rock. Following the Memorandum of Understanding (MoU) signed by the HKMA and the Bank of Thailand in May 2019, both authorities initiated the said project to explore the use of CBDC for cross-border payments. A prototype cross-border corridor network was developed, enabling

¹²² *Inthanon-LionRock. Leveraging Distributed Ledger Technology to Increase Efficiency in Cross-Border Payments*, Bank of Thailand, Hong Kong Monetary Authority, report available at: <https://www.bot.or.th/English/FinancialMarkets/ProjectInthanon/Documents/Inthanon-LionRock.pdf>

participating banks in Hong Kong and Thailand to conduct funds transfers and foreign exchange transactions on a peer-to-peer basis, helping to limit the settlement stages. Project Inthanon-Lion Rock was completed in December 2019. Key findings of the project are presented in the report *Inthanon-Lion Rock. Leveraging Distributed Ledger Technology to Increase Efficiency in Cross-Border Payments*, which covers topics such as token conversion, real-time interbank funds transfer, foreign exchange execution, liquidity management, and compliance.

In February 2021, the BIS announced the continuation of this initiative. With the People's Bank of China and the Central Bank of the United Arab Emirates joining the project, the project was renamed the Multiple CBDC (m-CBDC) Bridge.¹²³ The m-CBDC Bridge project aims to develop a proof-of-concept system for cross-jurisdictional cross-border foreign currency payments (using both participating countries' currencies and foreign currencies) in real time using 24/7 distributed ledger technology. Participating central banks will assess the feasibility of such a system for cross-border transfers of funds, international trade settlement and capital market transactions in their own jurisdictions.

3.4. International cooperation on CBDC issuance

In view of the potential impact of CBDC issuance that goes beyond the borders of a single jurisdiction, the needs of the digital economy, the dynamic development of modern technologies, the inefficiency of existing payment systems, primarily with regard to cross-border movement of funds, numerous initiatives of bilateral and multilateral nature are undertaken to enhance cooperation in connection with the concept of CBDC issuance. Bilateral cooperation is undertaken by central banks to test specific technological solutions related to CBDC for wholesale payments. Multilateral cooperation, with the coordinating role of the BIS, supported by the BIS Innovation Hub¹²⁴ and involving the IMF, the World Bank, the G20, the FSB and interested central banks, is intended to ensure the exchange of information on ongoing projects (primarily concerning the issuance of CBDC for retail payments), on the best technological solutions to be used and to agree on common principles and maybe also the standards¹²⁵ which will enable full interoperability of

¹²³ The official announcement on this matter is available at: <https://www.bis.org/press/p210223.htm>

¹²⁴ The BIS Innovation HUB (BIS Innovation Centre) was established in 2019 to identify, research and disseminate knowledge on key financial technology trends of relevance to central banks and take action to improve the functioning of the global financial system. In January 2021, the BIS Innovation Network was established, consisting of innovation experts representing BIS shareholder central banks. The aim of this initiative is to support the innovative activities carried out by the BIS Innovation Hub, sharing knowledge about technology projects and seeking innovative solutions to problems identified by central banks. It is planned that experts from central banks will undertake work in six working groups: (1) Suptech and regtech, (2) Next generation financial markets infrastructures (FMIs), (3) CBDC, (4) Open finance, (5) Cyber security, (6) Green finance. The working group on CBDC will be chaired by Marius Jurgilas, Member of the Board of the Bank of Lithuania. The official information on this topic is posted at: <https://www.bis.org/press/p210122.htm>

¹²⁵ In early 2021, the International Organisation for Standardisation (ISO) launched an initiative to establish an advisory group on digital currencies that will provide support for the development of standard definitions, identification and exchange of information for central bank digital money and non-fiat virtual currencies. The operation of the aforementioned group is intended to support the financial services market by providing advice and identifying areas where international standards already in place can enable more effective inclusion and use of both the CBDC and other virtual currencies. The group would operate within the technical committee ISO/TC 68 – Financial Services; cooperation with other groups such as ISO/JTC1 Information Technology and ISO/TC 307 Blockchain and distributed ledger technologies will also be necessary.

CBDC systems in the future. It is assumed that, among others, an improvement of cross-border transfers would be possible.

The most important initiatives undertaken within the cooperation of central banks and international financial institutions/bodies on the issue of the introduction of CBDC are presented below.

3.4.1. Agreement on the fundamental principles of CBDC issuance and the basic features of widely accessible CBDC

A group of 7 central banks, with the participation of the Bank of Canada, the ECB, the Bank of Japan, Sveriges Riksbank, the Swiss National Bank, the Bank of England, the Federal Reserve System, and the BIS, was established in January 2020 to exchange experience on the analysis of CBDC issuance concepts. On 9 October 2020, a report prepared by this group, entitled *Central bank digital currencies: foundational principles and core features*¹²⁶, was published.

The report emphasises that the decision to issue CBDC and to assign it specific features will be taken autonomously by national authorities, bearing in mind the possibility of supporting public policy objectives by offering secure means of payment. The CBDC can be used to promote more resilient, efficient, innovative and financially inclusive payments, which can be an alternative to less secure forms of private money (stablecoins). For countries experiencing a decline in the importance of cash in the economy, CBDC can provide access to and increase the utility of central bank money. Group members agreed on three fundamental principles for issuing the CBDC:

- 1) it must not undermine monetary and financial stability,
- 2) it should coexist with cash and other forms of money existing in a flexible and innovative payment ecosystem,
- 3) it should promote innovation and efficiency to a greater extent.

A single type of the CBDC system which would be acceptable to each country should not be expected. Decisions concerning the features of CBDC will be made based on the priorities (goals to be achieved) set in the country and the existing circumstances. Group members agreed on the basic features of future payment systems for the CBDC:

- 1) the CBDC system must be resilient and secure to maintain operational integrity;
- 2) CBDC as a useful payment instrument must be convenient to use and available cheaply or at no cost to end users;
- 3) the CBDC system must take into account the appropriate role for private sector actors, promoting competitiveness and innovation;

¹²⁶ The report is available at: <https://www.bis.org/publ/othp33.pdf>

- 4) the CBDC system must be based on a transparent legal framework.

At a later stage of the work, the Central Bank Group together with the BIS will focus on exploring the practical implications of the main features of CBDC identified in the report. The analysis will further include questions on the selection of the type of trade-offs in the design of CBDC that can mitigate risks to financial stability.

Further work carried out by individual central banks and performed jointly within the Group will also take into account the possibility of improving cross-border transfers in the future. In this regard, the Group intends to support the work initiated by the G20 on cross-border payments as well as the work led by the CPMI (Committee on Payments and Market Infrastructures) and the BIS on CBDC Block 19. The broad harmonisation of rules and compatibility of the systems of various digital currencies could form the basis for future work on safe and efficient cross-border fund transfers. The Group of Central Banks, together with the BIS, will cooperate with the BIS Innovation Hub on technological experiments conducted with respect to CBDC. Particular emphasis in this regard will be placed on the issue of the system interoperability and the cross-border flow of value using the CBDC issued in individual jurisdictions.

3.4.2. Improvement of cross-border flows of funds

Elimination of the constraints on cross-border payments, such as the time and cost of their execution as well as the lack of transparency regarding the conditions under which they are performed and the complexity involved in achieving the compliance with the regulations of each jurisdiction, has become the priority for the G20 in 2020. The importance of such transactions has increased over the past decade with the growth of tourism, the increase in remittances from individuals and the increasing popularity of e-commerce. In 2020, the G20 finance ministers and central bank governors asked the Financial Stability Board¹²⁷ (FSB) to coordinate the development of the strategy to streamline cross-border payments. The strategy was developed by the FSB in collaboration with the CPMI, which operates within the BIS, and other international organisations and bodies. The strategy sets out a plan to create faster, cheaper, more transparent and open cross-border payment services, while maintaining their security. The strategy determined a catalogue of challenges and problems associated with cross-border payments. This resulted in five main thematic areas divided into 19 building blocks. The final, 19th block is dedicated to the issue of central bank digital currency (*International dimension in CBDC design*, under the fifth category *Thematic Area E: Exploring the potential role of new payment infrastructures and payment agreements*). This block comprises three phases of activities:

- 1) November 2020 – July 2021 – the CPMI, in collaboration with the BIS Innovation Hub, the IMF, and the WB, will conduct an inventory of interim national CBDC projects and central bank tests

¹²⁷ An international body that monitors the global financial system and makes recommendations about it.

and determine the extent to which these projects can be used for cross-border payments. The IMF, in cooperation with other interested institutions, will analyse the international macro-financial implications of cross-border use of CBDC.

- 2) August 2021 – July 2022 – the CPMI, in collaboration with the BIS Innovation Hub, the IMF, and the WB, will identify and analyse access options and opportunities for interlinkages between various CBDC with different structures, accessibility patterns and interoperability (including with non-CBDC payments). It will also analyse the findings of Blocks 17¹²⁸, 18¹²⁹, which cover partly similar issues.
- 3) January 2022 – December 2022 – the BIS Innovation Hub will assess the practical and technological issues related to the implementation of various multi-currency solutions (multi-CBDC arrangement) and different types of interoperability; trials and tests will be conducted and prototypes of schemes will be created to access and link digital currencies and facilitate efficient CBDC payments in various currencies. Subsequently, the BIS in cooperation with the IMF and the WB will organise a conference to exchange information/promote cooperation on cross-border payments between (planned) CBDC (from July 2022).

Future CBDC systems will take into account solutions and objectives specific for each country. However, for the sake of efficiency and in order to avoid problematic adaptations in the future, issues related to interoperability between CBDC systems should already be addressed during the design phase of the national systems. If CBDC solutions assume the participation of commercial entities (e.g. banks, payment operators) in the system, they should also be involved at an early stage. In March 2021, the BIS presented a concept of three different options of cooperation between national systems of digital currencies in the context of the possibility of conducting international transactions:¹³⁰ 1) ensuring the compatibility of CBDC systems (compatible CBDC); 2) interlinking national CBDC systems (interlinked CBDC); 3) building a common CBDC system (single CBDC system).

In the case of the first solution, i.e. ensuring the compatibility of national CBDC systems (compatible CBDC), two separate CBDC solutions would cooperate with each other through multiple commercial intermediary solutions and each CBDC issuer would be responsible for the operating rules and oversight of its own system, the criteria for participation in the system and its infrastructure. The scope of cooperation of the central banks involved would include the acceptance of common standards for national CBDC, coordination of technical infrastructure and coordination of rules and criteria for participation in the system.

In the case of interlinked CBDC systems, participants in one CBDC system could perform transactions in another CBDC system owing to the common technological interface. Achieving beneficial effects will require expenditure to coordinate the requirements of multiple participants,

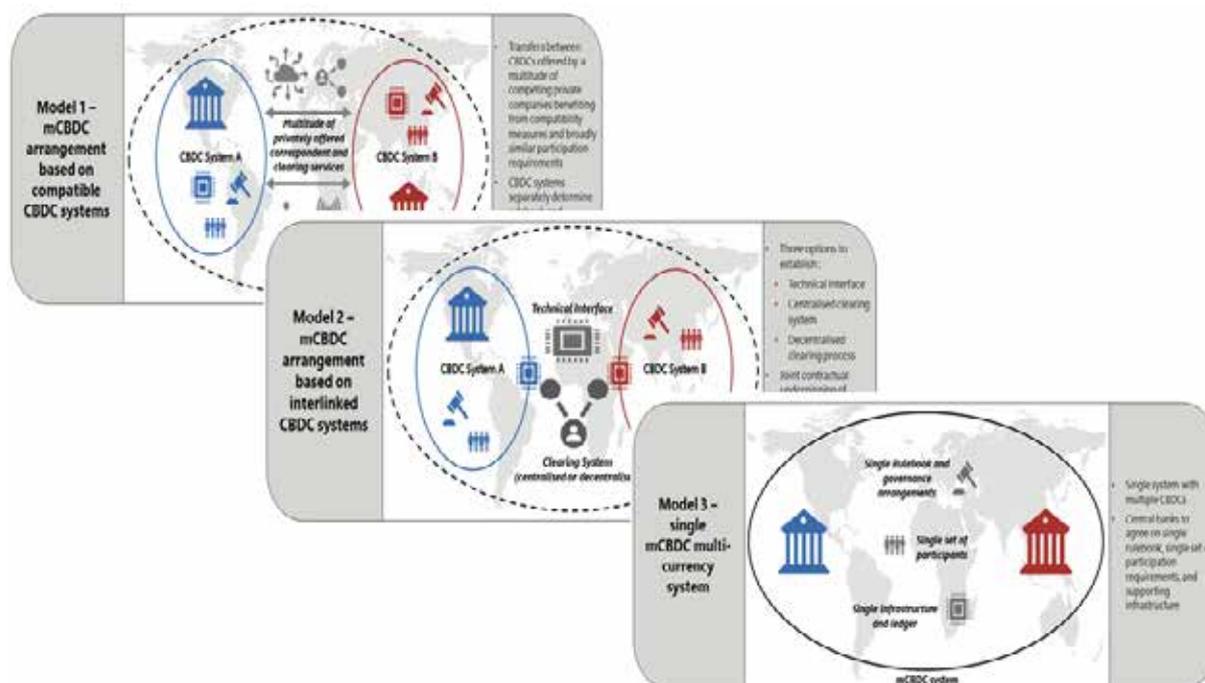
¹²⁸ Considering the feasibility of new multilateral platforms and arrangements for cross-border payments

¹²⁹ Fostering the soundness of global stablecoin arrangements for cross-border payments

¹³⁰ Auer, R., Ph Haene, H Holden (2021). The study is available at: <https://www.bis.org/publ/bppdf/bispap115.pdf>

enabling deeper cooperation and compatibility. Cooperation between central banks would require the design, establishment, management and operation of links between national CBDC systems.

Figure 10 Possible models for multilateral agreements of CBDC systems



Source: Auer, R., Ph Haene, H Holden (2021)

Under the single CBDC system option, national CBDC solutions could be combined into a multi-CBDC system. The multi-CBDC system could be based on distributed ledger technology. This concept entails major regulatory challenges related to the stability of the financial system and the operation of payment systems. Cooperation between central banks would require the design, establishment, management and operation of a single multi-CBDC system.

The analysis of the above solutions will be the subject of research work of the central banks concerned. Central banks will be supported by the BIS Innovation Hub. For example, the work programme of the BIS Innovation Hub for 2021-2022 for CBDC includes the last possibility described above, i.e. the development of a single m-CBDC system.¹³¹ The development of the operating prototype to handle instant cross-border payments versus payments (PvP) in multiple

¹³¹ More information on the project is included in section 3.4.5.

currencies across jurisdictions will enable participating central banks to explore the opportunities and key design challenges of DLT technology in this context. The project will explore scalability, interoperability, privacy and system governance. In addition, studies are planned for implementation between 2021 and 2022 on: (1) the operation of a platform for the settlement of cross-border payments using multiple CBDC for wholesale payments and (2) assessing the benefits and challenges of the existence of multi-tiered technology architecture for the distribution of CBDC for retail payments by commercial banks and payment service providers (in a hybrid CBDC and private e-money backed CBDC model).¹³²

¹³² Information available at: <https://www.bis.org/about/bisih/topics/cbdc.htm>

4. Conditions for the introduction of digital zloty in Poland

4.1. Existing NBP position concerning CBDC

NBP first commented on the issuance of central bank digital currency while preparing the report of the Special Task Force for Financial Innovation in Poland (FinTech), established in late 2016 at the Office of the Polish Financial Supervision Authority (UKNF).

As part of the work of the Task Force, representatives of market participants (including banks and depository and clearing institutions) indicated the need to undertake analytical work in the regulatory area in order to assess the legal implications of the issuance of virtual currency by a central bank as well as to identify the available technological solutions that could support such issuance while maintaining any safety considerations. This demand was reflected in a report prepared by the Task Force in 2017.¹³³ Task Force Recommendation No. 36, the proposal of the Council of Depository Banks, was amended to read: “The security of trading in distributed ledger technology (DLT) requires ensuring the possibility to perform clearing in central bank money (ePLN?). Currently tested clearing models based on cryptocurrencies, such as Bitcoin or Ether, do not ensure the required level of security, among others, due to the public nature of the blockchains in which these cryptocurrencies operate. It would be justified to allow monetary settlements in central bank money (ePLN?) in an issue dedicated to electronic trading (blockchain). Initially, for design purposes, issuing currency for a limited group of users should be considered (a so-called sandbox). Such a direction of the payment system development is foreseen in the ESMA report of 7 February 2017.”

The negative position of NBP prepared in connection with the above proposal, as presented in the aforementioned report, was accepted by the NBP Management Board at its meeting on 21 September 2017. It read as follows: “At this stage NBP has a negative opinion on the proposal to issue virtual currency and at the moment does not envisage any possibility of issuing such currency. In the opinion of NBP, neither legal requirements, i.e. the provisions of the Constitution of the Republic of Poland and the Act of 29 August 1997 on Narodowy Bank Polski concerning the issuance of currency in the form of banknotes and coins, nor the security considerations related to the immaturity of distributed ledger technology, which could be used in the issuance of virtual currency, allow to address the proposal indicated in a positive manner.” At the request of NBP, justified by the above position of the NBP Management Board, the recommendation of the Council

¹³³ Source: “Report on the work of the Special Task Force for Financial Innovation in Poland (FinTech) Working Group on the Development of Financial Innovation (FinTech)”, November 2017, pp. 59-60. https://www.knf.gov.pl/knf/pl/komponenty/img/Raport_KNF_11_2017_60290.pdf

of Depository Banks was considered unjustified in 2017 by the Task Force for Financial Innovation in Poland.

Information concerning the validity of the negative NBP stance on potential CBDC issuance in Poland, including the presentation of the rationale justifying this stance (included in Section 4.2), was presented by NBP in 2020 and 2021 in response to the initiatives described below.

On 10 September 2020, NBP's comments were submitted to the UKNF regarding a barrier that was identified in the work of the Task Force for Financial Innovation as an obstacle to the development of financial innovation in Poland (Barrier No. 19): "PLN Tokenization". In the opinion of the Coalition for Polish Innovation (KPI): "The lack of tokenization of Polish currency limits the implementation of many projects concerning innovative business models based on blockchain technology. In the long term, this state of affairs poses a threat of delays in the development of FinTech solutions due to the fact that other jurisdictions increasingly boldly declare their efforts aimed at tokenizing their national currencies. Similar announcements have also appeared recently with regard to the euro." The proposal to tokenize the zloty was also raised as a target solution to be worked out in the long term. At the current stage, according to the KPI assessment, market needs could be satisfied with tokenized zloty issued under the e-money formula.

On 14 September 2020, the position of NBP, including a detailed argumentation and a summary of the activities carried out in various countries around the world in the field of CBDC, was submitted to the Ministry of Finance in response to the Parliamentary Question no. 10470 of Mr Przemysław Koperski MP and the MPs of the Lewica Parliamentary Club regarding the governmental plans concerning issuing of digital currency of the central bank and the opinion in the scope of stablecoins.¹³⁴

On 5 February 2021, during a press conference devoted to the assessment of the current economic situation, the Governor of NBP, Professor Adam Glapiński, answered journalists' questions on, among others, the issue of the introduction of CBDC.¹³⁵ The Governor of NBP stressed that in the analyses conducted at NBP in this regard, negative conclusions had so far prevailed.

¹³⁴ The text of the Parliamentary Question no. 10470 is available at: <https://www.sejm.gov.pl/Sejm9.nsf/interpelacja.xsp?documentId=C6D37D779D333564C12585D7002DCC30>, while the response of the Ministry of Finance to the questions presented in the Parliamentary Question can be found at [http://orka2.sejm.gov.pl/INT9.nsf/klucz/ATTBU8J5Q/\\$FILE/i10470-o1.pdf](http://orka2.sejm.gov.pl/INT9.nsf/klucz/ATTBU8J5Q/$FILE/i10470-o1.pdf)

¹³⁵ A recording of the press conference is available at: https://www.nbp.pl/home.aspx?f=/aktualnosci/wiadomosci_2021/qa-20210205.html

4.2. Evaluation of the rationale for the potential introduction of central bank digital currency in Poland

NBP has been monitoring the analytical work, research and pilot tests carried out by other central banks in the scope of CBDC issuance for retail and high value payments for four years. Discussions on this issue on various international fora, including the EU, are also monitored.¹³⁶ Moreover, the functioning of the Polish payment system is analysed in the context of the needs and challenges faced by it.

So far, the premises driving other the in-depth theoretical analyses of central banks and the commencement of pilot tests in the scope of CBDC issuance have not been reflected in Polish conditions. With regard to Poland, the following observations should be made:

- the process of supplying banks¹³⁷ with Polish currency by NBP has been stable;
- NBP does not face problems related to the issuance and management of banknotes and coins. The streamlining measures carried out recently and planned for the nearest future have been and are aimed at, among others, modernising banknotes and reducing coin production costs and improving the effectiveness of cash management, optimising and standardising the process of banknote and coin circulation and movement across the chain, including ensuring electronic exchange of information according to a uniform standard. In addition, work has started on the development, in cooperation with public institutions and authorities as well as market players, of the National Cash Security Strategy, which will contribute to increasing the security of cash transactions in Poland and to improving its effectiveness in the future;¹³⁸
- the value of cash in circulation has been increasing for many years, which proves that cash still plays an important role in the Polish economy. The nominal value of cash in circulation (besides banks' cash registers) at the end of December 2020 amounted to PLN 306.7 billion (for comparison, it stood at PLN 203 billion at the end of December 2018 and PLN 224 billion at the end of December 2019), maintaining a high share in the M1 money supply (at end of December 2020 – 20.0% (20.1% at end of December 2018));
- although the share of cash in retail payments shows a downward trend, it remains high (57% at the end of 2018¹³⁹, 54% in 2019¹⁴⁰ and 46% in 2020¹⁴¹);

¹³⁶ Information on this subject is presented periodically to the NBP Management Board (currently, every two months).

¹³⁷ In this case, the term 'banks' also comprises entities other than banks with statutory powers to withdraw and lodge Polish currency from/in NBP.

¹³⁸ Preparation of the draft Strategy is the responsibility of the Cash Council, a consultative and advisory body established at the Management Board of Narodowy Bank Polski. The announcement concerning the commencement of the works on the Strategy was published on 4 March 2021 at: https://www.nbp.pl/home.aspx?f=aktualnosci/wiadomosci_2021/ROG-2021-03-04.html

¹³⁹ Source: "Payment attitudes and the development of card acceptance networks in Poland: Consumer Survey 2018", POLASIK Research. Selected results of the survey are available in the article: *Polacy zwolennikami płatności bezgotówkowych* [Poles are in favour of cashless payments], <https://www.rp.pl/Finanse/306069931-Polacy-zwolennikami-platnosci-bezgotowkowych.html>

¹⁴⁰ Source: "Payment habits of Poles in 2019", POLASIK Research ordered by the Polska Bezgotówkowa Foundation. The main findings of the study are presented in the "Special Report: Cashless Poland" published in *Miesięcznik Finansowy Bank of July 2020*.

¹⁴¹ Source: "Payment habits in Poland in 2020", survey conducted in 2020, ordered by the NBP.

- a strong preference for cash is observed in Poland, even among persons who use mainly cashless payment instruments on a daily basis (in 2020, 64% of Internet users were against withdrawing cash from circulation)¹⁴²;
- the level of financial inclusion is high (at the end of 2018, 91% of people aged over 15 had a payment account)¹⁴³;
- payment systems and instruments operating in Poland are highly innovative and effective (this applies, among others, to instant payment systems, the BLIK system, and contactless payments);
- the digital economy, including e-commerce, offers many diverse and efficient payment methods that provide consumers with choice and meet their needs;
- the Polish system of wholesale payments, SORBNET2, in which RTGS (Real-Time Gross Settlement) type interbank settlement is carried out for payments in zloty, enables an efficient and effective flow of money in the economy. The modernisation works planned by NBP for the coming years will result in the modernisation of the existing solutions (e.g. by introducing ISO 20022 compliant messages) and an enhancement in the effectiveness of the system.

It should be emphasised that at this stage, no central bank has identified sufficient maturity of DLT to become the basis for the construction of payment market infrastructure, including, in particular, wholesale payment systems (RTGS) and securities clearing and settlement systems. However, central banks find considerable progress achieved in the scope of solutions built using DLT. At the same time, the development and introduction of stablecoins (e.g. the Diem project) and their potential rapid popularisation in society may force central banks to create and issue their own digital currency in the future, which would offer users similar functionalities as private virtual currencies, while remaining under the control of the monetary authority.

So far, no specific social purpose has been identified that the issuance of digital zloty would serve, and neither have cases of possible use of CBDC in situations that have not yet been satisfied by payment service providers in Poland. Involvement in the concept of CBDC issuance in Poland could potentially be justified by: (1) the search for a back-up solution in the event of a long-term failure of existing retail payment systems, (2) the digital development of the economy and the need

¹⁴² The survey was carried out with using the CAWI method, i.e. using responsive electronic questionnaires issued on websites and sent by e-mail. The results are as follows: 64% of respondents declare that they would like to abandon using cash, while 28% have no opinion on the matter. Only 8% of respondents are in favour of its withdrawal. These are mainly individuals who make daily payments using various types of cashless payment methods rather than banknotes and coins. Among the arguments in favour of maintaining banknotes and coins, respondents identified two key issues: (1) phasing out cash would alienate older people (37% of respondents) and (2) Poland is not ready for such a change (35%). The data comes from the report on "Digital Payments 2020" published on the website of the Chamber of Electronic Economy at the address: <https://eizba.pl/wp-content/uploads/2020/12/Raport-Platnosci-cyfrowe-2020-10.12.2020.pdf>

¹⁴³ "Key factors in consumers' choice of a payment method", report on the study prepared by professor Janina Harasim, PhD Associate Professor (Economic University of Katowice) and Beata Świecka, PhD Associate Professor, Professor of the US (University of Szczecin), March 2019.

to meet the potential settlement needs in central bank money of entities other than banks¹⁴⁴ or (3) the development of alternative digital payment instruments (i.e. foreign CBDC and stablecoins).

It is difficult to identify obvious benefits for the introduction of CBDC in Poland at the current stage of development of the Polish payment system. However, it should be borne in mind that the development of modern technologies, including DLT, may lead to its increasingly widespread use, including by payment service providers. It is therefore worth considering the need to upgrade existing payment systems to take account of compatibility with modern solutions based on technology other than used to date (DLT or other).

The potential challenges and risks resulting from the introduction of digital money by NBP should be indicated. According to analyses conducted so far by the central banks of developed countries with well-functioning payment systems, there is no clear evidence that the introduction of CBDC will be a more efficient and cheaper solution than the current ones (e.g. with respect to the time and cost of settlement of payments and securities). This refers, in particular, to wholesale payment systems. In the case of retail payment systems, there are additionally significant challenges related to the changing role of the central bank in the banking system, financial stability, the conduct of monetary policy, and the changing scope of activities, as well as the emergence of new risks or an increase in the extent of existing risks (e.g. relating to cyber-security). The introduction of a new form of central bank currency would have many legal implications. In the case of publicly available CBDC, a legal basis for its issuance by the central bank would be required. The scope of other types of amendments to existing legislation would vary depending on the CBDC issuance model adopted and the specific features assigned to it.

Widely available CBDC would possibly be introduced in Poland as a payment instrument alternative to banknotes and coins rather than replacing cash. The activities of NBP undertaken so far are aimed at making it possible for the consumer to decide on the form of payment, i.e. based on available options – to indicate the form of payment preferred (taking into account, among others, habits, costs incurred, convenience, speed, trust). It should be clearly indicated that the introduction of innovative payment solutions, even legal tender as in the case of CBDC, must not lead to an increase in the financial (and technological) exclusion of certain social groups (mainly the elderly or persons with various disabilities). The aim of NBP is and should be to ensure conditions for the undisturbed use of central bank money (cash, and in the future maybe also the CBDC), while creating legal guarantees of its common acceptability.

NBP takes a prudent approach to the possibility of introducing digital zloty and does not currently choose to issue it, in the absence of any convincing justification. The current position of NBP regarding the issuance of digital zloty may be modified if factors (domestic or international) justifying such a change arise.

¹⁴⁴ It should be noted that allowing settlements in central bank money by non-bank entities does not require the central bank to introduce CBDC.

5. Summary and conclusions

CBDC as a digital form of central bank money, accessible to all, could become central banks' response to the demands of the contemporary increasingly digitised world. The rationale for potential CBDC issuance, however, varies depending on the circumstances in individual jurisdictions. In developing economies, the work on CBDC is primarily driven by the low efficiency of payment systems and the financial exclusion of a considerable part of the population. In developed economies, on the other hand, work on CBDC is often driven by the decline in the use of cash in retail payments, which may consequently lead to various risks, associated, among others with the formation of private monopolies in the payment system. The stimulus for central banks worldwide to work on the CBDC issuance is also the dynamic development of modern technology and the possible prospect of global stablecoins introduction by large technology companies. The Covid-19 pandemic has accelerated many projects related to the introduction of CBDC, among others in China.

The above conditions have led to intensive analytical and research work related to the issuance of widely accessible CBDC also initiated in other countries/regions of the world (including the euro area, Japan, Canada, the United Kingdom and the United States). This work is accompanied by initiatives supporting the stability of financial systems and increasing the efficiency of payment systems,¹⁴⁵ such as in the case of the EU: the establishment of a common European legal framework for the market of crypto assets, the adoption of a strategy for the development of retail payments and the creation of a pan-European retail payment system (EPI) based on the TIPS system as a counterbalance to the international systems operated by, for example, the card organisations such as VISA or Mastercard.¹⁴⁶

The nature of the challenges faced by central banks in connection with the introduction of CBDC for retail payments, the possibility of issuance effects crossing jurisdictional boundaries, the multiplicity of technological solutions and the inefficiencies of cross-border fund transfers have all influenced the need for increased international cooperation on CBDC issuance. Since the second half of 2019, an extensive discussion on digital money issuance by central banks has been carried

¹⁴⁵ On 24 September 2020, the European Commission published a package of documents related to digital finance which set out specific proposals for solutions related to, among others, crypto assets and the Commission's support was declared for the work of central banks (in particular the ECB) which explore the possibility of issuing CBDC for retail payments, accessible to the general public (households and economic operators), while protecting the legal tender, i.e. cash in euro. The digital finance package is available at: https://ec.europa.eu/info/publications/200924-digital-finance-proposals_en

¹⁴⁶ The European Payment Initiative (EPI), launched by 16 major European banks (in November 2020, PKO BP S.A. also joined), aims to create a pan-European solution: initially a card-based scheme, and subsequently to use instant payments in euro in stationary points of sale and cardless e-commerce.

out both in the EU and internationally (G20, BIS/CPMI). The central banks' analytical, research and pilot work is supported by the BIS Innovation Hub.¹⁴⁷

Regardless of the process and outcome of the discussions and the level of advancement of the works on the introduction of widely accessible CBDC, the potential issuance of digital currency in a country will be its sovereign decision, taken based on local circumstances. The CBDC should be considered a public benefit which, once in place, will address the challenges or social needs that exists in the particular country. Due to the role to be played by the CBDC and the importance of the issuer as an institution of the highest public trust, the CBDC system must be designed with special care, maintaining safety standards and involving all stakeholders. The system introduced must operate effectively. Its introduction will be preceded by the assessment of the benefits and costs of using digital currency in the context of the achievable balance between global competitiveness, innovation, security and privacy.

The main conclusions drawn from the analysis of the publications of the BIS, central banks and the discussion in international fora are presented below. They refer predominantly to the widely accessible CBDC. At the current stage of work on the CBDC issuance concept, the following conclusions are highlighted:

- 1) in view of the potentially significant impact of CBDC issuance on the monetary system, four main objections should be borne in mind: (1) CBDC should not introduce a structural change in financial intermediation, reduce the stability of funding sources for banking activities and disrupt the two-tier nature of the monetary system; (2) CBDC should have a limited impact on monetary policy and the monetary transmission mechanism itself; (3) the potential introduction of CBDC will not aim at replacing cash, the issuance of which is the primary responsibility of central banks; (4) the cross-border implications of CBDC introduction should be kept in mind, both negative ones such as “dollarization” and positive ones – a possible increase in the efficiency of cross-border payment systems;
- 2) the provision of an adequate/effective means of payment for the developing digital economy and the desire to preserve monetary sovereignty is currently the primary rationale for the introduction of widely accessible CBDC in developed economies;
- 3) the introduction of CBDC must be preceded by the creation of legal grounds for its issuance by the central bank;
- 4) it is necessary to exclude full anonymity in future CBDC systems for reasons of security of such systems as well as prevention of tax evasion, money laundering and terrorist financing;¹⁴⁸

¹⁴⁷ The BIS Innovation Hub currently has three centres operating from Switzerland, Singapore and Hong Kong. However, it will soon extend its activities to Canada (based in Toronto), the euro area (based in Frankfurt and Paris), the United Kingdom (based in London), the Nordic countries (based in Stockholm) and the United States (where the strategic partnership agreement was signed with the Federal Reserve System in New York).

¹⁴⁸ The text of the speech by Augustin Carstens, Director General of the BIS, on *Digital currencies and the future of the monetary system* is available at: <https://www.bis.org/speeches/sp210127.pdf>

- 5) if introduced, CBDC will most likely be distributed through a public-private partnership (in the hybrid or intermediated model). It is assumed that the central bank would provide the critical infrastructure of the CBDC system, while the private sector would support further development of the system by offering innovative user-friendly payment solutions. This solution makes it possible to preserve the two-tier banking system and the role of commercial banks as the main financial intermediaries in the economy;
- 6) the right choice of technology is important, varying depending on the purpose of the issuance and the assumed functionalities of the CBDC. Blockchain or more broadly the DLT does not have to be used for CBDC issuance. The key aspect is the interoperability of existing and newly created systems. Systems built based on DLT technology can deliver greater benefits over centralised systems using conventional technology in the situation of countries where trust in public institutions and compliance with the law is severely limited;
- 7) hybrid solutions are sought, combining the construction of new systems based on DLT/blockchain technology with the maximum use of existing market infrastructure (RTGS systems);
- 8) the impact of the introduction of CBDC on the functioning of the banking system and financial stability is difficult to determine *ex ante* – it will largely depend on the issuance model and basic characteristics;
- 9) a sensitive issue in the considerations concerning the issuance of CBDCs remains the confirmation of identity and the collection, storage and access to transaction data;
- 10) the future coexistence of CBDC with private payment solutions and potential competition between them is important;
- 11) with regard to the CBDC issuance concept for wholesale payments, the most efficient solutions resulting from the use of systems based on DLT are searched for (e.g. the introduction of synchronised settlement ('atomic' settlement) in the Delivery vs. Payment model). Assuming that it will be the prevailing technology in the financial system in the future, the streamlining will be aimed at connecting payment and securities clearing and settlement systems of multi-currency systems operating on a cross-border basis;
- 12) in the work on the CBDC, great emphasis has been placed on improving the cross-border transfer of funds, particularly with regard to remittances. This could be done through international cooperation by agreement on common standards for future CBDC systems.

NBP is monitoring closely the progress of CBDC issuance worldwide and assesses the needs of the Polish market in this area, so that, should the need arise, it can take appropriate action to introduce digital zloty in Poland. So far, NBP has not identified a systemic purpose of issuing digital zloty or any specific needs of consumers or business entities that could not be met by payment service providers in Poland, but only by the central bank through the introduction of CBDC. The results of the conducted analyses indicate that there are no clear benefits arising from the introduction of central bank digital currency in Poland in relation to the perceived risks of its issuance for the economy, cash transactions and the financial system. NBP takes a prudent approach to the possibility of introducing digital zloty and does not currently choose to issue it, in the absence of

any convincing justification. NBP's current stance on the issuance of CBDC may be modified should factors (domestic or international) justifying such a change emerge.

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Appendix: Status of work on CBDC issuance worldwide

Status of work on the CBDC issuance concept for retail payments worldwide¹⁴⁹

CBDC for retail payments					
No.	Country	Premises/objective	Project name/ Currency	Status	Additional Information
1.	Australia	No premises.	Digital dollar	Research	Last publication : September 2020.
2.	Bahamas	Increasing financial inclusion, combating money laundering, reducing the shadow economy, creating digital public administration.	Sand Dollar	Implementation	Implementation of CBDC was launched in October 2020. A public consultation on the draft regulation on CBDC was launched.
3.	Brazil	Improving well-being and increasing the financial inclusion of society.	SALT	Research	In August 2020, the working group on the implementation of the CBDC was appointed.
4.	China	Creating a digital representation of banknotes and coins.	DC/EP (Digital Currency/ Electronic Payments)	Pilot testing	Gradual expansion of the scale of the pilot project. In February 2021, the tests on the use of the digital yuan in retail payments in Beijing were conducted.
5.	Czech Republic	Providing central bank money in digital form amid a decline in the share of cash in retail transactions and the development of the digital economy.	Digitální koruna	Research	First publication : February 2021.
6.	Denmark	No sufficient premises.	E-krone	Research	Last publication : December 2017.
7.	Estonia	Providing central bank money in digital form amid the dynamic development of the digital economy.	e-euro	Research	The research project was launched in October 2020.
8.	Eswatini	Improving the efficiency of the payment system and increasing.	e-lilangeni	Research	In February 2020, the report on the completed first phase (of four planned) of a diagnostic

¹⁴⁹ Own study based on information published by central banks and the BIS, as at 31 March 2021.

		the use of digital financial services.			study on the future use of CBDC was published.
9.	Finland	Providing central bank money in digital form amid a decline in the share of cash in retail transactions and the development of the digital economy.	e-euro	Research	Last publication : May 2017.
10.	Philippines	Reducing financial exclusion, increasing access and reducing the cost of financial services.	ePiso	Pilot testing	In July 2020, the technical working group for assessing the impact of CBDC issuance was appointed.
11.	France	Offering a fully liquid and secure payment instrument, adapted to technological changes. This solution could help maintain EU sovereignty in transactions, being independent of private or foreign participants.	e-euro	Research	Last publication : February 2020.
12.	Netherlands	Providing central bank money in digital form amid a decline in the share of cash in retail transactions and the development of the digital economy.	E-euro	Research	Last publication : April 2020.
13.	India	Increased efficiency and security of payments and improved cash management process.	Digital rupee	Research	Last publication : February 2021.
14.	Indonesia	Providing central bank money in digital form amid the dynamic development of the digital economy.	digital rupiah	Research	Last publication : January 2019.
15.	Iceland	Providing central bank money in digital form amid a decline in the share of cash in retail transactions and the development of the digital economy.	Rafkróna	Research	Last publication : September 2018.
16.	Israel	Providing central bank money in digital form amid a continued decline in the share of cash in retail transactions; support the development of the digital economy, especially the FinTech sector; combating unregistered business activity.	e-shekel	Research	Last publication : November 2018.
17.	Jamaica	Increased efficiency and security of payments and improved cash management process.	Digital Jamaican dollar	Development	Work is underway to develop a prototype system and the CBDC

					implementation plan , foreseen for 2022.
18.	Japan	Ensuring the security and effectiveness of electronic payment systems.	Digital-Yen	Research	Last publication : December 2019. The Bank of Japan plans to launch technical tests of the digital yen in spring 2021.
19.	Canada	CBDC as a contingency solution for providing central bank money in digital form amid a decline in the share of cash in retail transactions and the further development of the digital economy.	E-dollar	Research	Focusing analyses on the issue of privacy and the introduction of an instrument for universal access to CBDC. Last publication : January 2021.
20.	South Korea	Providing central bank money in digital form amid the dynamic development of the digital economy.	E-won	Pilot testing	The second phase of the pilot project , which will run until December 2021, is underway.
21.	Lithuania	Increasing the security and efficiency of payments, especially cross-border payments.	Digital euro	Research	Last publication : December 2019.
22.	Malaysia	Providing central bank money in digital form amid the dynamic development of the digital economy and maintaining the monetary sovereignty.	E-ringgit	Research	Focusing analyses on increasing the effectiveness of cross-border transfer of value.
23.	Mauritius	Providing central bank money in digital form amid the dynamic development of the digital economy.		Research	In May 2020, the Governor of the Bank of Mauritius, Harvesh Seegolam, announced , that the project to create digital money is at the development stage and that further steps will be announced in the near future, including even the implementation of CBDC.
24.	Germany	Analysis of the opportunities and threats posed by the CBDC.	Digital euro	Research	In February 2021, Burkhard Balz, Member of the Executive Board of Deutsche Bundesbank, indicated that the most important features of a future CBDC system for retail payments should be interchangeability, interoperability and compliance with international standards.
25.	Norway	Providing central bank money in digital form amidst a decline in the share of cash in retail transactions and the	E-krone	Research	Last publication (at project stage 3): September 2020.

		development of the digital economy; providing a back-up solution in case of failure of retail payment systems; maintaining competition between various payment instruments.			
26.	New Zealand	Providing digital central bank money amid the dynamic development of the digital economy; reducing the cost of producing and distributing cash and its share in retail transactions; providing a back-up solution in case of failure of retail payment systems;		Research	Last publication : June 2018.
27.	Poland	Providing central bank money in digital form amid the dynamic development of the digital economy.	Digital zloty	Research	In February 2021, the Governor of NBP, Professor Adam Glapiński, officially informed that NBP has been analysing issues related to the central bank's digital currency, with negative conclusions prevailing so far.
28.	Russia	Creating a digital ruble to decrease payment costs, reduce financial exclusion and increase innovation in payment technologies.	Digital ruble	Research	The public consultation was launched on 13 October 2020 on the basis of the report on the digital ruble.
29.	United States	Provision of digital central bank money amid the dynamic development of the digital economy (maintaining fiduciary money in the centre of the payment system); alternative to stablecoins, increasing financial inclusion.	Digital-dollar	Research	The Federal Reserve conducts analyses of the effects of introducing CBDC and experiments in the scope of financial/payment solutions built on DLT.
30.	Euro area	Readiness of the European Central Bank to issue CBDC, in the event of: an increase in the demand for electronic payments in the euro area; a significant decline in the use of cash as a means of payment in the euro area; the introduction at global level of private means of payment with questionable legal status; the popularisation of digital currencies issued by foreign central banks.	Digital euro	Research	Last report of the High-level Eurosystem Task Force on the introduction of CBDC: October 2020. Social consultation : closed on 12 January 2021.
31.	Switzerland	Providing central bank money in digital form amid the dynamic development of the digital economy and the growing importance of virtual	e-franc	Research	Last publication : February 2021.

		currencies and digital payment solutions offered by private entities; providing electronic payments with the characteristics of being more resilient to disruption, more efficient, inclusive and innovative.			
32.	Sweden	Provision, amid the dynamic development of the digital economy, of central bank money in digital form as a response to the decline in cash in circulation and the decrease in the share of cash in retail transactions; creation of a back-up system in case of failure of payment systems	e-krona	Pilot testing	The pilot projects has been conducted since February 2020. (Accenture as technology partner) Last analytical publication : June 2020.
33.	Turkey	Providing digital central bank money amidst the dynamic development of the digital economy, and in particular supporting the financial sector (so that Istanbul becomes an attractive global financial centre).	Digital lira	Pilot testing	It is assumed that first stages of pilot testing will be concluded by the end of 2020. Latest report (in Turkish) on CBDC: November 2019.
34.	Ukraine	Providing central bank money in digital form amid a decline in the share of cash in retail transactions and the development of the digital economy; expanding the offer in the scope of available forms of electronic payments.	e-hryvnia	Pilot testing	In December 2020, an agreement with the Stellar Development Foundation was signed to create a strategy for the development of digital assets, including CBDC.
35.	Eastern Caribbean Union	Increasing financial inclusion, supporting economic growth and competitiveness, enhancing the resilience of the payment system.	DCash	Implementation	Implementation of CBDC has been carried out since 31 March 2021 in four pilot states of the region, namely St Kitts and Nevis, St Lucia, Antigua and Barbuda, and Grenada.
36.	Uruguay	Providing central bank money in digital form amid the dynamic development of the digital economy; enhancing financial inclusion; increasing the efficiency of existing payment systems and payment instruments.	e-Peso	Pilot testing	In April 2018, the first phase of the pilot project was completed successfully.
37.	United Kingdom	Supporting a flexible payments environment, avoiding the risks associated with new forms of private money, promoting competition, efficiency and innovation in payments.	E-pound	Research	Last publication : March 2020. On 12 June 2020, the collection of responses to the CBDC questions contained in the

					"Discussion Paper" was completed.
38.	Marshall Islands	Providing central bank money in digital form amid the dynamic development of the digital economy; providing a means of payment that is easier to use than cash for a population dispersed across many islands, reducing the cost of remittances especially between the Marshall Islands and the USA.	SOV	Development	The government has agreed to carry out pilot project . Preparations are underway.

Status of work on the CBDC issuance concept for wholesale payments worldwide¹⁵⁰

CBDC for wholesale payments					
No.	Country	Premises/objective	Project name	Status	Additional Information
1.	Saudi Arabia/United Arab Emirates	Assessment of the practical benefits and costs and possible technical risks of a DLT-based settlement system built for mutual financial transfers between two countries.	Aber	Research and tests	The report presenting the results of the work carried out under the project was published in November 2020.
2.	Australia	Analysis of the feasibility of using DLT to build a system in which it would be possible to integrate CBDC with the process of exchange and settlement of tokenized financial assets.		Building the proof-of-concept	Official announcement on launching the cooperation with private entities in November 2020.
3.	France	Analysis of the feasibility of using DLT to build a system in which it would be possible to integrate CBDC with the process of exchange and settlement of tokenized financial assets.	Madre	Research and tests	An experiment on using CBDC in interbank settlements (with IZNES company) was conducted: January 2021.
4.	Hong Kong/Thailand	Analysis of the feasibility of using DLT technology in building a settlement system for cross-border fund flows.	Inthanon - Lionrock	Research and tests	The results of the tests conducted within the project are presented in the report : January 2020.
5.	Canada	Identification of potential gains for interbank payments arising from the use of DLT.	Jasper	Research and tests	Four phases of the project have been carried out since 2017. Last report on the study: May 2019.
6.	South Africa	Analysis of the possibility of using DLT technology in the construction of financial market infrastructure.	Khokha	Research and tests	In February 2021, the start of the second stage of testing was announced.
7.	Singapore	Assessing the feasibility of using DLT to transfer funds in real time within the country, with the prospect of applying the technology to cross-border settlement of payments and securities.	Ubin	Pilot testing	Five phases of the project have been carried out since 2016. Last report on the study: July 2020.
8.	Euro area /Japan	Analysis of the possibility of using DLT technology in the construction of financial market infrastructure.	Stella	Research and tests	Four phases of the project have been carried out since 2017. Last report on the study: February 2020.
9.	Switzerland	Analysis of the feasibility of using DLT technology to build a digital asset trading platform and attempt to integrate central bank money into the DLT ecosystem.	Helvetia	Research and tests	The report presenting the results of the work carried out under the project was published in December 2020.

¹⁵⁰ Own study based on information published by central banks and the BIS, as at 31 March 2021.

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