ANALYSIS OF THE PROCESS OF ADOPTION OF CBDC BY SELECTED CENTRAL BANKS AND DISCUSSION OF OPPORTUNITIES AND THREATS RELATED TO THIS TECHNOLOGY

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Abstract

Background and Objective: In recent years, the financial system worldwide has been influenced by two phenomena. The first one is the growing popularity of cryptocurrencies. The second is the decline in cash transactions in favour of digital payments methods. In response to these developments, central banks considered issuing their own digital currencies. Such money would facilitate payments, promote financial inclusion, and avoid credit risk. The aim of the article is to present the potential impact of CBDC on the financial system and analyse individual banks' motivation for its introduction.

Materials and Methods: The article is based on reports and working papers published by central banks and international institutions. It employs the method of comparative analysis.

Results: Issuance of CBDC may help countering financial exclusion in countries with a poorly developed banking system. However, the widespread adoption of CBDC could threaten the financial stability through the risk of an inflow of deposits to credit risk free CBDC. The scale of this process and its effects will depend on CBDC holding limit. Increasing the scale of financing commercial banks by central banks does not have to increase the risk for the public sector due to well-developed deposit guarantee schemes. All in all, CDBC will not be the perfect substitute for stablecoins because of lower anonymity and tax issues.

Practical implications: Central banks should consider issuing CBDC. This will enable them to co-create the changing digital payment market and thus increase its reliability and security.

Conclusion and summary: There are many opportunities and threats associated with CBDC issue. A well-designed system has the ability to take advantage of the opportunities and avoid most threats. Designing CBDC properly is one of the main faiths facing central banks.

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1. The market situation is favourable for the issue of CBDC

In recent years, many phenomena have been taking place on a global scale. They have forced central banks to redefine their role in the economy and the role of money they issue – central bank money. One of the phenomena is the growing popularity of digital forms of payment, replacing cash. Electronic payment methods, when used for settlements in most transactions, entail many risks. The first is the creation of monopolies in the payment systems, which is fostered by network effects. High concentration leads to a situation where private companies control critical infrastructure in many countries. China is an example of the country that sees the growing role of private payment systems and tries to counteract it. In this country, 95% of city dwellers use Alipay or Wechat as their primary payment method (Daluxe Consulting, 2021). The second result of replacing cash with other payment systems is the risk for settlement of transactions in the event of failure of electronic payment systems. Moreover, declining cash acceptance poses a problem for people who are financially excluded.

Another problem faced by modern financial institutions and citizens is the high cost of international payments. Research shows that the average cost of a transfer to another country is over 6% of the amount transferred (The World Bank Group, 2021, p. 6). In addition to the high fee, long accounting times are also an issue.

The last of the main phenomena affecting financial stability and forcing to rethink the importance of various forms of money in the economy is the growing popularity of cryptocurrencies, in particular stablecoins. Stablecoins are digital currencies whose purpose is to reflect the price of another asset, for example U.S. Dollar (ECB Crypto-Assets Task Force, 2020, p. 3). The two stablecoins with the highest capitalization (as of May 10, 2022) - Tether (USDT) and USD Coin (USDC) – base their value on the USD, and in order to obtain a stable price they have assets corresponding to their capitalization (Tether, n.d.; Circle, 2022). Their mode of operation can be compared to money market funds, with the difference that the profits generated do not increase the value of the stablecoin.

Stablecoins have become popular because they enable convenient transactions between cryptocurrencies, acting as a dollar substitute. Thanks to the fact that stablecoin is based on blockchain infrastructure, it is possible to make transactions relatively anonymously on many cryptocurrency exchanges (Europol, 2021, pp. 7–10). Additionally, in the tax systems of some countries, trade between cryptocurrencies

(including stable coins) is tax-neutral, which allows investors to delay tax settlement. For example, Poland (Ministry of Finance, n.d.)[2] and France (Koinly, 2022) have such tax system.

However, it should be noted that some of the stablecoins are not regulated, which raises investors' doubts as to the quality of their reserves and the possibility of maintaining the assumed exchange parity to the underlying asset. For example, when the market was concerned about the bankruptcy of the Chinese developer Evergrande, some market participants then suggested that Tether may have bonds of other Chinese developers also at risk of collapse (Faux, 2021). Insolvency of one of the large stablecoins could negatively affect the entire financial system and translate into significant losses for many investors. In addition, doubt about the quality of collateral or other market phenomena may lead to a rapid outflow of capital from stablecoin, which creates a liquidity risk (Board of Governors of the Federal Reserve System, 2022b, pp. 42–44).

Among other things, the above-mentioned phenomena have caused many central banks to work on the issue of their digital currency – Central Bank Digital Currency (CBDC). A recent study by the Bank of International Settlements (Boar & Wehrli, 2021, pp. 5–6) shows that 86% of the surveyed central banks are working on CBDC. Such a currency would be a direct claim against the central bank and the third form of central bank money – next to cash and (available only to selected enterprises) deposit in central bank (Payment Systems Department, 2021, pp. 14–15)[3]. CBDC as the money of the central bank is distinguished by the lack of credit and liquidity risk, while the payment system that could be built based on it would be independent of the current one and controlled by CBDC issuer. Moreover, simplicity, low cost, and confidence in CBDC can support the financial inclusion of those who do not have access to financial services (Group of Central Banks, 2020).

2. Progress in CBDC adoption by central banks

Among the many central banks that study the possibility of CBDC issuance or are advanced in technology implementation, the most important from the analytical point of view are these which: issue the most important global currencies, provide money for the largest economies and those that have already implemented CBDC. Central banks that play the most important role in the global economy are the Federal Reserve System (FED) and the European Central Bank (ECB). These organizations are researching the possibility of implementing CBDC, but have not decided on its future issue. However, from the studies prepared in these banks, one can get an idea of the possibilities of technical solutions as well as the opportunities and threats related to the issuance of CBDC in these currency areas.

[2] Ministerstwo Finansów

[3] Departament Systemu Płatniczego NBP

China is an important country in the global economy. CBDC project implemented by the People's Bank of China is currently in the pilot phase in selected regions of the country. It is possible to implement CBDC in China in the coming years, which would be the first CBDC used in such a large economy (Kumar, 2022).

Banks that have already issued CBDC are Central Bank of the Bahamas and Central Bank of Nigeria (CBDC Tracker, n.d.). The analysis of the solutions applied by these banks provides valuable information on their effectiveness and implementation possibilities. However, it should be noted that the Bahamas, which first launched their CBDC – Sand Dollar – did it in October 2020 (Sand Dollar, 2020), so it is not long enough to fully analyse the success of these CBDC.

It should be noted that the above-mentioned central banks focus their attention on the issue of CBDC for the domestic market of retail payments. The use of CBDC for large-value payments or international transfers is less advanced.

Before proceeding to further analysis, it should be clarified what two main methods of CBDC distribution are developed by central banks. The first one assumes opening a central bank account for individuals. It would give access to similar possibilities as accounts in commercial banks, and transactions between users would be settled immediately - like transactions within one bank. It would also be possible to pay with cards or smartphone application (Payment Systems Department, 2021, pp. 20–21).

The second model involves the use of a Blockchain-like infrastructure. Thanks to this, the central bank could issue its token which would then be distributed to users' wallets. This distribution would take place with greater or lesser participation of intermediaries. There are possible solutions in which intermediaries execute most of the payments and the central bank only provides liquidity, as well as solutions where central bank maintains a centralized register of all transactions (European Central Bank, 2020, pp. 24–41). In this model, public and private keys and cryptography could be used to perform transactions (Payment Systems Department, 2021, pp. 18–22). Similar system is used, for example, by the Bitcoin network.

3. Opportunity analysis

One of the many advantages of CBDC issue is the possibility of using it as an alternative means of payment. This would be an alternative to currently used electronic payment systems, which, due to the convenience of use, force cash. Thanks to this market participants could trade in the safest form of money, which would be as convenient as other digital systems. Moreover, CBDC would also be available in Internet shopping, where previously it was not possible to make payments with central bank money (Lagarde, 2022). It should be noted here that the goal of most central banks is not to eliminate cash, but to expand the available forms of payments. Cash is to be delivered as long as there is a demand for it – such a declaration was

made, among others, by the central banks of Canada, Euro Area, Japan, Sweden, Switzerland, England, the United States (Group of Central Banks, 2020, p. 1).

If the payment system were based on a different technical infrastructure than the current one (in most countries, the point of sale (POS) card payment system or with the use of smartphones), it could function in the event of a failure of the current one. Some studies point out that the use of CBDC as legal tender could be mandated by law, for this reason, sellers will not be able to refuse to accept the payment in CBDC. Government could also pay out household benefits and transfers from the state in CBDC. Such a solution would help in the quick adoption of CBDC by the participants of economic life (Group of Central Banks, 2021b, pp. 3–7).

The payment system in CBDC could also differ from the current one in the possibility of making payments without an Internet connection. The ability to make such transactions is important in places with limited internet access, during internet access failures, and natural disasters. Making offline payments using CBDC is the goal of many central banks and one of the requirements that a digital EURO would have to meet (European Central Bank, 2020, p. 11).

A study prepared at the ECB indicates the possibility of creating two payment systems: online and offline. An online system would require an internet connection and could be based on smartphone applications. Offline payments would be made using payer and payee hardware devices. Citizens using both forms of CBDC would be able to transfer money between them (European Central Bank, 2020, pp. 30–32). Other studies indicate the possibility of making offline payments available to users up to a specified amount and for a specified period, without the need to create two systems (Group of Central Banks, 2020, p. 11). The system, which is piloted in China, assumes offline transactions with cards or smartphones using wireless communication (Atlantic Council, 2022).

The use of CBDC should also increase the efficiency of payment systems. A special opportunity for improvement is seen in international transfers. Work at BIS identifies three potential models for merging CBDC issued by different central banks to facilitate payments between users in different currency areas (Auer, Haene, & Holden, 2021, pp. 5–9).

The first model are separate CBDC systems but based on the same technical standards and the Know Your Customer (KYC) verification. Similar CBDC systems would enable the creation of private intermediaries in transfers between different currencies.

The second option are CBDC connected through the same technical interface or a common transaction settlement mechanism. In this model, central banks would recognize the KYC verification performed for another CBDC currency. Most of the central banks, which have already decided on their preferred model of links with other CBDC, chose this model. Additionally, some central banks see the possibility of intermediation in currency exchange (Bank for International Settlements, 2021, p. 89).

The third model are CBDC issued by different central banks combined into a single multiple CBDC system. In this model, all currencies would have a common transaction register and clearing mechanism. Establishing such a system would require many arrangements between central banks and ceding control over the system to a common institution.

The introduction of CBDC could also lower the cost of retail domestic payments. CBDC may involve lower commissions charged to merchants than current payment systems. For example, in China, accepting payments at CBDC is (and will likely remain) free, as opposed to Alipay and Wechat costing between 0.38–0.6% of the transaction amount (Bloomberg Intelligence, 2021). In countries where CBDC would translate into a decrease in the use of cash, this would mean a lower cost of its circulation. This is one of the incentives for the introduction of CBDC, especially for island and large territorial countries (Payment Systems Department, 2021, pp. 29–30). Moreover, the electronic payment system is easier and faster to restore after a disaster than the cash one. This is one of the advantages highlighted in the context of the hurricane-prone Bahamas (Rolle, 2021).

The use of CBDC is to be free (for individuals) and convenient, thanks to the possibility of using both the phone application and the hardware wallet. The security of CBDC is guaranteed by its issuer, the central bank, which enjoys the greatest trust among all financial institutions (Official Monetary and Financial Institutions Forum, 2020, p. 7). The goal of CBDC issuers is easy onboarding of new users. Such a shape of the system will support financial inclusion both in emerging markets with an underdeveloped banking sector (Central Bank of Nigeria, n.d., p. 11) and in developed markets where, due to lack of trust or high fees, some citizens still do not have access to financial institutions (Board of Governors of the Federal Reserve System, 2022a, p. 8).

Making payments using CBDC will be more anonymous than other forms of digital payments. First of all, greater anonymity will result from lower KYC requirements. There are different tiers of user verification in CBDC projects. Providing more data afford larger limits on funds, but it is not required for basic use of CBDC. In the case of the Bahamas, the following is required to open an account: name and surname, date of birth, address, telephone number, and photo. Presenting the official ID is not required. Such a verified account allows to make transactions up to $1,500 per month and have a balance of up to $500 (Central Bank of The Bahamas, 2019, p. 23). The system developed in China assumes the possibility of verification only by a telephone number, which gives the possibility of making a single payment up to $297 and $741 of the total transaction amount during the day. The maximum limit of funds held has been set at $ 1,453 (Atlantic Council, 2022).

What's more, central banks, unlike private operators, will not seek to monetize their user data. Although they will have to process it to a limited extent due to legal requirements, such as anti-money laundering and counter financing of terror-

ism (Group of Central Banks, 2021a, pp. 7–8). KYC verification is needed also to introduce limits for its use, which will be described later in the article. On the other hand, central banks indicate the necessity to cooperate with private entities during the KYC verification (Board of Governors of the Federal Reserve System, 2022a, pp. 13–14) so the users' privacy will also depend on their model of cooperation with intermediaries.

4. Threat analysis

The introduction of CBDC will be an important change for the financial system as citizens will have convenient access to central bank money. The analyses indicate that it may be the preferred form of money and cause an outflow of deposits from the banking sector. This would increase the cost of banks financing and decrease their importance in the economy. Additionally, a sudden outflow of deposits will require refinancing of banks' assets by the central bank to provide them with liquidity (Bindseil, 2020, pp. 11–12). This risk is also associated with the risk of an increase in the scale of bank panics, during which depositors will massively convert deposits to CBDC (Group of Central Banks, 2020, p. 8).

These threats can be counteracted with the appropriate design of CBDC. Studies prepared at central banks point out that thanks to the introduction of quota limits and unfavourable interest rates (including negative ones), it is possible to introduce CBDC as a means of payment, not a store of value. Due to the concentration of banks' work on CBDC for retail payments and use by individuals, the analysis will mainly focus on restrictions for citizens.

The first limitation preventing the substitution of bank deposits is CBDC balance limits. The maximum amounts that users can hold are presented in Table 1. Depending on the local market conditions, other central banks may introduce lower limits. The limit of funds does not mean that every citizen will withdraw a given amount from the banking sector. Some citizens do not have enough money to use the full limit of their CBDC holding, and for some, it will be only a fraction of their savings – the rest will remain in the bank.

Another factor preventing the outflow of deposits may be unfavourable interest rates. Currently implemented projects and a pilot in China do not assume interest payments, as CBDC is supposed to be like cash. In the case of currencies where the interest rates are negative, there is a possibility of introducing negative interest rates on CBDC. One idea is to introduce two interest tiers – the first level would be more favourable and would be sufficient for a statistical household to make everyday purchases. The second level would discourage citizens from investing their funds in CBDC. A study prepared by the ECB proposes a first level of deposits up to €3,000. The interest rate on both limits would be set as the ECB deposit facility rate minus margin. With the proviso that the first tier would never bear interest below zero and

the second tier would be a maximum of zero. In the event of a significant outflow of deposits to CBDC, there would be an option to increase the margin to discourage people from transferring funds to CBDC (Bindseil, 2020, pp. 22–26). Additionally, to prevent bank panics, a limit on the accumulation of CBDC over a certain period may be introduced (Board of Governors of the Federal Reserve System, 2022a, p. 18).

Assuming an unfavourable CBDC interest rate relative to a bank deposit, a massive outflow of capital from individual clients to CBDC seems unlikely. What is more, in the analysed countries, there are deposit guarantee schemes (DGS) that protect the deposits in banks up to a specific amount – the data is presented in Table 1. Persons whose savings exceed the guaranteed amount, depending on the solutions of individual DGS, have the option of increasing the value of guaranteed deposits by opening accounts in many banks or having ones with another person. Thanks to such solutions, the effective amount of the deposit guarantee may be very high and significantly exceed the potential limits of funds in CBDC. This means that there is no incentive for citizens to transfer funds to central bank money, even during a severe banking crisis.

Table 1. Amount guaranteed by the DGS and the maximum limit of funds on CBDC in selected countries

Country	CBDC holding limit	Guaranteed deposit amount
Bahamas	$8,000	$50,000
China	$74,135	$74,135
Euro area	€3,000*	€100,000
Nigeria	$12,041	$1,204
United States	no information	$250,000

* Proposal for the first tier of interest

Values in currencies other than USD and EUR converted into USD at the rate of May 18, 2022 based on: stooq.pl.

Source: own study based on Deposit Insurance Corporation (2022); Central Bank of The Bahamas (2019, p. 24); Atlantic Council (2022a); Fitch Ratings (2019); Bindseil (2020, p. 24); European Council (2019); Central Bank of Nigeria (n.d., p. 14); Nigeria Deposit Insurance Corporation (2022); Board of Governors of the Federal Reserve System (2022a, p. 5).

Some studies indicate the risk that the central bank would bear if, due to the outflow of deposits, they had to finance commercial banks (European Central Bank, 2020, pp. 16–18). However, to evaluate if central banks would bear the credit risk previously incurred by depositors, attention should be paid to the DGS.

Assume, as before, that the outflow to CBDC mainly affects individuals. If they are aware of the various forms of money, they should also be aware of the DGS structure and ensure that all their funds are covered. (This is impossible for very rich people, but due to CBDC balance limits, they would not be able to withdraw a large part of their savings from the banks). With such assumptions, the flow of deposits to CBDC combined with the refinancing of banks would mean an increase in risk for the central bank equal to a decrease in the amount of deposit guarantees. This would mean a transfer of risk from the DGS to the central bank. Given that the government is responsible for ensuring an adequate amount of funds in DGS (Directive 2014/49 /EU, Art. 10), this is a transfer of risk within the public sector. Appropriate legal regulations could transfer the risk back from the central bank to the DGS. For example, DGS could guarantee part of the refinancing operations provided by the central bank. Tables 2 and 3 show the impact of the transfer of the deposit to CBDC on the risk for the public sector.

Table 2. Balance sheets of household, commercial bank, central bank, and DGS guaranteed amount before transfer of the deposit to CBDC. Simplified diagram.

Assets		Liabilities	
HOUSEHOLD			
Bank deposits	85	Equity	87
CBDC	2		
COMMERCIAL BANK (CO)			
Credits	80	Deposits	85
Deposit in CE	5	Refinancing operations	0
CENTRAL BANK (CE)			
Foreign currency	7	Liabilities to CO	5
Refinancing operations	0	CBDC	2
DEPOSIT GUARANTEE SCHEME			
GUARANTEED AMOUNT		85	
CE risk		0	
Public sector risk		85	

Assumptions: sum guaranteed in the bank 100, limit of CBDC held 50, initial deposit 85.
Source: own study.

Table 3. Balance sheets of household, commercial bank, central bank, and DGS guaranteed amount after transfer of the deposit to CBDC. Simplified diagram.

Assets		Liabilities	
HOUSEHOLD			
Bank deposits	37 –48	Equity	87
CBDC	50 +48		
COMMERCIAL BANK (CO)			
Credits	80	Deposits	37 –48
Deposit in CE	5	Refinancing operations	48 +48
CENTRAL BANK (CE)			
Foreign currency	7	Liabilities to CO	5
Refinancing operations	48 +48	CBDC	50 +48
DEPOSIT GUARANTEE SCHEME			
GUARANTEED AMOUNT		37 –48	
CE risk		48 +48	
Public sector risk		85 = 0	

The change in value resulting from the transfer of the deposit to CBDC is marked in red. The green is a change resulting from refinancing operations.

Source: own study.

However, central bank financing of commercial banks could lead to a greater role of central banks in the allocation of resources in the economy. Commercial banks would have to buy assets that would be accepted as collateral, thus indirectly influencing the availability of financing for the economy. However, it should be noted that banking activities are already heavily regulated, and banks have imposed requirements regarding, for example, credit assessment (Gałązka, 2019, pp. 97–98). Moreover, refinancing operations are already conducted, for example, in the Euro area (TLTRO) and have become one of the instruments of monetary policy (European Central Bank, 2021).

Another risk associated with the introduction of CBDC is "dollarization".[4] In a situation where CBDC issuer would allow people from other countries to open their wallets, they would be able to conveniently make payments in this curren-

[4] The term is used to name the phenomenon of crowding out the national currency by another one. It is not intended to indicate a specific currency.

cy. In countries where an official currency is not trusted by the public, this would facilitate its replacement by another. In such a situation, a country affected by this phenomenon would lose the ability to conduct monetary policy. It could also cause conflicts between CBDC issuing country and the affected country. To counteract this phenomenon, it is possible to introduce restrictions for non-residents in access to CBDC, they could concern: holding limits, unfavourable interest rates, restrictions on opening an account, or performing only specific transactions (European Central Bank, 2020, pp. 21–29). Such restrictions will make dollarization with cash or stablecoins more likely.

5. Conclusions

CBDC emission can bring many benefits to society. The most important of these are cheaper, safer, inclusive, and more anonymous transactions. Additionally, as a cash substitute, CBDC will enable offline payments, facilitating transactions in places with limited access to the Internet and during its failure. To use the full potential of CBDC, cooperation between central banks is important.

If CBDC project is not carefully prepared, it may hit the banking sector, causing an outflow of deposits to a convenient and credit risk-free central bank money. It seems that by creating appropriate limits and restrictions, it is possible to effectively minimize the negative impact of CBDC on the banking sector while maintaining most of its benefits. However, even in a situation where CBDC affects the deposit base of commercial banks, the central bank may take measures to reduce the related risks, by offering banks refinancing operations. Such operations do not have to imply additional risk-taking by the public sector as DGS previously insured funds that would be transferred to CBDC.

It seems that in the era of digital transformation, central banks should conduct research and start issuing CBDC when it is justified. Thanks to this, they will create a well-thought-out system which they will have under control, instead of giving the initiative to the private sector creating, for example, stablecoins that may threaten financial stability. However, the introduction of CBDC will not mean an immediate loss of utility offered by stablecoin, because, unlike CBDC, they enable anonymous transactions and tax optimization (OECD, 2020, p. 49). Additionally, stablecoins have no balance limits and can be traded on decentralized exchanges. Probably CBDC and stablecoin will function in parallel, with the first being widely used and the second utilized by cryptocurrency traders.

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