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# The Ockham's Razor: How to Implement CBDC Simply: The Idea of a Digital Currency Bank

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**Abstract**: Central banks that intend to implement Central Bank Digital Currency (CBDC) must decide whether to leverage blockchain as their technology or introduce digital currency on their own terms. We argue that the first option is not a good idea, as it implies the application of a very complicated, non-intuitive, and expensive solution, which cannot meet some central banks' expectations. Instead, we propose a special entity – a Digital Currency Bank (DCB) – as a method to implement CBDC. The DCB would use traditional information technology successfully employed by banks for years, instead of the intricate blockchain technology used to implement cryptocurrencies.

**Keywords**: Central bank digital currencies (CBDC), cryptocurrencies, blockchain, money.

**JEL classification:** E42, E51, E58

## 1. Introduction

In October 2008, an article titled "Bitcoin: A Peer-to-Peer Electronic Cash System" (Nakamoto, 2008), authored by the enigmatic Satoshi Nakamoto, who remains unidentified to this day, appeared online. It likely would have gone unnoticed if, a few months later in January 2009, Satoshi Nakamoto had not released perfectly conceived, incredibly innovative open-source Bitcoin software on the Inter-

net, available for everyone to use, inspect, copy, and utilize for their purposes. Thus, cryptocurrencies were born – a novel, previously unknown form of electronic payment instrument, eventually aspiring to become a new form of money.

In the wake of cryptocurrencies' success, central banks felt somewhat threatened and decided to respond to this threat by initiating mainly analytical work to design a Central Bank Digital Currency (CBDC). Given the rapidly progressing digitization of economies and societies, considering a move away from paper cash to digital solutions was understood to be undoubtedly sensible. However, the question that needed addressing was: "How should it be done"?

Central banks were fascinated by the solution proposed by Satoshi Nakamoto in Bitcoin, particularly the blockchain (distributed ledger technology), and they decided to adopt this technology to implement the CBDC. However, as we demonstrate in this paper, this approach would not succeed because the assumptions under which Bitcoin and other cryptocurrencies were developed are inconsistent with the objectives that individual central banks set for themselves in creating the CBDC. Moreover, building CBDC this way brings too many complications and low transparency. In this context, this paper aims to present a CBDC solution that is not based on blockchain but on the creation of a Digital Currency Bank (DCB). This new specific entity is entirely subordinate to the central bank.

The paper is organized as follows: Section 2 presents an overview of the current state of the art with regard to CBDC, with special attention paid to its potential benefits and disadvantages. Section 3 outlines the distinctive features of paper cash: privacy and anonymity, while Section 4 sheds light on the problem of the ability to make offline payments. These issues are discussed in the context of CBDC, demonstrating that they are unachievable. Then, Section 5 discusses the drawbacks of implementing the CBDC using the blockchain and the conclusions drawn from them. Section 6 is dedicated to the Digital Currency Bank, its principles, an analysis of potential disadvantages and advantages, and the issue of CBDC interest. Section 7 concludes and provides direction for further study.

## 2. CBDC – State of the Art

Research and discussions on the concepts and various aspects of issuing central bank money in digital form have been ongoing since 2014, when the People's Bank of China started activities in this area (Cheng, 2023; Turrin, 2021). In particular, the emergence and increase in popularity of CBDCs stem from a combination of many factors, accumulating, as it were, during the COVID-19 pandemic:

1. the rise and fast proliferation of cryptocurrencies (Hazlett & Luther, 2020; Popper, 2016, Yermack, 2016);
2. increasingly difficult conditions for the implementation of monetary policy by central banks since the Global Financial Crisis (Bordo & Levin, 2017; King, 2017);
3. the digitalization of economic activity (Ahnert et al., 2024; Marszałek & Ratajczak-Mrozek 2022);
4. the evolution and specific emancipation of financial institutions on the one hand and the development and proliferation of fintech and non-financial payment institutions on the other hand;
5. the rise of BigTech agents' interest in financial area (Carstens, 2017; Stulz, 2022);
6. recognizing the problem of financial exclusion (Lanquist & Tan, 2023; Philippon, 2019);
7. the decreased demand for paper cash and moves towards so-called cashless economy (Brunnermeier, James, & Landau, 2019; Fabris, 2019; Marszałek & Szarzec, 2022);
8. discussions regarding the monetary sovereignty of individual countries (Cohen, 2015; Wilson, 2019).

Since 2020, individual central banks have markedly increased their involvement in research on the possibility of issuing CBDCs. By the beginning of 2023, over 100 central banks worldwide were working on issuing their own digital money in both wholesale and retail types. This group includes institutions such as, among others, the Bank of Canada (2017), the Sveriges Riksbank (2021), the Bank of England (2020), and the European Central Bank (ECB), which, since the first remarks about CBDC, made by the ECB's President, Christine Lagarde (2020), has made large conceptual and organizational work on digital euro (see e.g. ECB, 2020, 2023, 2024, Panetta 2022, 2023).

The intensification of analytical, research, and pilot work (and in a few cases also implementation) regarding CBDCs and their increasingly broader perception as an instrument for solving specific socio-economic problems of individual countries causes growing interest in this instrument and proliferation of the publications on that topic (see e.g. syntheses made in: Auer, Cornelli, & Frost, 2023, Carapella & Fleming 2020, Chapman et al 2023, Dionysopoulos, Marra & Urhart, 2024, Garratt, Yu & Zhu, 2021, Guo, Kreitem & Moser, 2024, Hoang, Ngo & Wu, 2023, Kaczmarek, 2022, Kiff et al., 2020, Meaning, Dyson, Barker, & Clayton, 2021, Ozili, 2025; Ozili & Alfonso, 2024; Souissi & Nabi, 2023, Williamson, 2022).

The popularity of CBDC is a straightforward consequence of their alleged potential benefits (e.g., ECB, 2020; Meaning et al., 2021; Prasad, 2021; Tan, 2023; Turrin, 2021). The commonly cited benefits include: (1) improvement of the payment system; (2) improving tax collection and reducing the shadow economy; (3) broader financial inclusion; (4) possibility of conducting a more effective and flexible monetary and fiscal policy; (5) greater control over the issuance of money and cash management; (6) seigniorage issues and (7) maintaining monetary sovereignty.

On the other hand, some potential flaws connected with introduction and functioning of the CBDCs are also listed: (1) disruption of bank business models; (2) risk of decreased reputation and loss of credibility; (3) risk of rapid outflow of money, which may have a crisis-generating impact; (4) the problem of ensuring stability (and in this context the impact of CBDC on international liquidity and exchange rate dynamics) and (5) lack of anonymity and vast possibilities of state control provided by the use of CBDC.

The overall balance of advantages and disadvantages of CBDCs remains, due to many reasons, neither uniform nor obvious. First, it will shape differently depending on the specific technical solutions. It seems that the most controversial arrangements are a "direct" variant of CBDC that assumes the elimination of banks and the functioning of the central bank as a so-called "monobank", a situation of interest-bearing CBDC, and, finally, CBDC with an expiration date. Second, some of the benefits indicated above seem exaggerated and not properly justified. Third, many benefits are indicated mechanically without deeper reflection and understanding of their consequences. Finally, CBDC is often treated as a highly universal instrument, while different technical, economic, and social contexts in different countries are ignored.

This paper explores the specific technological dimension of CBDCs, which is often omitted or overly simplified in the discussion of digital currencies. In this regard, we argue that the excessive complexity of technical issues of CBDCs following the imitation of solutions used by cryptocurrencies is pointless. First, blockchain does not help to prevent the drawbacks of CBDCs mentioned above. Second, blockchain applications do not guarantee that CBDC, presented as an alternative to paper cash, will have certain crucial features of such cash (privacy, anonymity, and excluding the possibility of double spending), no matter how complex and sophisticated the adopted solution may be. Thus, we advocate for simplification – as far as possible – of the construction and deployment of digital currencies by central banks.

## 3. Drawbacks of implementing CBDC using blockchain, and their consequences

Bitcoin and Ethereum radically depart from the need to trust any institution – trust arises here from the adopted IT solutions, particularly from the construction of the blockchain and reaching a global consensus. However, this comes at a price resulting from the system's dispersion across numerous nodes scattered worldwide – about 21,600 Bitcoin nodes (*Bitnodes*), as mentioned above, and about 6,000 Ethereum nodes (*Etherscan*) owned by independent entities. Their number and independence are guarantees of a very low probability of conducting a 51% attack (or an attack involving a conspiracy of nodes possessing over 51% of the computational power to falsify the blockchain).

In the case of Bitcoin, the cost of the adopted solution is the massive consumption of electric energy needed for proof-of-work (White House, 2022; Zhang, Cheng, Lau, & Xu, 2023), and for Ethereum (in its current Merge version), maintaining half a million validators is necessary for proof-of-stake, also independent and scattered worldwide. Concerning CBDC, such assumptions are unjustified. Central banks enjoy public trust, which should be utilized in CBDC without incurring unnecessary costs.

Therefore, adopting a block mining mechanism such as Bitcoin's is unjustified. Validation of transmitted transactions can be carried out by a relatively small number of trusted validators who are only risking their reputation (*What Is Proof-of-Authority?*)

There is also no justification for implementing such a complicated and generic solution as Ethereum for CBDC. The Ethereum platform can serve any purpose – it is enough to program an appropriate smart contract on the platform alongside an arbitrary number of other smart contracts. In the case of CBDC, we are dealing with a single purpose – digital currency – so a two-tier architecture is not needed: the first tier – supporting Ethereum accounts, and the second tier - supporting a smart contract implementing CBDC with addresses to which tokens corresponding to CBDC are assigned. Just one tier implemented from scratch would be sufficient.

An open question remains whether the transaction history needs to be kept in such a simplified blockchain, as presented above. Of course, accumulating transactions in blocks and linking them in a chain by referring to the hashes of their headers increases security. However, in the case of resigning from mining, altering the blockchain no longer requires such a significant amount of electric

energy, so the central bank in whose possession the blockchain would be could change it quite easily, which obviously would be an abuse of public trust. If we assume a high level of public trust in the central bank, then protecting the transaction history from the bank itself becomes unnecessary. The transaction history could thus be stored in a traditional database with standard security measures.

Considering the abovementioned issues, it can be stated that the technology and solutions used in cryptocurrencies are unsuitable for implementing CBDC due to numerous reasons. First, central banks are considered to be institutions of public trust – so techniques and solutions developed specifically to eliminate trusted third parties, such as blockchain, mining, miner rewards, and achieving global consensus motivated by miners' desire to win rewards, are unnecessary or even undesirable in the case of CBDC.

Second, central banks are (and want to remain) the sole issuers of their currencies. They want to be able to adjust money issuance appropriately depending on the economic situation, so any automatic issuance of CBDC in blocks as they are mined or verified is, for these institutions, an unfavourable solution.

Third, central banks do not want the anonymity or even pseudonymity of CBDCs due to the need to combat financing of terrorism, drugs, and other criminal activities, as well as money laundering, circumvention of sanctions, tax evasion, and similar illegal activities. Anonymity, as one of the two basic features of paper cash, is unacceptable in the case of CBDC.

Fourth, the second basic feature of paper cash – the ability to directly pay the payee by the payer – also cannot be ensured in the case of CBDC due to the double-spending problem.

The general conclusion from the analysis of technical aspects is that central banks in countries where the internet is widely available should focus on ensuring mobile payments and those made via stationary internet, which are fast, cheap, and unlimited in terms of transfer amounts unless the payer imposes restrictions on themselves. CBDC offers no visible benefits to payers or payees compared to mobile payments, which consist of fast transfers. A proposition based on these assumptions is the Digital Currency Bank, the concept of which is presented in the next section.

## 4. Digital Currency Bank (DCB)

### 4.1. DCB Assumptions

1. The central bank issues its own digital currency – CBDC. CBDC would complement paper cash and, except for form, possess all other characteristics of "traditional" cash, being legal tender and potentially serving as a store of value.
2. Like paper cash, CBDC would not bear interest.
3. The central bank creates a special entity – the Digital Currency Bank (DCB). Having an account in this bank would be the only option for individuals and non-financial business entities to obtain CBDC and use this form of money. This account would be free for customers. The central bank would bear all costs of operating the DCB as part of fulfilling its issuing function.
4. The DCB would operate based on well-recognized, traditional IT solutions commonly used in banks, i.e., based on a centralized database with appropriate safeguards.
5. The cybersecurity of CBDC stored in the DCB would be essentially the same as that of other banks, which use the same security methods.
6. The structure of the M0 aggregate would change, now covering paper cash in circulation and in banks' vaults, digital cash, and bank funds on accounts in the central bank. The M1 aggregate would also change, covering paper cash in circulation, digital cash in the DCB, and demand deposits (a vista).
7. The DCB, in cooperation with the central bank, would exchange paper cash for CBDC at the request of account holders in the DCB and vice versa at a 1:1 ratio. This exchangeability would be guaranteed by law. The total volume of cash in circulation would not change in the case of exchanging paper cash for digital currency, and vice versa.
8. It would be possible to transfer money from an account in another bank to an account in the DCB, which would be equivalent to converting non-cash bank money into CBDC. This would then change the structure of the M1 aggregate, without changing its volume. Similarly, it would be possible to transfer money from an account in the DCB to an account in another bank, which would be equivalent to converting CBDC into non-cash bank money.
9. CBDC would be a widely accepted means of payment, discharging obligations in all types of transactions. Account holders in the DCB could freely make CBDC payments (including public law obligations); they could also hold it as their liquid reserves. In the absence of interest, this might be questionable

in times of high inflation, but reasonable with moderate inflation, and very appropriate in crisis situations - the argument for this would be the complete security of CBDC stored in the DCB compared to funds in banks (even considering deposit insurance schemes).

10. Payments and settlements resulting from the use of CBDC would be conducted through a clearing house.
11. The scale of CBDC issuance would be determined by its demand and the supply of paper cash and on-demand bank deposits held by individuals and non-financial business entities. It would not be possible for the DCB to independently create ("empty") CBDC. Appropriate legal provisions would exclude this.
12. Benefits for CBDC holders:
    - An additional payment instrument, enabling instant payments between account holders in the DCB;
    - The ability to safely store funds;
    - Access to basic financial payment and deposit services even in the absence of ability/willingness to use banks – important in case of lack/loss of trust in banks, for example, in case of crises in the banking sector;
    - Cheaper access – no transaction costs present in banks.
13. Benefits for the central bank:
    - Less issuance of paper cash, thus lower costs;
    - An instrument that improves the efficiency of the payment system;
    - The ability to create demand for CBDC;
    - Prestige and image considerations.
14. Benefits for banks:
    - Despite the operation of CBDC, banks are not eliminated from the financial market;
    - They retain the ability to carry out all banking operations;
    - The credit processes remain unchanged.

## 4.2. Analysis of indicated CBDC disadvantages in the case of implementation using DCB

**Risk 1**: Disruption of banks' business models, resulting from their diminishing significance in the presence of CBDC.

*This is not applicable since banks remain a significant actor in the financial system, offering all traditional services; they may note a decrease in demand deposits and an increase in the costs of passive operations.*

**Risk 2**: Risk of reputation decline and loss of credibility (if the emission of CBDC contains errors, the central bank might not have a second chance after an image failure).

*The DCB would be implemented using traditional IT solutions that are well-recognized and widely used in the banking industry. Thus, no risk is associated with experimenting with new, complicated, untested digital technology.*

**Risk 3**: The risk of a rapid outflow of money from banks, which may act as a crisis trigger.

*Depending on the regulations of the banks in this respect, the outflow of money from them can be limited or even stopped; moreover, CBDC and DCB could act in a stabilizing manner.*

**Risk 4**: The problem of ensuring stability and, in this context, the influence of CBDC on international liquidity and the exchange rate dynamics.

*This is a rather stabilizing solution; international issues require deeper analysis, as appropriate international agreements would be required between central banks, but one can find rather positive effects here.*

**Risk 5**: The issue of violation of privacy (lack of anonymity) and broad control possibilities by the state, which the use of CBDC provides.

*Direct control of the central bank over transfers to/from accounts in the DCB. Information about these transfers may only be available to other state bodies based on relevant legal provisions. This control is greater than paper money; however, the latter remains in circulation - possession of CDBC is voluntary and complementary to paper cash.*

## 4.3. Analysis of the advantages of CBDC as signalled in the literature in case of the DCB solution

**Advantage 1**: Improved tax collection and reduction of grey economy.

*No significant impact, as cash transactions remain possible.*

**Advantage 2**: Financial inclusion.

*Possible. CBDC may encourage people who do not use banking services due to low trust in banks or potential costs of using their services to hold and use funds in DCB.*

**Advantage 3**: Disintermediation.

*The role of banks as intermediaries only undergoes a minor reduction due to the possibility of holding financial assets in the form of CBDC.*

**Advantage 4**: Greater system security.

*Yes, thanks to an increased level of trust in CBDC and DCB.*

**Advantage 5**: The ability to conduct more effective and flexible monetary policy.

*Possible in case of "emergency" introduction of interest on CBDC and the use of DCB as an instrument to absorb excess liquidity.*

**Advantage 6**: The ability to conduct more effective fiscal policy.

*No, given the voluntariness of having a DCB account alongside bank accounts.*

**Advantage 7**: Greater control over money issuance.

*Unchanged – CBDC issuance would be endogenous, occurring to the extent that the market demands.*

**Advantage 8**: Seigniorage.

*With the increase in popularity of CBDC, seigniorage would increase (a higher difference (margin) between the face value of CBDC and the cost of their production).*

**Advantage 9**: Monetary sovereignty.

*Unchanged - CBDC is a new form of cash, but represents the same domestic money, being legal tender and national unit of account; potential image benefits, with the extension of payment options to the international sphere, the possibility of greater overall popularity of CBDC; increased chances of becoming an international currency.*

### 4.4. The issue of interest on CBDC

One might consider a situation in which CBDCs accumulated in DCB accounts are interest-bearing. This interest would be paid to CBDC holders by the central bank *via* DCB. In our opinion, this solution should not be implemented for two reasons.

First, the worst-case scenario would be adopting a solution where interest paid on CBDC is a permanent feature. This would create a permanent alternative to

bank deposits, representing a non-market challenge to bank competition. Furthermore, instead of being an instrument to increase the efficiency of payments and settlements, CBDC would become yet another monetary policy instrument, with its interest rate being another of the central bank's official interest rates. This situation would contradict the very concept and purpose of introducing CBDC and DCB.

Second, less doubt is raised by the temporary introduction of interest on DCB accounts in extraordinary situations (e.g., excess liquidity). This would mean a certain *ad hoc* intervention by the central bank in a situation justified by reasons of financial system stability or monetary stability. Nonetheless, such a solution would also be a violation of market competition. Moreover, there is an undeniable risk of such temporary CBDC interest becoming entrenched, as the central bank, encouraged by the effectiveness of such action, might be tempted to apply it even without a clear need (although it would also imply costs for it). On the other hand, CBDC holders could get accustomed to their funds in DCB being interest-bearing, and withdrawing from such a solution could pose problems.

## 5. Conclusions

Central banks should strive to introduce their digital cash, offering citizens a new form of money tailored to current technological, economic, and cultural conditions. This could bring numerous benefits not only of pure economic nature but also political and social. However, it should always consider a particular country's conditions and situation. Policymakers should also answer the question of what purposes digital cash would serve and the hierarchy of these goals.

We argue that central banks, when implementing digital currency, neither must nor should use technologies developed for cryptocurrencies for this purpose. The main assumption of these technologies, especially blockchain, is the lack of trust in all institutions, favouring algorithms, decentralized solutions, and giving decision-making power to communities of independent users, while central banks want to remain institutions of public trust and retain their power in the financial systems of countries. Moreover, using cryptocurrency technologies to implement CBDC requires such deep modifications that they lose their unique properties.

The introduction of CBDC through such a complex and non-intuitive method as blockchain still does not provide properties that would make digital cash fully equivalent to paper money, i.e., anonymity and privacy, nor is it perceived as purposeful by monetary authorities. Moreover, the second basic feature of paper

cash – the ability to directly pay the payee by the payer – also cannot be ensured here due to the double-spending problem.

Thus, we recall here the famous concept of the Occam's razor. Since there are no clear benefits and advantages from the introduction of CBDC using complicated technology derived from cryptocurrencies, central banks should consider simpler, transparent, and reliable solutions that allow them to benefit from the introduction of digital cash.

Therefore, in this paper, we propose the creation of a Digital Currency Bank. It allows retaining the benefits of digital cash while eliminating the drawbacks resulting from treating CBDC as "central bank cryptocurrencies". The proposal to create a Digital Currency Bank is well-adapted to developing digital payments, including mobile ones, in countries with highly developed telecommunications, so it could form a basis for introducing CBDC.

We are aware that our concept of introducing digital cash requires certain self-restraints of central banks – they should not use CBDC for monetary policy purposes. However, the proposed simple structure of CBDC could help build trust in digital money, being a simple and transparent solution for citizens. This could be important in the situation of a lack of public demand for CBDCs.

## References


1. Ahnert, T., Assenmacher, K, Hoffmann, P., Leonello, A., Monnet, C. & Porcellacchia, D. (2022). The economics of central bank digital currency. *ECB Working Paper Series* No. 2713. https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2713~91ddff9e7c. en.pdf
2. Auer, R., Cornelli, G. & Frost, J. (2023) Rise of the Central Bank Digital Currencies. *International Journal of Central Banking*, vol. 19 (4), 185-214.
3. Bank of Canada (2017). Digital Currencies and Fintech. Retrieved from https://www.bankofcanada.ca/research/digital-currenciesand-fintech/.
4. Bank of England (2020). Central Bank Digital Currency: Opportunities, Challenges and Design. Discussion Paper, Bank of England.
5. BIS (2018). Central Bank Digital Currencies. *Committee on Payments and Market Infrastructures, Markets Committee*.
6. BIS (2020). *Central bank digital currencies: foundational principles and core features*. Report no 1 in a series of collaborations from a group of central banks. Basel.
7. BIS (2024). *Embracing diversity, advancing together – results of the 2023 BIS survey on central bank digital currencies and crypto*. BIS Papers No. 147, Monetary and Economic Department, June.
8. Bitnodes, Retrieved from https://bitnodes.io/
9. Bordo, M., and Levin, A. (2017). Central Bank Digital Currency and the Future of Monetary Policy. *NBER Working Paper,* 23711.
10. Brunnermeier, M, James, H. & Landau, J.P. (2019). The Digitalization of Money. *NBER Working Papers*, 26300.
11. Carapella, F. & Flemming, J. (2020). Central Bank Digital Currency: A Literature Review. FEDS Notes. Washington: Board of Governors of the Federal Reserve System, November 09. https://doi.org/10.17016/2380-7172.2790.
12. Carstens, A. (2017). *Big tech in finance and new challenges for stability*. Keynote address by Mr Agustín Carstens, General Manager of the BIS, at the FT Banking Summit, London, 4 December 2018. Bank for International Settlements, Basel.
13. Chapman, J., Chiu, J, Davoodalhosseini, M., Hua Jiang, J., Rivadeneyra, F. & Yu Zhu (2023). Central Bank Digital Currencies and Banking: Literature Review and New Questions. *Discussion Papers* 2023-4, Bank of Canada.
14. Cheng, P. (2023). Decoding the rise of Central Bank Digital Currency in China: designs, problems, and prospects. *Journal of Banking Regulation*, 24(2), 156–70. doi: 10.1057/s41261-022-00193-5.

15. Cohen, B. J. (2015). Currency Power: Understanding Monetary Rivalry. Princeton University Press.
16. DigiCash, https://en.wikipedia.org/wiki/DigiCash
17. Dionysopoulos, L. Marra, M. & Urhart, A. (2024). Central bank digital currencies: A critical review. *International Review of Financial Analysis*, vol. 91, 103031, https://doi.org/10.1016/j.irfa.2023.103031
18. ECB (2020), Report on a Digital Euro. October. https://www.ecb.europa.eu/pub/pdf/other/Report_on_a_digital_euro~4d7268b458.en.pdf
19. ECB (2023). Opinion of the European Central Bank of 31 October 2023 on the digital euro (CON/2023/34). https://www.ecb.europa.eu/pub/pdf/legal/ecb.leg_con_2023_34.en.pdf
20. ECB (2024). *Progress on the preparation phase of a digital euro Second progress report*, December. Frankfurt am Mein.
21. Etherscan https://etherscan.io/nodetracker
22. Fabris, N. (2019). Cashless Society – The Future of Money or a Utopia? *Journal of Central Banking Theory and Practice, Central Bank of Montenegro*, vol. 8(1), 53-66.
23. Garratt, R., Yu J & Zhu, H. (2021). *Central Bank Digital Currency Design: Implications for Market Composition and Monetary Policy*. Massachusetts Institute of Technology and University of California, Santa Barbara working paper.
24. Guo, S., Kreitem, J., & Moser, T. (2024). DLT options for CBDC. *Journal of Central Banking Theory and Practice*, 13(1), pp. 57-88. doi: 10.2478/jcbtp-2024-0004
25. Hazlett, P., & Luther, W. (2020). Is Bitcoin Money? And What That Means. *The Quarterly Review of Economics and Finance*, 77, 144–149. https://doi.org/10.1016/j.qref.2019.10.003.Popper 2016
26. Hoang, Y.H., Ngo, V.M. & Vu, N.B. (2023). Central bank digital currency: A systematic literature review using text mining approach. *Research in International Business and Finance*, vol. 64, https://doi.org/10.1016/j.ribaf.2023.101889.
27. Kaczmarek, P. (2022). Central Bank Digital Currency: Scenarios of Implementation and Potential Consequences for Monetary System. *Journal of Central Banking Theory and Practice*, 11(3), pp. 137-154. https://doi.org/10.2478/jcbtp-2022-0027
28. Kiff, J., Jihad, A., Davidovic, S., Aquiles, F., Ashraf, K., Tanai, K., Majid, M., Hunter, M., Nobuyasu, S., Herve, T., & Zhongyong, Z. (2020). A Survey of Research on Retail Central Bank Digital Currency. *IMF Working Paper*, WP20/104. http://dx.doi.org/10.2139/ssrn.3639760
29. King, M. (2017). *The end of alchemy*. W. W. Norton & Company.

30. Lagarde, Ch. (2020). *Payments in a digital world*. Speech by Christine Lagarde, President of the ECB, at the Deutsche Bundesbank online conference on banking and payments in the digital world. Frankfurt am Main, 10 September 2020.
31. Lanquist, A. & Tan, B. (2023). *Central Bank Digital Currency's Role in Promoting Financial Inclusion*. Note 2023/011. International Monetary Fund.
32. Marszałek, P., & Ratajczak-Mrozek, M. (2022). *Introduction: Digitalization as a Driver of the Contemporary Economy*. In: M. Ratajczak-Mrozek & P. Marszałek (Eds.), *Digitalization and Firm Performance. Examining the Strategic Impact* (pp. 1–15). Palgrave McMillan. https://doi.org/10.1007/978-3-030-83360-2_1
33. Marszałek, P., & Szarzec, K. (2022). *Digitalization and the Transition to a Cashless Economy*. In: M. Ratajczak-Mrozek & P. Marszałek (Ed.), *Digitalization and Firm Performance. Examining the Strategic Impact*, pp. 251–281. Palgrave McMillan. https://doi.org/10.1007/978-3-030-83360-2_10
34. Meaning, J., Dyson, B., Barker, J. & Clayton, E. (2021). *Broadening Narrow Money: Monetary Policy with a Central Bank Digital Currency. International Journal of Central Banking*, vol. 17(2), 1-42, June.
35. Nakamoto, S. (2008). *Bitcoin: A Peer-to-Peer Electronic Cash System*. https://bitcoin.org/bitcoin.pdf
36. Ozili, P. K. (2025). How Politics Hinder Central Bank Digital Currency (CBDC) Development and What to Do about It. *Journal of Central Banking Theory and Practice*, vol. 14(1), Central Bank of Montenegro, 59-74. https://doi.org/10.2478/jcbtp-2025-0004
37. Ozili, P. K., & Alonso, S. L. N. (2024). Central Bank Digital Currency Adoption Challenges, Solutions, and a Sentiment Analysis. *Journal of Central Banking Theory and Practice*, 13(1), pp. 133-165.
38. Panetta, F. (2022). *The digital euro and the evolution of the financial system*. Introductory statement by Fabio Panetta, Member of the Executive Board of the ECB, at the Committee on Economic and Monetary Affairs of the European Parliament, June 15.
39. Panetta, F. (2023). *Shaping Europe's digital future: the path towards a digital euro*. Introductory statement by Fabio Panetta, Member of the Executive Board of the ECB, at the Committee on Economic and Monetary Affairs of the European Parliament.
40. Philippon, T. (2019). On Fintech and Financial Inclusion. *BIS Working Paper* 841.
41. Prasad, E.S. (2021). *The Future of Money. How the Digital Revolution is Transforming Currencies and Finance*. Harvard University Press

42. Souissi, S. B. & Nabi, M.S. (2023). Could the Issuance of CBDC Reduce the Likelihood of Banking Panic? *Journal of Central Banking Theory and Practice*, 12(2), pp. 83-101. https://doi.org/10.2478/jcbtp-2023-0015
43. Stulz, R.M. (2022). FinTech, BigTech, and the Future of Banks. *Journal of Applied Corporate Finance*, 34, 106-117. https://doi.org/10.1111/jacf.12492
44. Sveriges Riksbank (2021). "E-krona."Retrieved from https://www. riksbank.se/en-gb/payments--cash/e-krona
45. Tan, B. (2023). Central Bank Digital Currency and Financial Inclusion. *IMF Working Papers* 2023/069.
46. Turrin, R. (2021). *Cashless: China's Digital Currency Revolution*. Authority Publishing.
47. What Is Proof-of-Authority? https://www.coindesk.com/learn/what-is-proof-of-authority/
48. White House (2022). *Climate and Energy Implications of Crypto-Assets in The United States*. White House Office of Science and Technology Policy. Washington, D.C.
49. Williamson, S. D. (2022). Central Bank Digital Currency: Welfare and Policy Implications. *Journal of Political Economy* 130 (11): 2829–2861.
50. Wilson, P. (2019). Hostile money. *Currencies in conflict*. The History Press, Stroud.
51. Yermack, D. (2016). Is Bitcoin a Real Currency? An Economic Appraisal. In: D.L.K. Chuen (ed.) *Handbook of Digital Currency: Bitcoin, Innovation, Financial Instruments, and Big Data*. Elsevier.
52. Zhang, D., Chen, X. H., Lau, C. K. M., & Xu, B. (2023). Implications of cryptocurrency energy usage on climate change. *Technological Forecasting and Social Change*, vol. 187, 122219, https://doi.org/10.1016/j.techfore.2022.122219.