

Digital Currencies, Cryptocurrencies and Central Bank Digital Currencies

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Abstract

The history of money reveals a pattern: there has been a trend of money dematerialization over the centuries. The majority of money now circulates in electronic form. Banks, governments, and institutions are analyzing and researching the economic and technical viability of implementing digital money, as well as the implications for monetary and fiscal policy. Digital currencies are essentially e-cash that does not require any specific encryption technologies. The financial system has the potential to be transformed by digital money, and the digital money revolution will take place on a worldwide scale. Cryptocurrencies are digital currencies that encrypt and verify network transactions using cryptography. Cryptocurrencies like Bitcoin could be the future of payment systems or even how we exchange value over the Internet in the coming years. Bitcoin has the potential to be a revolution because it provides people with a new level of sovereignty and, as a result, a new form of freedom, and it represents an alternative to our current financial system. Most central banks, on the other hand, are experimenting with central bank digital currencies (CBDCs). A CBDC is a digital currency that is issued by a central bank and is widely used. Thanks to the enormous labor and attention that central banks are spending to digital currencies, they will soon become a reality. We present and discuss the characteristics of digital currencies and crypto currencies in this study, as well as the digital currencies used by central banks (CBDCs) and open issues.

1 Introduction

Money is defined by economists as anything commonly accepted by people for the exchange of goods and services. Money is used to make transactions easier since it avoids the need for labor and capital resources that would be required if barter were the only form of exchange. Depending on how broadly we define it, money also includes cash in the wallet, bank deposits that may be transferred through check, other bank deposits, and highly "liquid" assets that can be easily changed into cash at predetermined rates. In contemporary economies, the government controls the amount of money available. Managing the money supply is the responsibility of the central bank. Crypto-assets, or private digital assets that largely rely on encryption and distributed ledger technology for record keeping, have sparked a wave of financial innovation that is likely to completely alter the structure of money and how it is used (Alnasaa et al, 2022).

This study begins by defining money and outlining its uses and characteristics. Money's anonymity and ability to function offline are mentioned as two of these characteristics. The history of money is then briefly covered, and money's history enables us to demonstrate the necessity of electronic money and the fact that it will eventually become Pure Money. Then digital currencies, crypto currencies and central bank digital currencies are explained, and open issues are held in following sections.

2 Evolution of Money

The importance of money is explained by Kaufman (1981) as: "A substantial body of evidence – generated over the course of history – indicates that money is related more closely to aggregate levels of spending, prices, income, production, and employment than any other single economic variable." One may argue that the discovery of the concept of money and the creation of an object that could be used as money are essential to every civilized society's progress. Societies could not advance without something to support commerce and permit specialization. Money is one of the oldest social institutions. Furthermore, the standard of the things used as money determines the future of any civilized community. To better meet requirements and get around difficulties, societies and economies are changing the form of money (coins, banknotes). This is itself a search for Pure Money, often known as Perfect Money (Chouseinoglou, 2004).

Money, according to Adam Smith (1776), serves as a unit of account; it is not a valuable object; rather, its usefulness is limited to expressing the value relationships among other objects. Money can be analyzed either with respect to what it does (functions) or with respect to its characteristics (properties). Listing the functions of money may help us to distinguish between different money forms. These functions, according to Davies (1994), are:

- Standard unit of account
- Common measure of value
- Medium of exchange
- Means of payment
- Standard and means of deferred payments
- Store of value

The desire to acquire a consumer good made by another person, the intrinsic values of the goods (such as storability), extrinsic beliefs about other traders' willingness to accept certain goods, and the evolutionarily acquired practice of copying successful traders are what matter in the evolution of money (Luo,1998). The financial industry was among the first to adopt the new information and communications technologies (ICTs) and to profit from the advancements made in terms of computer power, the internet, or cryptography over the majority of the second half of the twentieth century. Banking and money thus developed alongside industrial technology (Berg et al,2020). Examples include the development of digital payment cards, the important role of new ICTs in banking organizations' internal accounting processes, and the expanding use of electronic banking and mobile payment services.

Money is a social institution that develops alongside technology. The fact that computer scientists were behind the development of digital crypto-currencies and that economists were entirely unprepared for their arrival is important. It also compels our profession to reconsider the fundamental phenomenology of money as a result. According to Wieser and Schumpeter's theories, digitization emphasizes money's immaterial function as a measure of value and its role as a medium of exchange, which is progressively absorbed by social technology of account (Schumpeter, 1970). This might have a significant effect on economic policy (Wieser,1927). The wide range of cryptocurrency coins has demonstrated the technical viability of competing private currencies, as Hayek had suggested (Hayek,1976). However, there is cause to question the long-term viability of fierce rivalry. Major digital platforms' potential to expand their current domination in multisided virtual markets to encompass digital payments and money must be feared. In order to maintain public sovereignty over the common unit of account, central banks are considering creating their own digital fiat currency. After the current period of strong creative experimentation, central bank digital currencies (CBDCs), whose creation will depend on deliberate public decisions and regulations, are likely to replace the potentially new spontaneous order of private cryptocurrency (Peneder,2022).

The definition of money, the right to use legal tender, the function of central banks, the concept of financial intermediation, and the dissemination of monetary policy are all put to the test when private electronic money replaces public fiat money. The extraordinary growth of cryptocurrencies has put pressure on central banks to respond by enhancing the effectiveness of payment networks (Ward, Rochemont, 2019). So far, central bank money in digital form has been available only to commercial banks. A CBDC would make it available to the public.

3 Digital Currencies

The phrase "e-money," which was first used in the 1990s when payment systems went digital, refers to electronic money. Money has evolved into a network system with hundreds of thousands of different types of computers connected to one another, according to J. Kurtzman's study from 1993. Although its intended usage varies from country to country, electronic money is not physically printed money and has a distinct form than cash (Kurtzman,1993). Software on a computer creates electronic coins in return for money. In other words, through making loans, deposit banks "print." According to statistics, electronic currency generated by banks is significantly more prevalent than paper currency, such as cash, created by central banks (Tatliyer,2018).

Electronic storage and transfer are both possible for digital money. The most significant characteristic that sets digital currencies apart from the idea of electronic money is the fact that they can only be issued by central banks. Traditional currency has begun to transition to the digital age as a result of the decline in cash transactions (Pişkin, 2021). The money in our bank account, for instance, is digital. The gap between digital money and cash has shrunk as POS (Point of Sale) systems have become more prevalent and banks' accessibility through mobile applications has increased. (Griffith, 2014)

The bank debit card is a prime example of how, broadly speaking, the concept of digital currency combines the conventional characteristics of money with the ease of electronic transactions. A different type of digital currency, unattached to a bank account or other traditional store of value, whose credibility is based on the computer algorithms that underpin its creation and distribution, has emerged as a result of the public acceptance of electronic financial transactions (Gilbert, Loi, 2018).

4 Cryptocurrencies

FinTech, as it is commonly known, is financial innovation that uses technology to offer fresh approaches to the established institutions. One such recent technological advancement significantly improved the global business climate today. We now have more secure, affordable, and quick means to make transactions all around the world, specifically in financial services. The rise of digital currencies and the "blockchain" technology that underpins them has attracted considerable attention in a number of implications sectors (Mattila, 2016). Through Satoshi Nakamoto's whitepaper that was released in 2008, the idea of cryptocurrency first entered our culture (Nakamoto, 2008). Companies racing to adapt blockchain include UBS, Microsoft, IBM and PwC. The Bank of Canada is also experimenting with the technology (Hutt, 2016). As the digital economy has grown over time, nations have begun to place more emphasis on digital changes and to create their own digital currencies to compete with

cryptocurrencies in the retail market. Numerous investigations have been conducted to determine whether cryptocurrencies have the characteristics of money or to what class of money they belong.

Although there have always been virtual forms of currency (such as mobile money and e-money), the introduction of Bitcoin in 2009 changed how the concept of "virtual currency" was thought of. Bitcoin is an electronic payment system that uses cryptography and runs on the blockchain protocol, a peer-to-peer distributed ledger technology (DLT) that securely logs transactions between computers (Nakamoto,2008). Despite the fact that DLT has been around since 1991 (Haber,Stornetta, 1991), it was Bitcoin that first envisioned the technology in a way that allowed it to be used to create a peer-to-peer transaction network and a unique type of cryptographically encrypted currency known as a cryptocurrency. With a few rare exceptions, these blockchain-based cryptocurrencies existed in an unregulated environment for a long time, but their incredibly volatile and speculative nature prevented them from becoming widely accepted as alternative "currency" (Foster et al, 2021).

Actually, cryptocurrency history predates 2008. People might believe that Satoshi Nakamoto only recently discovered cryptocurrencies, although they have actually been debated for more than three decades. Blind signatures for untraceable payments is the initial concept of it that is explored in David Chaum's article. Chaum is an American computer scientist and cryptographer (Chaum, 1982). For the first time ever, the idea of untraceable electronic payments and a safe digital cash system was put out. The fundamental concept was that consumers may withdraw digital currency from a platform or a bank without that platform or any other third party tracking them. In order to implement an online payment system that guarantees user transaction confidentiality, Chaum established DigiCash in 1990. Even though DigiCash's attempt to introduce cryptocurrency was unsuccessful, it nonetheless made valuable contributions for other projects. By 1998, computer scientist and cryptographer Nick Szabo had started developing "bit gold," a decentralized digital currency and system for digital contracts. The technical manual for Bitcoin, or "white paper," was published in 2008, and it finally revealed how to use the money (Cuofano, 2021).

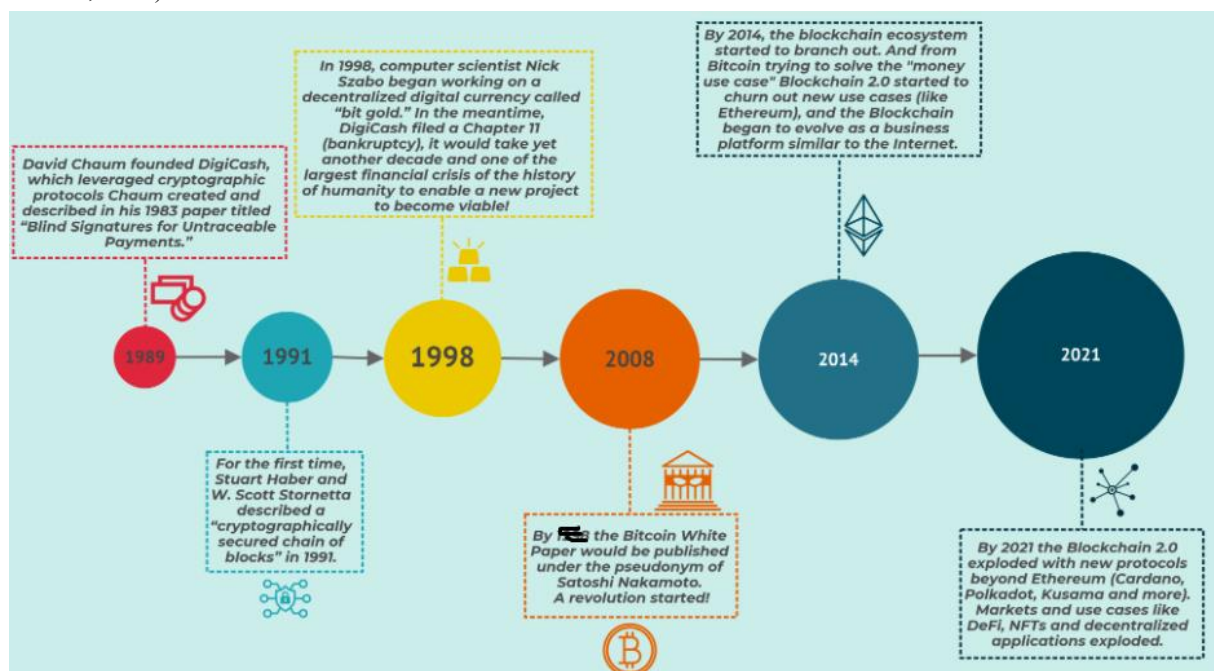


Figure 1. Evolution of Cryptocurrencies *Source:* Cuofano, 2021.

Contrary to popular belief, Bitcoin and other cryptocurrencies called "altcoins" did not come out of nowhere. The figure below shows the history of the technology that exists in our homes today, including computers, networks, the Internet, cellphones, virtual currencies, and exchanges. Many people have contributed their expertise to the advancement of technology to get us where we are today.

Moving beyond the fundamental use case of Bitcoin, one of the most popular coins called Ethereum has an incredible potential and is making its name on Decentralized Applications (dApps). As of July 02, 2022, the crypto market cap is \$866 billion. The list of most popular top 10 coins among 20088 cryptos is shown in Table 2.

Since the start of the COVID-19 pandemic and against a backdrop of very permissive global financial conditions, crypto-asset transaction volumes have seen fast expansion on a worldwide scale, driven by institutional and retail acceptance. Understanding the primary forces motivating the use of crypto-assets is important for policy makers, users, and industry alike due to its rising scale, diversity, complexity, and interconnection with the regulated financial system, which may increase hazards (Feyen,et al, 2022). Crypto-assets are increasingly regarded as an emerging and diverse asset class as economic functions and risks differ across crypto-assets.

Due to their significant volatility, it is challenging for the market to view these currencies as reliable forms of payment for upcoming transactions. Governments, however, are concerned about the emergence of cryptocurrencies, which has prompted many CBs to look into the possibility of launching their own digital currency, also known as a CBDC. Governments control fiat currencies, and as a result, they utilize central banks to set monetary policy in order to exercise economic influence. This is why it is important to look into these methods. When non-governmental organizations establish their own currencies, this authority over currency is lost, which could have an impact on fiscal policy and financial intermediation (Ward, Rochemont, 2019).

5 Central Bank Digital Currencies

Central banks and academics are examining the advantages of central bank digital currencies (CBDC) that are available to the general public as a result of IT advancement and its application to the financial sector (Bindseil, 2020). Since it will have an impact on national currency systems, CBDC (Central Bank issued Digital Currency), one of several topics within digital currency, has drawn a lot of interest recently.

Physical banknotes and commercial bank deposits, often known as reserves, have been used as central bank money for a long time (Table 1). The same is true of digital money, which is money that is exchanged or kept on computers. However, the non-bank population has historically only had access to central bank money in the form of tangible notes, which limits its use to modest retail transactions (Dwor-Frecaut, 2022).

	Form	Issuer	Type of Money	Transactions Validation	Use
Neither Safe Nor Liquid!	Crypto i.e. electronic tokens	Network	Digital	Fully decentralized	Investment
Least Liquid & Safe	Account at non bank	Non banks financial institutions e.g. MMF	Digital	Centralized ledger	Retail transactions
Liquid & Safe	Checking accounts at banks	Commercial banks (i.e. deposit funded)	Digital	Centralized ledger	Retail transactions
Most Liquid and Safe	Bank notes	Central bank	Physical	Fully decentralized	Small retail transactions
	Accounts at central bank (reserves)		Digital	Centralized ledger	Wholesale i.e. vs large transactions
	CBDC		Digital	Hybrid	Retail transactions

Table 2: Types of Money, Relative Safety, Liquidity *Source: (MacroHive, 2022)*

Particularly in established and emerging economies, the COVID-19 epidemic increased the need for "contactless" payment and the "digitalization" of payment systems. Public and private authorities' interest in distributed ledger technology (DLT) culminated in two releases: China created its first digital currency, the Digital Currency-Electronic Payment (DC/EP), and the Bahamas unveiled the Sand Dollar, a central bank digital currency (CBDC) pegged to the US dollar. As the Eastern Central Caribbean Central Bank (ECCB) launched its pilot of DCash, a regional CBDC to be operated in seven island states, CBDC is also taking on a regional form (Foster et al, 2021). General purpose CBDC could be implemented in two alternative technical formats:

- CBDC could be offered in the form of deposit accounts with the central bank to all households and corporates
- Alternatively, the central bank could offer a digital token currency that would circulate in a decentralized way without central ledger

Deposit-based CBDC appears to be easier to use and offers superior protection against money laundering and other illegal purposes. Additionally, it appears to allow for a high degree of security and control over the quantity of CBDC base money that is in circulation without the need for complicated or computationally costly solutions (Berentsen and Schar, 2018). CBDC offers a number of advantages with regards to the convenience, efficiency, stability and accessibility of retail payment. Benefits of CBDCs are summarized in Table 3.

Given the diversity of models and uses, a vast body of material produced in 2018 indicates the intense global effort to evaluate the viability of CBDCs. The absence of a standardized definition and specification of a CBDC appears to be a reflection of the early stages of opportunity discovery and risk assessment. Studies often revealed more risks than were initially thought possible, including risks in the technical, legal, economic, security, operational, and monetary policy domains. At this stage of development, current solutions appear to be more efficient than blockchain (Ward, Rochemont, 2019). Table 4 summarizes public policy responses, as of January 2019.

Benefit of CBDC	Possible further factors or requirements
A. Efficient retail payments-	
A.1 Making available efficient, secure and modern central bank money to everyone	In particular in economies without high-quality electronic commercial bank money, and/or without a secure and efficient payment system
A.2 Strengthening the resilience, availability and contestability of retail payments	In particular in economies in which banknote demand vanishes and private electronic payments solutions lack competition
B. Overcome use of banknotes for illicit payment and store of value	
B. Better control of illicit payment and saving activities, money laundering, and terrorist financing	Requires (i) discontinuation of banknotes (or at least of larger denominations); (ii) CBDC to not take the form of anonymous token money
C. Strengthen monetary policy	
C.1 Allows overcoming the ZLB as negative interest rates can be applied to CBDC	Requires discontinuation of banknotes (or at least of larger denominations)
C.2 Interest rates on CBDC provide for additional monetary policy instruments, independently of ZLB	
C.3 Easier ability to provide helicopter money	Requires that each citizen has a CBDC account
D. Sovereign money related	
D.1 Improve financial stability and reduce moral hazard of banks by downscaling the role of the banking system in money creation	CBDC takes over to large or full extent sight deposit issuance by banks
D.2 Larger seignorage income to state (and citizens) as state takes back money creation from banks.	CBDC takes over to large or full extent sight deposit issuance by banks

Table 3: Overview of benefits that some have associated with CBDC, and related factors or requirements
Source: (Engert and Fung, 2017; Mancini-Griffoli et al, 2018)

Central Bank positions towards Central Bank Digital Currencies (CBDC) (Jan 2019) (References)	
Recognise potential value of CBDCs	<ul style="list-style-type: none"> • Maintain public access to Central Bank liability in event of declining use of cash: Norway, Sweden. • Facilitate de-cashing: Curaçao and Sint Maarten, Israel. • Improve cross border transaction systems: Canada, Hong Kong, Saudi Arabia, Singapore, United Kingdom. • Modernise interbank settlement systems: BIS, Singapore, Thailand. • Address underserved markets: Bahamas.
Have decided against planning to implement CBDC	Azerbaijan, Australia, Denmark, ECB, Estonia, Germany, Hong Kong, India, Israel, Japan, New Zealand, Norway, South Korea, Switzerland, USA.
Continue studies for long term potential	Brazil, Canada, China, Indonesia, Israel, Norway, Singapore, UAE, United Kingdom, USA, ECB and Japan (FMI).
Are actively developing experiments, trials	Bahamas, Eastern Caribbean, Kazakhstan, Philippines, Russia, South Africa, Sweden, Thailand, Ukraine, UAE, Uruguay.
CBDC operational	Iran, Marshall Islands, Senegal, Tunisia, Venezuela.
CBDC decommissioned	Ecuador

Table 4: Central Bank attitudes towards Central Bank Digital Currencies (CBDCs) *Source: (Ward, Rochemont, 2019)*

Several central banks who are looking into the idea of a retail CBDC have issued studies or remarks on the reasons, structures, dangers, and advantages involved. More and more institutions, including central banks, banks, and private corporations, are currently working on initiatives aiming to establish a new technological foundation for money in response to the advent of crypto assets and the underlying distributed ledger technology (DLT) with the origination of Bitcoin in 2008. The role and influence of central banks in the monetary system would decrease if there was a reduction in the demand for banknotes. Central banks are thinking of creating its own digital

currency, known as a retail CBDC, that is accessible to end users in order to solve these issues and maintain their position in the financial system. CBDC pioneers that are likely to issue a CBDC in the next few years are e.g., China, the Eastern Caribbean Currency Union, the Marshall Islands and Sweden. (Sandner et al, 2020). According to latest data, nine countries have already launched a CBDC, 14 have pilots underway, and 57 are in research and development phase (Dwor-Frecaut, 2022). The key advantage of CBDC would be to give the financial industry a platform to create novel DLT-based products. They might also lead to more effective payment systems and new, stronger tools for monetary policy.

6 CBDC Open Issues

There are important implications from the rise of fintech and the introduction of CBDC in recent years. Future competition between state-issued currency and digital currencies is of more concern. Due to a lack of adequate frameworks for examining money and its applications in general, much alone whether they are real or virtual, there is a vacuum in our understanding of economics. In spite of this, we make a guess here that platform economics might contribute to a deeper knowledge of monetary economics in light of our investigation into these concerns.

The pros and cons of establishing central bank digital currencies (CBDC), or any type of central bank money managed electronically and available to the general public, have begun to be considered by academics and central banks alike. In addition to overnight deposits with the central bank, which are currently only available to banks, certain non-bank financial institutions, and some depositors in the official sector, CBDC could be viewed as a third form of base money. Banknotes are widely available but may be of limited efficiency and rely on antiquated technology. Some sources make a distinction between "wholesale" and "general purpose" CBDC, the latter of which is available to any household while the former is exclusively available to specific businesses (Bindseil, 2020).

Today, almost each nation is working to foster an environment that will foster the development of novel (blockchain) technologies and recognizes the potential for using these technologies both in the public and commercial sectors. Also, in order to regulate cryptocurrencies at a worldwide level, it is essential to create the required legal, financial, and technical infrastructure. A unified set of criteria for the regulation of digital currencies needs to be developed because there are already more than a thousand distinct cryptocurrencies on the market.

The launch of a CBDC involves significant risks because the intended, but mostly unproven benefits could outweigh potential economic disruption. With risks and rewards that are intrinsically different in developing countries, what may be true for some established economies may not be true for others. In order to investigate the possibility for issuing central bank digital currencies, central banks have started exploratory projects. The impact of a CBDC on interest rates, financial stability, and security needs to be carefully considered; nevertheless, despite the analysis of a variety of models, a clear solution is elusive. Financial intermediation changes would affect bank funding and liquidity (Ward, Rochemont, 2019).

A CBDC implementation could also cause a run on the digital banks. In such cases, clients "per click" take a sizable portion of their bank savings and convert it to a CBDC. The following is how Mersch (2018) discusses the bank run danger associated with CBDC: "During a systemic banking crisis, holding risk-free central bank-issued CBDC could become vastly more attractive than bank deposits. There could be a sector-wide run on bank deposits, magnifying the effects of the crisis. Even in the absence of a crisis, readily convertible DBM could completely crowd out bank deposits – putting the existence of the two-tier banking system at risk. In this situation, the efficient flow of credit to the economy would likely be impaired." (Mersch, 2018).

It is urgent to research the broad-based macroeconomic effects of digital currencies and how these might change the dynamics of the current monetary and payment systems as well as global financial stability. Technology continues to be a major catalyst in changing the paradigm of monetary and payment systems (both influenced by public and private authorities). Additionally, this necessitates research on repercussions in relation to least developed countries (LDCs) and how those nations' Sustainable Development Goals are affected (SDGs) (Foster et al, 2021).

7 Conclusion

The goal of mankind has always been to simplify payment and purchasing. That was evident even in ancient times, when tortoise shells, wampum, and whale teeth were employed as payment methods to facilitate trade. This propensity made the 20th and 21st centuries a hub for innovation. The visibility of money as an object has rapidly changed over time, beginning with payment coupons, checks, and plastic cards, which resulted in diminished visibility. In the modern world, electronic money and electronic currencies are being used in addition to credit, debit, and prepaid cards. Bitcoin and other cryptocurrencies even pose a threat to the states' monopoly on issuing and regulating money. The response of the financial markets, where confidence and stability are crucial components, to this new financial paradigm will be crucial for the development of these new financial instruments. Questions about money, such as "Will money as a thing continue to exist?", "How will electronic money and

electronic currencies affect the financial markets?" and "How central banks respond to digital currencies" are likely to gain importance over time and attract greater attention as people try to find the answers. The discussion over technical frameworks, accessibility, the function of the commercial banking system, and the role of the private sector is still going on as CBDC is starting to gain direct interest from central banks all over the world.

Today, central banks discuss the introduction of their own digital currencies, so-called CBDCs. The accessibility and layout of a CBDC, whose form is accessible to many distinct alternatives, will affect its effects. The new regulatory framework put in place by the CB to support commercial banks will have an effect on the CBDC implementation as well. Many nations are currently in the exploratory phase, but the risk of establishing a CBDC at the expense of a healthy banking sector will be carefully considered. Each CB will need to take into account the impact they want a CBDC to have on monetary policy, which will be determined by whether or not the CBDC generates interest, the potential for implementation using current technology, and the personal and business ramifications.

In particular, anonymity, universal access, and resilience to infrastructure outages are cash-like characteristics that a CBDC system would need to possess in order to be competitive with other forms of money and payment. A CBDC system should aim to improve financial and digital inclusion in addition to these cash-like characteristics, for instance by enabling purchases from online retailers. These are difficult to design and construct and will necessitate more study.

References

- Alnasaa, M., Gueorguiev, N., Honda J., Imamoglu, E., Mauro, P., Primus, K., Rozhkov, D., 2022. "Crypto, Corruption, and Capital Controls: Cross-Country Correlations", IMF Working Paper Fiscal Affairs Department.
- Berentsen, A. and Schär, F., 2018. "The Case for Central Bank Electronic Money and the Non-case for Central Bank Cryptocurrencies", Federal Reserve Bank of St. Louis Review, Second Quarter.
- Berg, C., Davidson S., Potts J., 2020. "Proof of work as a three-sided market. Frontiers in Blockchain.", <https://www.frontiersin.org/articles/10.3389/fbloc.2020.00002/full> .
- Bindseil U., 2020. "Tiered CBDC and The financial system", European Central Bank Working Paper Series, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3513422 .
- Bitcointalk, 2019. "<https://bitcointalk.org/index.php?topic=5126554>", Access Date: 02/07/2022 .
- Chaum, D., 1982. "Blind Signatures For Untraceable Payments", <http://blog.koehntopp.de/uploads/Chaum.BlindSigForPayment.1982.PDF> .
- Chouseinoglou, O., 2004. "An Electronic Money Model For Micropayments", The Middle East Technical University, Thesis Of Master Of Science In The Department Of Information Systems.
- Cuofano, G., 2021. "History Of Bitcoin: How The Blockchain Ecosystem Evolved", <https://fourweekmba.com/history-of-bitcoin/> .
- Davies, G., 1994. **A History Of Money: From Ancient Times To The Present Day**. Cardiff: University of Wales Press.
- Dwor-Frecaut, D., 2022. "CBDC: Central Bank Digital Currency and the DLT Revolution". <https://macrohive.com/hive-explainers/explainer-central-bank-digital-currencies-and-the-money-revolution/>, Access Date: 02/07/2022.
- Engert, W. and Fung B. S., 2017. "Central Bank Digital Currencies: Motivations And Implications", Staff Discussion Paper 2017-16, Bank of Canada.
- Feyen, E., Kawashima, Y., Mittal, R., 2022. "The Ascent Of Crypto-Assets: Evolution And Macro-Financial Drivers", World Bank Blogs, <https://blogs.worldbank.org/developmenttalk/ascent-crypto-assets-evolution-and-macro-financial-drivers> .
- Foster, K., Blakstad S., Gazi S., Bos M., 2021. "Digital currencies and CBDC impacts on least developed countries (LDCs)", https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3871301, UNDP, Technical Paper 1.2.
- Gilbert, S., Loi, H., 2018. "Digital Currency Risk", International Journal of Economics and Finance; Vol. 10, No. 2
- Griffith, K., 2014. "A Quick History of Cryptocurrencies BTC - Before Bitcoin", Bitcoinmagazine, Access Date: 01.07.2022.
- Haber, S., Stornetta, W. S., 1991. "How to Time-stamp a Digital Document", Journal of Cryptology volume 3, pages99–111.
- Hayek, F. A., 1976. **The Denationalisation of Money** ,The Institute of Economic Affairs, London.

- Hutt, R., 2016. "All you need to know about blockchain, explained simply", <https://www.weforum.org/agenda/2016/06/blockchain-explained-simply/> .
- Kaufman, G. G., 1981. **Money, The Financial System, And The Economy**, 3rd ed., Boston: Houghton Mifflin.
- Kurtzman, J., 1993. **The Death of Money: How Electronic Economy Has Destabilised the World's Market and Created Financial Chaos**, Publisher: Simon & Schuster Ltd.
- Luo, Y. G., 1998. "The Evolution Of Money As A Medium Of Exchange", *Journal of Economic Dynamics and Control*, Volume 23, Issue 3, 19 November 1998, Pages 415-458, <https://www.sciencedirect.com/science/article/abs/pii/S0165188998000293> .
- Mancini-Griffoli, T., Martinez Peria M. S., Agur, I., Kiff, J., Popescu, A., Rochon, C., 2018, "Casting Light on Central Bank Digital Currency", IMF Staff Discussion Note, 18/08.
- Mattila J., 2016. "The Blockchain Phenomenon The Disruptive Potential of Distributed Consensus Architectures." ETLA Working Papers, 38, 26.
- McFarland C., 2018. "McAfee Researchers Analyze Dark Side of Cryptocurrency Craze", <https://www.mcafee.com/blogs/other-blogs/mcafee-labs/mcafee-researchers-analyze-dark-side-of-cryptocurrency-craze-its-effect-on-cybercrime/> .
- Mersch, Y., 2018. Virtual or virtueless? The evolution of money in the digital age. Lecture at the Official Monetary and Financial Institutions Forum, London.
- Nakamoto, S., 2008. "A Peer To Peer Electronic Cash system", <https://bitcoin.org/bitcoin.pdf> .
- Peneder, M., 2022. "Digitization And The Evolution Of Money As A Social Technology Of Account", *Journal of Evolutionary Economics* volume 32, pages 175–203.
- Pişkin, F., 2021. "Analysis Of Public Perception Of Central Banks Digital Currencies: A Survey Analysis", Istanbul Bilgi University, Master of Thesis.
- Sandner, P., Gross, J., Grale, L., Schulden, P., 2020. "The Digital Programmable Euro, Libra and CBDC: Implications for European Banks" , https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3663142, Access Date: 02/07/2022.
- Schumpeter, J. A., 1970. **Das Wesen des Geldes**, Göttingen: Vandenhoeck & Ruprecht.
- Smith, A., 1776. **An Inquiry Into The Nature And Causes Of The Wealth Of Nations**, London, Printed for W. Strahan and T. Cadell.
- Tatliyer, M., 2018. "Parayi Kim Basiyor?", *Kriter* dergisi yil 2 sayi 22.
- Ward, O., Rochemont, S., 2019. "Understanding Central Bank Digital Currencies (CBDC)" <https://taostartup.vn/wp-content/uploads/2020/07/Understanding-CBDCs-Final-disc.pdf> .
- Wieser, F., 1927, "Geld" in *handwörterbuch der Staatswissenschaften*, 4th ed., Vol. IV, Jena.