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Central Bank Digital Currencies: A Primer

Matthew N. O. Sadiku[1], Paul A. Adekunte[2], Janet O. Sadiku[3]

[1]Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA
[2]International Institute of Professional Security, Lagos, Nigeria
[3]Juliana King University, Houston, TX, USA

ABSTRACT

Central bank digital currencies (CBDCs) are digital forms of national currency, issued and controlled by a central bank. CBDC is a new form of money that exists only in digital form and is widely available to the general public. It is digital or electronic money a country's central bank can issue alongside cash like notes and coins. It is designed to provide a secure and convenient alternative to physical cash and to make digital payments easier for individuals and businesses. It is a liability of the central bank. CBDCs are backed by the central bank, which means they hold the same value as traditional fiat currencies and can be used for a wide range of transactions, such as online and in-person purchases, bill payments, peer-to-peer transfers, paying employees or purchasing goods and services. They are unlike cryptocurrencies, which are not regulated by a central authority. This paper aims at explaining central bank digital currency (CBDC) in detail.

KEYWORDS: *central bank digital currencies, CBDC, digital fiat currency, digital base money, finance, finance industry*

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INTRODUCTION

Traditionally, fiat money has been banknotes and coins, but technology has allowed governments and financial institutions to supplement physical fiat money with a credit-based currency. Cash may be king, but the crown seems to have lost some of its luster of late. Figure 1 shows some cash [1]. Conventional money requires many intermediaries in the payment chain, resulting in less efficient and secure payment experiences. Central bank digital currencies (CBDC) could find solutions to these issues, developing a more efficient, fast, secure, and sovereign form of payment process.

CBDC is a global phenomenon, with dozens of countries studying the idea and a handful already implementing some version of a CBDC. In a world that is always-on, some central banks are looking to advance and promote digital payments that allow for 24/7 payment processing. CBCDs are designed to be accessible to the public and can be used for payments and transactions like traditional cash. Instead of printing money, the central bank issues widely accessible digital coins so that digital transactions and transfers become simple. As connectivity increases and smartphones proliferate, CBDCs could also be a way to include more people in the digital economy who are currently shut off from basic financial services. The place of CBDC is the currency landscape is shown in Figure 2 [2].

WHAT IS A CENTRAL BANK DIGITAL CURRENCY?

A central bank digital currency (CBDC), also called digital fiat currency or digital base money, is a form of digital currency issued by a country's central bank, rather than by a commercial bank. There are already thousands of digital currencies, commonly called cryptocurrencies. Bitcoin is the most well-known fully decentralized cryptocurrency. CBDC is similar to cryptocurrencies and it uses blockchain or distributed ledger technology, except that its value is fixed by the central bank and is equivalent to the country's fiat currency. Fiat money is a government-issued currency that has no physical commodity like gold or silver backing it up. Unlike cryptocurrencies like Bitcoin, CBDCs are fully regulated, centralized, and backed by the government. CBDC is intended to function as a digital version of traditional fiat money.

The differences between CBCD and crypocurrency are displayed in Figure 3 [3], while Figure 4 shows their relationship [4]. CBDC is considered a form of legal tender that is government-backed and can be exchanged for goods and services. Its aim is to modernize payments, reduce cash dependency, and improve financial inclusion while maintaining government control over money supply and policy. A nation's monetary authority, or central bank, issues a CBDC, which promotes financial inclusion and simplifies the implementation of monetary and fiscal policies. Figure 5 shows a presentation of CBDC [5], while Figure 6 shows a transaction using CBDC [1].

Central bank money refers to money that is a liability of the central bank. In the United States, there are currently two types of central bank money: physical currency issued by the Reserve and digital balances held by commercial banks at the Federal Reserve. The Federal Reserve regard a CBDC as a means to expand safe payment options, not to reduce or replace them. It is studying how a CBDC could improve on an already safe and efficient US domestic payments system. Figure 7 displays Chicago Federal Reserve Bank building [6].

There are many reasons to explore digital currencies, and the motivation of different countries for issuing CBDCs depends on their economic situation. Figure 8 shows some of these reasons [7]. Common motivations include promoting financial inclusion by providing easy and safer access to money for unbanked and underbanked populations; introducing competition and resilience in the domestic payments market; increasing efficiency in payments and lowering transaction costs; creating programmable money and improving transparency in money flows; and providing for the seamless and easy flow of monetary and fiscal policy [8].

There are two types of CBDCs: wholesale and retail. Financial institutions are the primary users of wholesale CBDCs, whereas consumers and businesses use retail CBDCs. It is possible to develop and implement the two types of CBDCs and have them function in the same economy. Figure 9 compares the two types [3]. CBDC could be developed in a number of ways. In a centralized approach, transactions are recorded in ledgers managed by central banks that also provide user-facing services. In a decentralized approach, a central bank sets rules and requirements for the settlement of CBDC transactions that are then recorded by users and/or financial intermediaries [9].

Some features of CBDC are shown in Figure 10 [4]. Key characteristics of CBDCs include:

- Digital Form: CBDCs exist only in digital form, not as physical currency.
- Central Bank Issued: They are issued and backed by a central bank, not by private entities like cryptocurrencies.
- Widespread Access: They are designed to be accessible to the general public.
- Payment and Transaction Functionality: They can be used for payments and transactions like traditional cash.
- Blockchain or centralized database: Some CBDCs use blockchain-like technology, while others rely on traditional banking infrastructure.

Although the term "CBDC" did not become widely used until after 2019, central banks have researched and launched digital currency projects for decades. Digicash and e-gold were some of the first virtual currencies issued by central agencies. However, these currencies never saw widespread support or usage. Efforts towards CBDC grow all over the world for many reasons. Many countries are developing CBDCs, and some have even implemented them. Central banks in many countries have launched pilot programs and research projects to determine the viability and usability of a CBDC in their economies. As of 2023, over 120 different jurisdictions were evaluating national digital currencies. The BRICS countries—Brazil, Russia, India, China, and South Africa—are exploring a CBDC. As of March 2024, three countries had a functioning CBDC: the Bahamas, Jamaica, and Nigeria. The names of the currencies are Bahamas Sand Dollar, DCash, and eNaira, respectively. All three countries are focused on expanding the reach of their retail CBDCs domestically. In US, the Federal Reserve and its branches are researching CBDCs and ways to implement them in the financial system [9]. President Trump recently issued an executive order prohibiting the establishment, issuance, circulation, and use of a CBDC. Figure 11 displays a map showing the CBDC status of nations around the world [3].

EXAMPLES OF CENTRAL BANK DIGITAL CURRENCIES

The emergence of CBDCs has sparked global interest among policymakers, financial institutions, and the public, as they hold the potential to transform financial systems, enhance payment systems efficiency, foster financial inclusion, and reshape monetary policy frameworks. An overwhelming 134 countries are actively exploring CBDCs. They represent 98% of the world's economy. These countries are at the forefront of CBDC development

and implementation. They serve as testbeds for innovation. They provide valuable insights into the potential impacts of these digital currencies. The following are examples of implementation of CBDC [10]:

- *China's Digital Yuan* (e-CNY): China, notably, leads the charge. China's digital yuan (e-CNY) has undergone extensive trials in major cities. These trials processed substantial transaction volumes. The 2022 Winter Olympics was a prominent platform. It demonstrated e-CNY's practical applications and wide-reaching impact. This emphasized its potential to influence global trade.
- *The Bahamas' Sand Dollar:* The Bahamas, interestingly, was the first to launch a national CBDC. The BSD focuses on enhancing financial inclusion. Although it represents a small fraction of their circulating currency, its implementation is a significant step. It modernizes the country's economic system.
- *Nigeria's eNaira:* The eNaira aims to facilitate easier money transfers. It also aims to reduce cash dependency. This demonstrates Nigeria's commitment. Nigeria leverages digital currency for financial inclusion and economic growth. This is important in emerging markets.
- *The European Union's Digital Euro:* The European Central Bank is actively developing a "Digital Euro." This will streamline transactions among EU countries. It will also enhance the region's financial infrastructure. The European Central Bank, after exploring possible design scenarios for launching a Digital Euro and consulting with stakeholders, decided to launch a CBDC project with an investigation phase that should last from October 2021 to October 2023.
- *Jamaica's DCash:* Jamaica's digital currency follows a similar program by a group of Eastern Caribbean nations called DCash. Antigua and Barbuda, Grenada, Saint Kitts and Nevis, Saint Lucia and Saint Vincent are now using DCash. In 2020, Bahamas was the first country in the region to issue digital currency.

APPLICATIONS OF CENTRAL BANK DIGITAL CURRENCIES

Going by the number of countries invested in researching, developing and implementing digital currencies, it is safe to assume that CBDC will be a part of the future of money. CBDCs are being explored by many central banks worldwide, including the US Federal Reserve**.** Common applications of CBDCs include the following [1,12]:

- *Electronic Payments:* Electronic payments are on the rise as cash usage declines across the globe, leading an increasing number of governments to think about launching digital versions of their currencies. CBDCs offer faster and cheaper payments, allow people currently outside the traditional banking system access to financial infrastructure, and could reduce settlement risk and delays on international trade. Nations with a high percentage of electronic payments, or a relatively concentrated and small banking system, may find it easier to introduce some form of a CBDC. Retail banks, merchants, and payment service providers should consider the level of infrastructure investment that might be needed to implement CBDCs successfully as they address other requirements for modernizing payments.
- *Cross-border Payments:* Many central banks are exploring retail CBDC issuance, hoping to improve cross-border payments. CBDC is a safe, liquid asset that can decrease the reliance on financial intermediaries and reduce settlement risks. Additionally, CBDC is a clean slate on which cross-border payment processes can be redesigned and optimized. It is vital to consider cross-border implications early in the development process to prevent unintended barriers, even if the CBDC is only intended for domestic use initially.
- *Financial Inclusion:* Financial inclusion is often a key policy objective for a retail CBDC, especially in emerging and lower-income countries. Many individuals throughout the world have no access to bank accounts; so a CBDC would give them a way to be paid, hold their money, and pay bills. CBDCs could expand access to financial services for those who are unbanked or underbanked. If properly designed to address barriers to financial inclusion, CBDCs could gain acceptance as a payment mechanism for financially excluded populations.
- *Blockchain:* The introduction and evolution of cryptocurrency and blockchain technology have spurred additional interest in cashless societies and digital currencies. A variety of recent digital disruptions, including the emergence of cryptocurrencies and blockchain technology, have made waves in the financial-services sector. Central bank digital currencies are designed to be similar to cryptocurrencies, but they may not require blockchain technology or consensus mechanisms. Some CBDCs use blockchain-like technology, while others rely on traditional banking infrastructure.

- *Commercial Banks*: CBDCs have the potential to impact commercial banks significantly. For example, banks could lose deposits if depositors prefer to hold CBDC instead of money in commercial bank deposits. They could also lend less. Consequently, they would support the liquidity of the forex market less. Commercial banks should learn to conduct effective KYC and anti-money-laundering monitoring of digital currencies. In models that involve commercial banks issuing CBDCs to customers (in return for deposit-based revenue opportunities), they will also be expected to carry the cost burden for KYC compliance.
- Markets: The advent of CBDCs presents both transformative opportunities and complex challenges. This affects retail traders and institutions. CBDCs promise to enhance transaction efficiency and transparency. They have the potential to alter traditional currency dynamics. They can also create new trading opportunities. CBDCs, for example, streamline compliance. They also reduce transaction fees. This, therefore, fosters more efficient and transparent markets. This increased transparency can, importantly, reduce information asymmetry. It can also enhance market integrity. Traders should closely watch how governments address regulatory and technical challenges. These challenges will shape the future of global currency trading.

BENEFITS

A CBDC could potentially offer a range of benefits. CBDC should provide benefits to households, businesses, and the overall economy that exceed any costs and risks. A main purpose of CBDCs is to provide businesses and consumers conducting financial transactions with privacy, transferability, convenience, accessibility, and financial security. A CBDC also provides a country's central bank with the means to implement monetary policies to ensure stability, control growth, and influence inflation. CBDC can drive inclusion, transform customer experience, enable seamless digital transactions/payments, boost the digital economy, curb money laundering, and expand the horizons of international commerce. Other benefits include the following [13-15]:

- *Increased Transparency:* CBDC could help to increase transparency in the financial system by providing a digital record of all transactions, which could be useful for tracking the flow of money and detecting illicit activity. CBDC can be designed to allow for the traceability of transactions, which can help to increase transparency and reduce the risk of financial crimes such as money laundering and terrorist financing. Promoting transparency in the regulatory framework enhances accountability and fosters public trust in CBDCs.
- *Interoperability:* CBDCs can be designed to be interoperable with existing payment systems and infrastructure, which can make it easier for new payment service providers and fintech companies to enter the market and offer new and innovative services.
- *Improved Efficiency:* CBDC could help to improve the efficiency of financial transactions by reducing the time and cost associated with traditional payment methods. Instead of relying on intermediaries such as banks and clearing houses, money transfers and payments could be made in real time, directly from the payer to the payee. For example, for a large country like India, replacing cash usage with CBDCs will help the government in lessening the cost of printing, storing, and distributing currency. It makes the payment system easier, cheaper, and quicker.
- *Reduced Risk:* Payment for goods and services often needs to be done in a timely manner and when payment verification is slow, merchants usually accept the risk of some payments not succeeding in exchange for faster service to customers. When these risks are eliminated with instant payment verifications, merchants no longer need to use intermediaries to handle the risk or to absorb the risk cost themselves.
- *Eliminates Transaction Fees*: current payment systems like Visa, Mastercard, American Express etc. have a fee attached to each transaction and lowering or eliminating these fees could lead to widespread price drops and increased adoption of digital payments.
- *Proof of Transaction*: A digital record exists to prove that money changed hands between two parties which avoids problems inherent to cash such as short-changing, cash theft, and conflicting testimonies.
- *Banking Competition:* The provision of free bank accounts at the central bank offering complete safety of money deposits could strengthen competition between banks to attract bank deposits.
- *Enhanced Financial Stability:* CBDC could help to enhance financial stability in developing countries by reducing the risk of bank runs and

other financial crises. This could be achieved by allowing people to hold their deposits with the central bank directly, rather than with commercial banks.

CHALLENGES

There are many challenges, and each one needs careful consideration before a country launches a CBDC. Citizens could pull too much money out of banks at once by purchasing CBDCs, triggering a run on banks. A CBDC could pose certain risks and raise a variety of important policy questions. A switch to a CBDC could have an unknown effect on a financial system's stability. CBDCs have faced a lot of criticisms, including concerns about privacy and the potential for them to be used as a "tool for coercion and control." A major challenge with central bank digital currencies is deciding whether the currency should be easily traceable. Other challenges include [13-15]:

- *Privacy Concerns:* CBDCs raise concerns related to user privacy and surveillance. Privacy is considered as the most important feature of a digital currency by both citizens and professionals. Concentration of data in the hands of central banks could lead to increased privacy risks for citizens. CBDCs could raise privacy concerns, as all transactions would be recorded on a central bank's ledger. Any CBDC would need to strike an appropriate balance between safeguarding the privacy rights of consumers and affording the transparency necessary to deter criminal activity.
- *Centralization:* The centralized control inherent in CBDCs raises questions about the collection and storage of user data. Since most central bank digital currencies are centralized, rather than decentralized like most cryptocurrencies, the controllers of the issuance of CBDCs can add or remove money from anyone's account with a flip of a switch. Central banks must establish clear policies and safeguards to protect user information, addressing concerns about potential data breaches, unauthorized access, or misuse of sensitive financial data.
- *Cybersecurity:* Cybersecurity is an important risk to any payment infrastructure. The digital nature of CBDCs exposes them to cyber threats and attacks. Malicious actors may target CBDC systems to compromise user data, disrupt transactions, or engage in fraudulent activities. While CBDCs offer resiliency by providing a new payment method, they would also represent a critical infrastructure, potentially making them a high-value target for cyber attacks. CBDC could be vulnerable to cyberattacks, which could compromise the security of the digital currency and undermine confidence in the financial system. The large amount of data that would be generated by CBDC transactions could be vulnerable to hacking, data breaches, and other cyber-attacks.
- *Complexity:* Introducing CBDCs could be complex and require significant technological and logistical infrastructure. Exploring CBDCs is a significant undertaking that involves complex decisions in a rapidly changing digital environment. Domestic authorities should undertake a careful assessment of their capacity to experiment with, regulate, oversee, and eventually implement CBDCs. The implementation and management of CBDC could pose operational challenges, such as the need to upgrade IT systems and train staff.
- *Regulation:* As CBDCs continue to garner attention and consideration globally, the establishment of robust regulatory frameworks becomes paramount. These frameworks serve as the bedrock for the development, implementation, and oversight of CBDCs, ensuring that they operate within established guidelines and principles. Divergent regulatory approaches across jurisdictions may create inconsistencies in the treatment of CBDCs. Regulatory frameworks should specify the entities subject to oversight, such as central banks, financial institutions, technology providers, and other relevant parties.
- *Scalability:* The scalability of CBDCs becomes a critical consideration as transaction volumes increase. High-frequency transactions on a CBDC network may strain the underlying technological infrastructure, leading to delays and inefficiencies. Central banks must invest in scalable and resilient technological solutions to ensure the smooth functioning of CBDCs.
- *Money Laundering*: CBDCs, like cash, could be used for illegal activities such as tax evasion, money laundering, and financing of terrorism. It would be hard to trace transactions made with CBDCs, making it more difficult to detect and prevent illegal activities.
- *Monetary Policy Risks:* With a CBDC in circulation, the central bank's ability to control the money supply would be limited, which could make it more difficult to achieve their monetary policy objectives and change the way that central banks influence the money supply and interest rates. CBDC remains fiat money, created or destroyed by a central bank as part of its

monetary policy decision-making. Chief risk officers should monitor the impact of digital currencies on bank liquidity and capital requirements in light of potential policy changes.

- *Global Coordination:* CBDCs of different countries, for example, must be interoperable. This ensures smooth cross-border transactions. Conversely, a lack of coordination could fragment markets. It could also increase forex trading costs. CBDCs' cross-border use raises challenges related to international coordination and the establishment of common standards. The lack of harmonized regulatory frameworks and interoperability agreements may hinder the seamless exchange of CBDCs between countries. Central banks must engage in collaborative efforts to address regulatory challenges and create a cohesive international framework for the use of CBDCs.
- *High Implementation Costs*: CBDC infrastructure is costly. This cost applies to both setting up and maintaining the infrastructure. This is especially true for smaller economies. High costs, consequently, may slow down the rate of adoption. They may also lead to unequal diffusion across countries.

CONCLUSION

A central bank digital currencies (CBDC) is virtual money backed and issued by a central bank. They are like a digital version of cash, and CBDC can be used for transactions just like physical cash. Instead of printing money, the central bank issues electronic coins or accounts backed by the full faith and credit of the government.

CBDCs have gained immense traction in recent years. Governments and central banks are studying CBDCs and their implications for financial inclusion, economic growth, technology innovation, and the efficiency of bank transactions. CBDCs should be implemented to enhance existing financial networks and fiat currencies, not replace them. Proposals for CBDC implementation often involve the provision of universal bank accounts at the central banks for all citizens. It is possible to envisage the coexistence of fast payment systems, e-money, and CBDC in many payment landscapes across the world.

Although the use of CBDC is still in the early stages of development and many of these risks are not fully understood, some countries are exploring the potential advantages and disadvantages of implementing such a system. The United States has lagged many countries in pursuing a central bank digital currency (CBDC). Experts believe that there is an urgent need for the US to catch up, arguing that the lack of a US CBDC threatens the primacy of the dollar [16]. More information about central bank digital currencies can be found in the books in [17-27].

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Figure 1 Some cash [1].

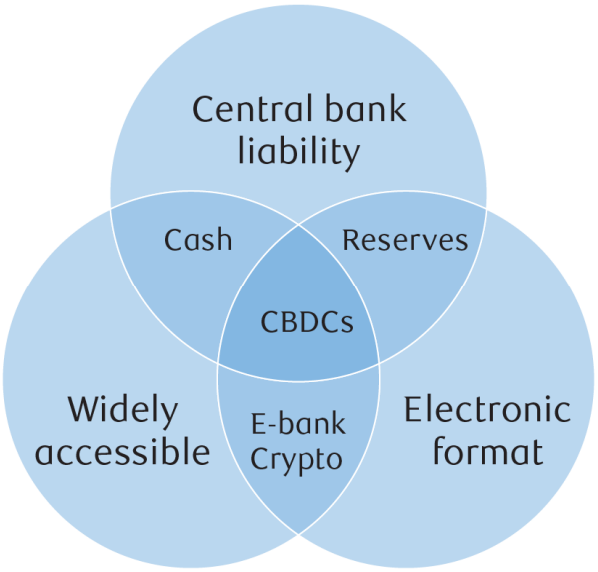

Figure 2 The place of CBDC in the currency landscape [2].

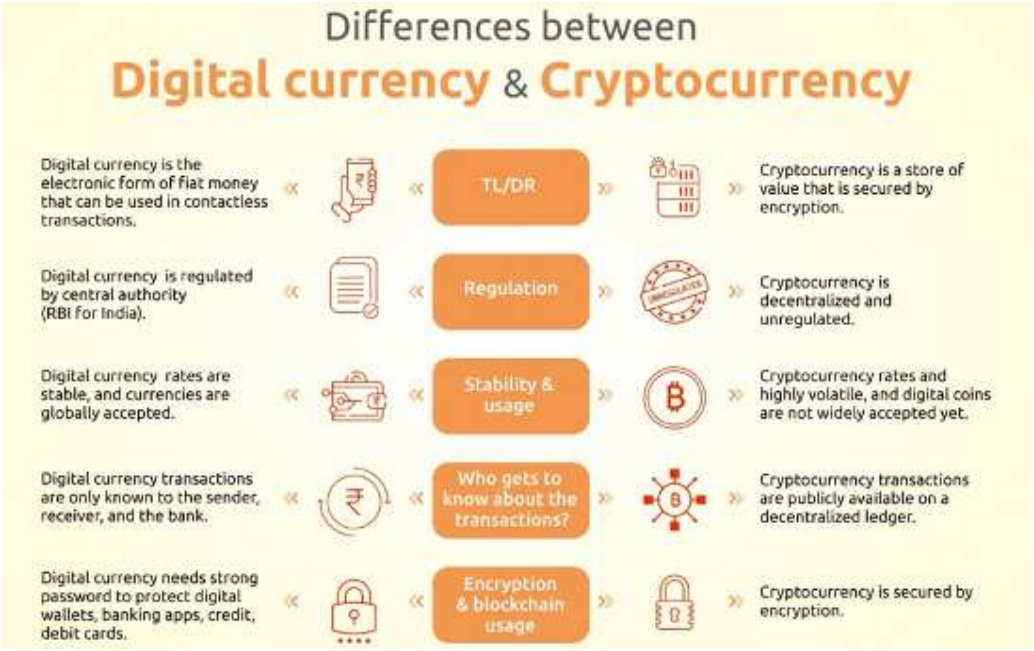

Figure 3 The differences between CBCD and crypocurrency [3].

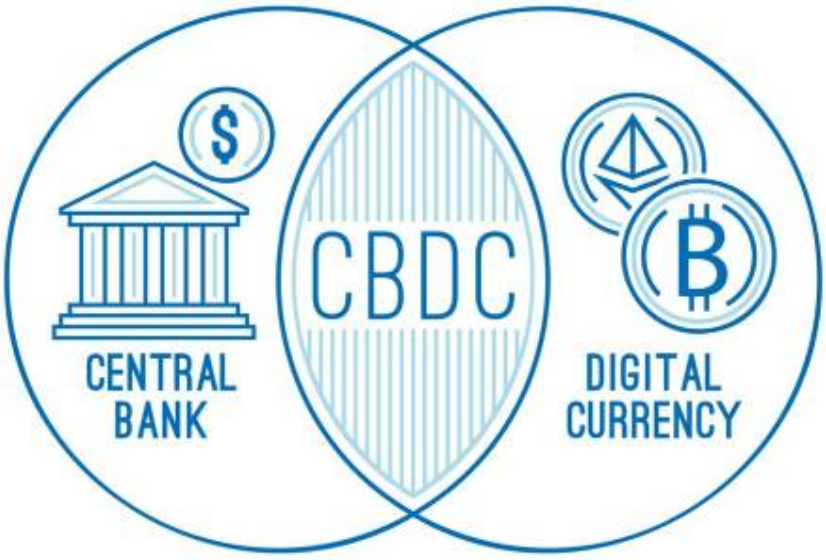

Figure 4 The relationship between CBCD and digital currency [4].

Figure 5 A presentation of CBDC [5].

Figure 6 A transaction using CBDC [1].

Figure 7 Chicago Federal Reserve Bank building [6].

Figure 8 Some reasons for CBDC [7].

Figure 9 Two types of CBDC [3].

Figure 10 Some features of CBDC [4].

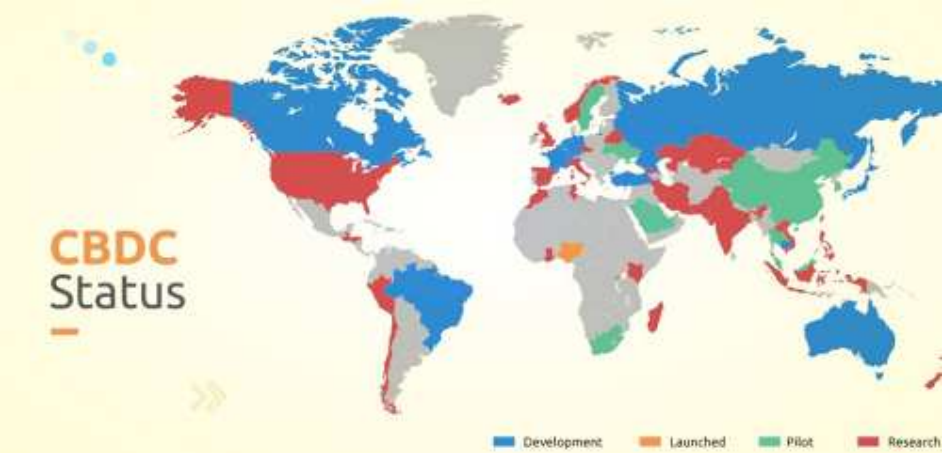

Figure 11 A map showing the CBDC status of nations around the world [3].