

Central Bank Digital Currency: Driving the Shift Towards a Global Cashless Society.

Sushma Yadav¹, Prof. (Dr) Vidhi Bhargava²

¹Phd. Research Scholar, Amity College of Commerce, Amity University, Gurugram, Haryana.

²Professor, Amity College of Commerce, Director Online Education, Amity University, Gurugram, Haryana.

Abstract:

The evolution of money from traditional physical cash to Digital Currency marks a significant paradigm shift in the global financial landscape. This conceptual paper provides an overview of the emerging form of central bank money known as Central Bank Digital Currency (CBDC) and its progression amidst the digitalization era. It discusses the transition from cash to CBDC, exploring global advancements and initiatives. Drawing upon existing literature, it comprehensively addresses CBDC's forms, features, types, motivations, and implications. Specifically, it emphasizes the practical application of CBDC through pilot projects in India, highlighting the interoperability of Unified Payments Interface (UPI) with CBDC, a significant step towards adoption by the Reserve Bank of India (RBI). This study contributes to existing literature by highlighting the necessity for further research to understand the complexities and implications of CBDC adoption, crucial for its widespread acceptance. It underscores the imperative need for additional research and practical exploration to fully understand the ramifications of CBDC adoption, particularly within the Indian context and beyond.

Keywords: CBDC Central Bank Digital Currency, Retails CBDC, Wholesale CBDC, RBI (Reserve Bank of India), UPI (Unified Payment Interface)

1. Introduction

Money has been the lifeblood of human civilization, evolving from humble barter systems to the intricate world of digital currencies. Initially, the barter system prevailed, involving direct exchanges of goods and services within smaller communities but faced limitations like the requirement for a double coincidence of wants. With expanding societies, commodity money emerged, recognizing items like grain and livestock for their inherent value.

The introduction of standardized metal coins by the Lydians marked a pivotal shift, using precious metals for crafting coins and enhancing trust in society. As societies grew, the need for more portable currency led to the emergence of paper money initially backed by physical assets. Central banks were subsequently established to address the challenges posed by a profusion of competing currencies. In the 17th century, central banking and the transition to fiat currency facilitated greater government control over monetary policy.

The digital age then ushered in a transformative era with digital currencies, cryptocurrencies, and efficient online transactions. The advent of credit and debit cards introduced a convenient and widely accepted means of transaction, significantly impacting the way people manage their finances. This shift also

witnessed the rise of digital payment platforms and mobile wallets, revolutionizing transaction speed, security, and global accessibility.

As the world moves toward a digital-first approach, the rise of Central Bank Digital Currency (CBDCs) takes center stage. These digital versions of traditional currency hold the potential to streamline financial operations and broaden access to economic resources. While promising enhanced efficiency and broader financial access, this shift sparks debates on privacy, security, and the necessity for comprehensive regulations in the evolving landscape of a cashless society. The future of money holds immense potential for shaping the global economy, but it requires careful consideration of the implications and responsibilities that come with embracing digital currencies and financial technologies.

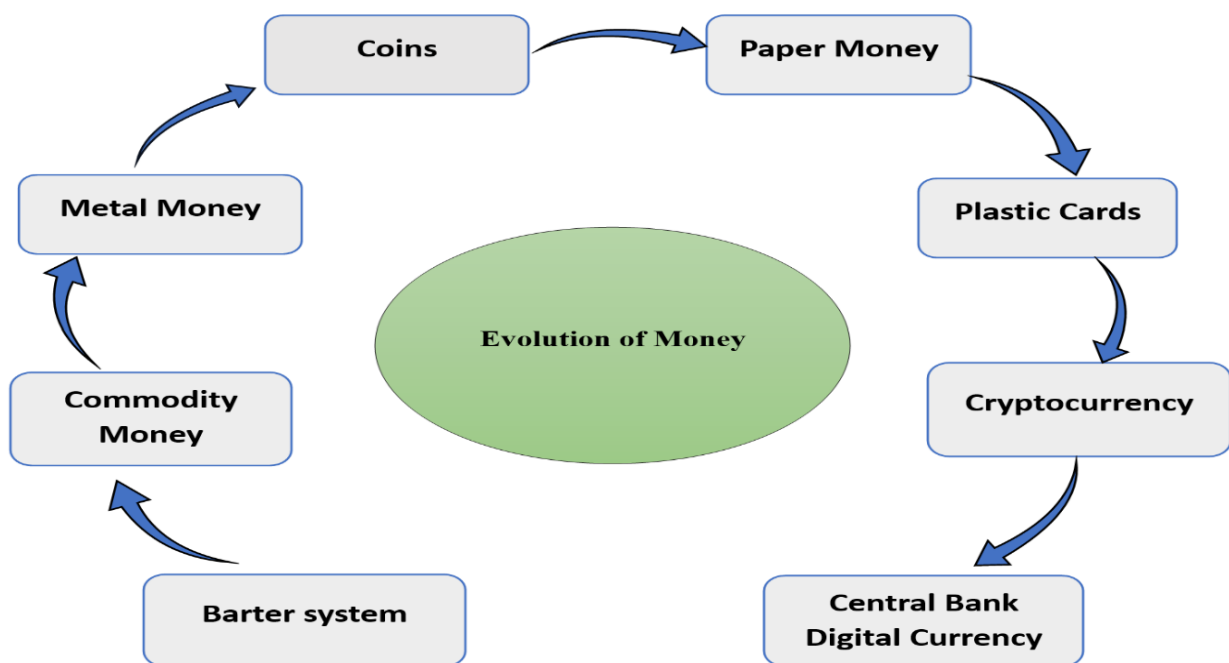


Figure 1. Evolution of Money

This present paper provides a conceptual exploration of the transition towards a cashless society in the digital era, with a focus on the introduction of CBDCs as a significant catalyst of financial innovation and digital transformation. It offers an overview of CBDCs, detailing their benefits, forms, and motivations for implementation, emphasizing their transformative potential. Furthermore, the paper delves into the implications of CBDC adoption in economies and examines the status of CBDC initiatives worldwide. Transitioning towards the Indian context, it explores the nation's digitalization journey, particularly spotlighting the role of the Unified Payment Interface (UPI) and ongoing pilot projects. Lastly, the paper highlights the Reserve Bank of India (RBI) initiatives, especially its efforts to ensure UPI interoperability with e-rupee for CBDC adoption, further propelling India's digital economy. Through insights taken from existing literature, this conceptual paper aims to contribute to the fast-growing literature on CBDC.

2. Money in the era of Digitalization

In the era of digitalization, money is undergoing a profound transformation, with technological advancements reshaping the way we perceive, use, and manage currency. The traditional physical representation of money is giving way to digital forms, challenging conventional banking and financial

systems. Despite this evolution, the fundamental purposes of money, serving as a medium of exchange, a store of value, and a unit of account, remain consistent.

The rise of the internet paved the way for a fundamental shift in how financial transactions are conducted. Internet banking emerged as a convenient alternative to traditional brick-and-mortar banking, allowing individuals to manage their finances remotely. This transition brought with it unprecedented accessibility and efficiency, enabling customers to perform various banking tasks from the comfort of their homes or on the go. Alongside internet banking, the introduction of debit and credit cards revolutionized the payment landscape, offering users a convenient and secure way to make purchases electronically. These plastic cards not only replaced cash but also introduced new features such as fraud protection and purchase insurance, enhancing the overall safety and convenience of transactions. As technology continued to evolve, mobile wallets and payment apps emerged as the next frontier in digital finance. These applications leverage the power of smartphones to enable contactless payments, further streamlining the payment process and enhancing security through features like biometric authentication and tokenization. In this digital age, money has become more fluid and accessible than ever before, reshaping the way we think about and interact with financial services.

The rise of cryptocurrencies, exemplified by Bitcoin and Ethereum, introduced decentralized forms of digital currency. Blockchain technology, the foundational framework for cryptocurrencies, ensured secure and transparent transactions without the need for intermediaries. Cryptocurrencies provided an alternative to traditional fiat currencies and pioneered the concept of decentralized finance (DeFi). However, the advent of cryptocurrencies brought forth challenges such as regulatory concerns, price volatility, and security issues. Governments and financial institutions grappled with the development of appropriate regulations to manage the risks associated with this innovative form of currency.

In response to the evolving landscape, central banks globally embarked on exploring the development of CBDCs. These digital versions of national currencies aim to combine the advantages of digital currencies with the stability and backing of traditional fiat currencies. CBDCs provide central banks with new tools for implementing monetary policy and offer a regulated alternative to privately issued digital currencies. CBDCs, as a government-backed digital currency, have the potential to reshape the financial landscape by providing a regulated and secure alternative to private cryptocurrencies.

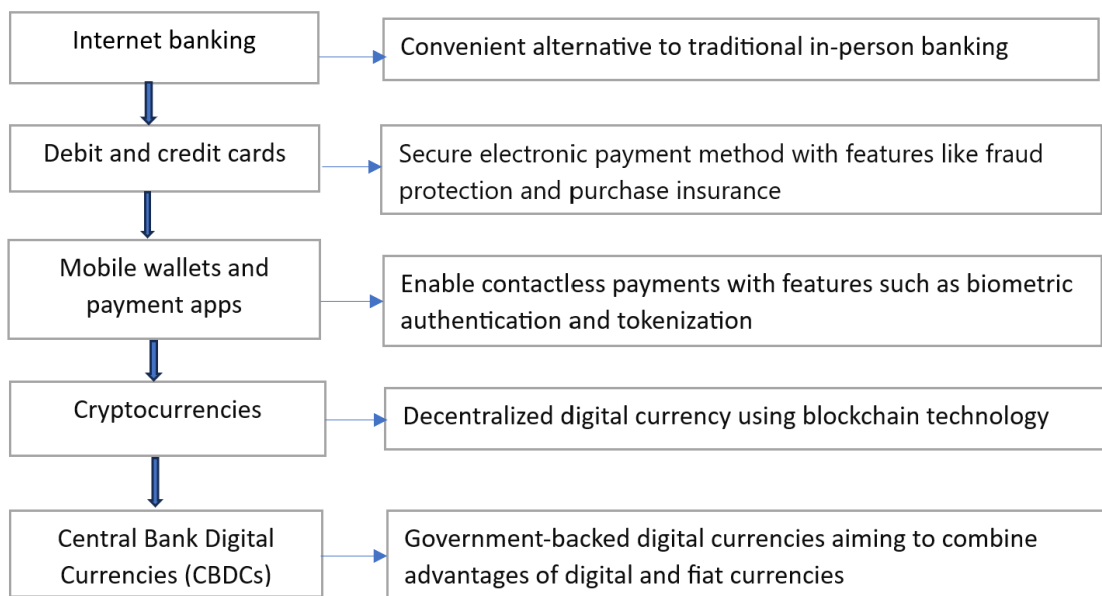


Figure 2: Transforming digital Forms of money in digital era

3. Shift Towards a Cashless Society

The vision of a cashless society, where every financial transaction is electronically documented, is becoming a reality in several countries and it has been steadily gaining traction in recent years. Several countries worldwide have made substantial strides in moving toward a cashless model, with some even aiming to completely phase out physical currency. Governments worldwide are spearheading initiatives to encourage digital transactions and propel societies towards a cashless future. These efforts include investing in digital payment infrastructure, enacting regulatory measures for security and reliability, and launching public awareness campaigns to educate citizens.

There are numerous compelling reasons to consider the advantages of a cashless society, including the potential to lower the expenses and risks tied to managing physical cash, record keeping, enhance financial transparency, financial inclusion cost efficiency and stimulate innovation in financial systems. A cashless society is also considered effective in combating parallel economies, primarily due to its ability to leave digital trails, enhance transparency, encourage tax compliance, discourage cash hoarding, and provide regulatory oversight.

The transition towards a cashless society was already gaining momentum prior to the onset of the COVID-19 pandemic. However, the global health crisis acted as a catalyst, accelerating this societal shift even further. The fear of virus transmission through physical currency, coupled with lockdowns and social distancing measures, prompted an increased adoption of cashless transactions as individuals sought safer and more hygienic alternatives. The trends observed during the pandemic underscored and expedited the ongoing shift towards a cashless future, emphasizing that the move towards digital transactions was not merely a consequence of the pandemic but rather a pre-existing trend that the crisis intensified.

As per global payment report 2023 the use of cash is diminishing globally, representing a maximum of 44% of point-of-sale (POS) transaction value at a regional level and merely 18% on a global scale in 2021. Projections indicate a further decline to 10% worldwide by the conclusion of 2025, with North America, Asia-Pacific, and Europe at the forefront of the shift away from physical currency.

In the contemporary digital era, digital currency has become indispensable, supplanting the traditional reliance on physical cash. Across the globe, major central banks are actively exploring the integration of CBDCs, motivated by the diminishing use of cash and the surge in digital transactions.

4. The Emergence of Central Bank Digital Currency

The financial world is on the brink of a revolutionary transformation with the emergence of CBDCs, as noted by the European Central Bank in 2020. This shift has been rapid, from the rise of cryptocurrencies to the recent innovation of CBDCs. CBDCs, in many ways, can be compared to the introduction of banknotes in the 19th century, aiming to modernize payments in response to the changing landscape.

4.1 What is CBDC?

CBDCs represent a form of digital currency issued by a nation's central bank, directly tied to its official fiat currency. It is a digital currency that can solely be issued and backed by a country's central authority. As a legal tender, a CBDC must be accepted by all economic actors for any legal purposes, such as paying utility bills and paying taxes. CBDC constitutes a distinct category of central bank money alongside physical banknotes and electronic bank reserves, offering a modernized form of currency in the digital realm.

The 2018 report by Committee on Payments and Market Infrastructures - Markets Committee (CPMI-

MC) defines CBDCs as new variants of central bank money distinct from physical cash or central bank reserve/settlement accounts. Described as liabilities of central banks, CBDCs are denominated in existing units of account and serve both as mediums of exchange and stores of value. The report outlines four defining properties of money: issuer (central bank or not), form (digital or physical), accessibility (wide or narrow), and technology (peer-to-peer tokens or accounts).

The advent of CBDCS stands as a crucial milestone in the evolution of banking and payment systems (Bhawana & Kumar, 2021). According to (Ozili, 2022), CBDC is essentially the digital counterpart of a fiat currency. (Bitter, 2020) expresses the view that a CBDC is a liability of the central bank that has the potential to accrue interest.

In contrast to privately issued digital currencies, a CBDC serves as a tool through which the government can exercise influence over aspects such as transparency, illicit activities, financial inclusion, and fiscal/monetary policies (Söilen & Benhayoun, 2021). However, such a development could intensify the competition for bank deposits, potentially influencing the operations of commercial banks operating under the supervision of the central bank (Fernández-Villaverde et al., 2020).

Studies have indicated that the ongoing decline in the global use of paper currencies can be attributed to the rise of digital currencies and assets (Viñuela et al., 2020). Therefore, CBDC stands as a transformative instrument, not only reshaping consumer perspectives but also playing a pivotal role in preserving equilibrium within the intricate financial system. Some potential avenues for CBDC applications are to streamline cross-border settlements, addressing challenges arising from currency exchange processes, variations in legal and technological infrastructures across countries, time zone disparities, and coordination issues among intermediaries.

4.2 Features of CBDCs

CBDCs introduce a paradigm shift in currency management, offering a host of distinctive features designed to enhance efficiency, accessibility, and security in financial transactions. The features of CBDC as in the literature are as follows:

- CBDC is the official currency issued by Central Banks, aligning with their Monetary Policy Objectives.
- It is recorded as a liability on the Central Bank's Balance Sheet, reflecting its status as an official form of Currency.
- CBDC is mandated to be accepted as legal tender, serving as a recognized medium of payment and a secure store of value for all citizens, businesses, and government entities.
- CBDC can be freely converted into Commercial Bank money and physical cash, providing flexibility in transactions.
- CBDC is fungible legal tender, allowing holders to use it without the necessity of having a bank account.
- The introduction of CBDC is anticipated to reduce the costs associated with Currency issuance and transactions.

4.3 Types of CBDC

When exploring the landscape of CBDCs it's essential to study the various forms through which digital central bank money is manifested. CBDCs can come in various types and forms, each with its own

characteristics and implementation methods. CBDCs can be classified on the basis of their intended users and use cases as well as on the basis of technical implementation and issuance method.

On the basis of their intended users and use cases CBDCs can be classified as Retail and Wholesale CBDC. A retail CBDC is accessible to the general public and can be utilized for all types of transactions, serving as a digital counterpart to physical cash. Individuals and businesses can use retail CBDCs for everyday purchases, peer-to-peer transfers, and other financial activities. On the other hand, wholesale CBDCs are primarily used by financial institutions and are designed for interbank transactions and settlements. These wholesale CBDCs facilitate efficient and secure transactions between banks, optimizing liquidity management and reducing settlement risks in the financial system.

Table 1 provides a concise summary of the distinctions between retail and wholesale Central Bank Digital Currencies (CBDC).

Table 1. Differences Between Retail and Wholesale CBDC

Feature	Retail CBDC	Wholesale CBDC
Target Users	General public, individuals and businesses	Financial institutions, banks, other eligible market participants
Use Cases	Everyday payments, purchases, transfers	Interbank settlements, securities transactions, financial operations
Motivation	Maintain access to central bank money in digital form, improve financial inclusion, increase competition and innovation	Enhance efficiency, security, and risk management in wholesale markets
Potential Benefits	Secure and reliable digital payments, resilience against cash decline, competition with private tokens	Faster and cheaper settlements, reduced counterparty risk, improved collateral and liquidity management
Challenges	Privacy concerns, potential disintermediation of banks, technology development, legal framework	Access control, impact on monetary policy and financial stability, competition with existing infrastructures
Current Status	Mostly in research or pilot phase, few launched examples (Bahamas, Jamaica)	More actively explored, several pilot projects underway, but no major launches yet

On the basis of technical implementation and method of issuance CBDCs can be classified as Token based CBDC and Account based CBDC. A token-based CBDC operates akin to physical banknotes, where possession of the tokens implies ownership. Account-based system maintains records of balances and transactions for all CBDC holders, indicating ownership through account management.

Table 2 provides a concise summary of the distinctions between Token-Based and Account-Based Central Bank Digital Currencies (CBDC).

Table 2. Differences between Token Based and Account Based CBDCs

Feature	Token-Based CBDC	Account-Based CBDC
Nature of Representation	Digital tokens representing claims on the central bank	Account balances recording ownership of monetary balances
Ownership	Bearer instrument; whoever holds the token owns it	Ownership indicated by account records
Verification	Recipient verifies token authenticity	Intermediary verifies account holder identity
Transaction Process	Transfer tokens electronically between holders	Transfer balances between accounts
Authentication	Authenticate token authenticity	Verify payer authority and balance in accounts
Identity Verification	Not dependent on account holder identity	Account holder identity verified during creation
Transaction Record	Ledger records ownership chain for each token	Transaction history maintained for each account
Security	Tokens authenticated to prevent counterfeits	Account security ensures authorized transactions
Transaction Verification	Verification of token authenticity	Verification of account holder authority

4.4 Models for issuance of CBDCs

There are three distinct models employed globally for the issuance and administration of CBDCs. These are the Indirect model, also known as Two-Tier model, the Direct model, also referred to as the Single-Tier model and Hybrid Model.

- 1. Indirect Model-** In the Indirect model involves a collaborative approach where the central bank and other intermediaries, such as banks and service providers, each have distinct roles. In this setup, the central bank issues CBDCs to consumers indirectly through intermediaries. Any claims or issues raised by consumers are handled by the intermediary, as the central bank focuses primarily on wholesale payments to these intermediaries. This model introduces an additional layer of intermediaries between the central bank and the end-users of CBDCs.
- 2. Direct Model-** In a Direct CBDC system, the central bank assumes full responsibility for overseeing all aspects of the CBDC framework, including issuance, account management, and transaction validation. Under this model, the central bank administers the retail ledger, with its server being integral to all payment processes. The CBDC in this setup represents a direct claim on the central bank, which maintains comprehensive records of account balances and updates them with each transaction. One notable advantage of this approach is its robustness, as the central bank possesses complete knowledge of retail account balances, facilitating straightforward claims fulfilment.
- 3. Hybrid Model-** In Hybrid Model, a direct connection to the central bank is paired with a private sector messaging layer. The central bank issues CBDC to entities, making them responsible for customer-related activities. In this setup, commercial intermediaries (payment service providers) deliver retail services to end users, while the central bank maintains a record of retail transactions.

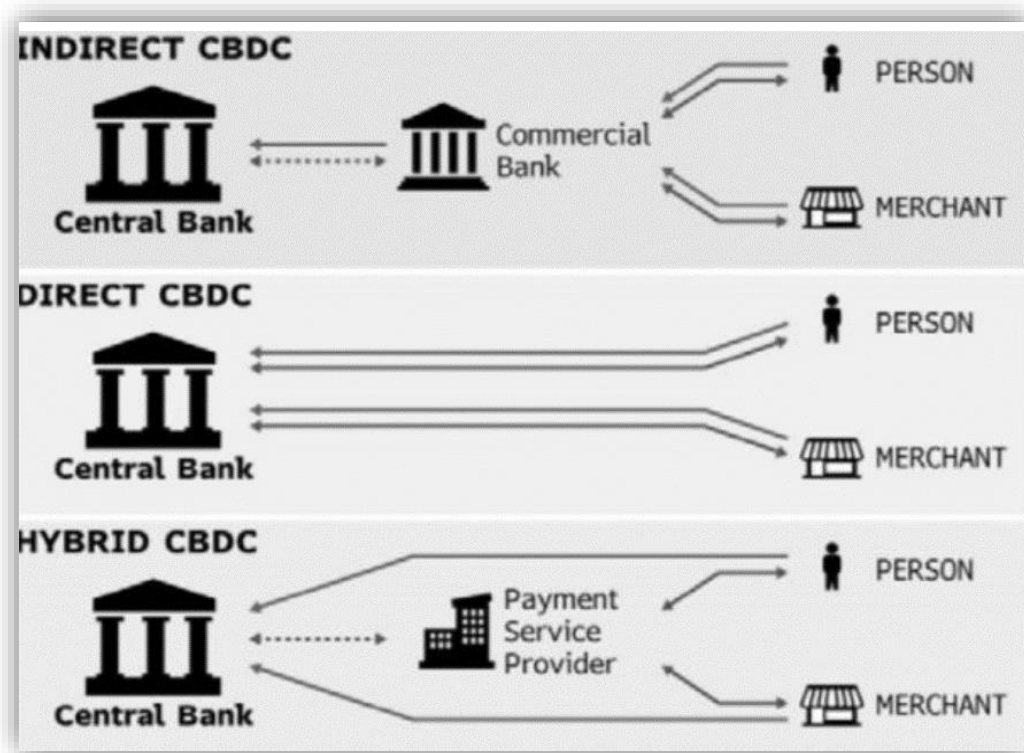


Figure 3: Models of CBDCs issuance (source: PwC)

4.5 Motivations for issuance of CBDC

This section explores the primary motivations driving central banks worldwide promoting for issuance of CBDCs. According to major researches conducted by (Mancini-Griffoli et al., 2018), (Barontini & Holden, 2019), (Bech et al., 2020), (Maniff, 2020) and (Concept Note on Central Bank Digital Currency FinTech Department Reserve Bank of India, 2022) below are the summarized motivations for issuance of CBDCs by central banks.

- CBDC has the potential to improve competition, efficiency, and resilience within payment systems amidst growing dominance by a handful of large corporations.
- CBDC can help with financial digitalization, cut down on costs related to handling physical cash, and boost financial inclusion, especially in countries with less advanced financial systems and many people who don't use banks.
- CBDC has the potential to enhance the effectiveness of monetary policy by enabling more precise policy implementation or by leveraging detailed payment flow data to improve macroeconomic forecasts.
- CBDC would also assist in decreasing or preventing the acceptance of privately issued currencies, which might pose risks to monetary sovereignty and financial stability.
- CBDC would aid in increasing the usage of local currency for transactions in regions striving to decrease reliance on the dollar.
- A central bank-issued CBDC would present a governmental resolution, furnishing more cost-effective and streamlined cross-border payment services.

- CBDCs enhance the security of financial transactions by leveraging advanced cryptographic technologies and secure blockchain systems. This ensures a robust and tamper-resistant infrastructure, safeguarding the integrity of financial transactions and reducing the risk of fraudulent activities.

To further the cause of digitization and foster a transition towards a less cash-reliant economy, central banks are exploring the introduction of CBDCs as a strategic measure to modernize financial systems and enhance digital payment infrastructures.

4.6 Implications of CBDCs

The introduction of CBDCs has spurred considerable discussions regarding their multifaceted implications across various dimensions. Scholars and researchers have explored the far-reaching effects of CBDCs on critical aspects such as monetary policy, banking dynamics, financial inclusion, and financial stability. Existing literature presents a diverse range of perspectives, with authors highlighting the potential impacts of CBDCs on these facets. From reshaping traditional monetary policy frameworks to influencing the operational landscape of banking institutions, and from fostering financial inclusion to posing challenges to financial stability, the exploration of CBDC implications is rich and varied in scholarly discourse. Researchers have delved into the complexities and nuances of these potential effects, offering valuable insights into the transformative potential of CBDCs on the financial and economic landscape.

In this section, we present notable implications of CBDCs, extracted from the existing literature. These implications, encompassing various aspects such as cross-border settlements, currency dynamics, financial stability, banking, international spillovers, and financial inclusion, are discussed.

Cross border settlements

Researches explored the function of CBDCs in facilitating cross-border trade and payments, indicating that CBDCs may decrease transaction expenses and improve efficiency in international transactions. One such study conducted by the Central Banks of Canada, the U.K., and Singapore (Cross-Border Interbank Payments and Settlements: Emerging Opportunities for Digital Transformation, 2018) explored the potential benefits of using a wholesale central bank digital currency (CBDC) for cross-border interbank payments and settlements. They found that a wholesale CBDC with cross-border exchange capabilities could effectively mitigate counterparty credit and payment risks. Conversely, a CBDC limited to a specific jurisdiction without cross-border exchange offers little improvement over existing systems. Additionally, a universally accepted wholesale CBDC could provide significant risk management enhancements for counterparties, payments, and settlements.

Currency Dynamics

Many papers explored the implications of CBDCs on currency substitution and exchange rate dynamics, providing insights into how the introduction of CBDCs could influence the physical currency aspect.

- (Barontini & Holden, 2019) argues that the primary purpose of implementing CBDC is to decrease the amount of physical currency in circulation.
- (Ozili, 2022) stated that a CBDC has the capability to rival physical currency and lower the expenses related to the production and administration of cash within the economy.

Financial stability

- (Cœuré, 2018) highlights the potential benefits of CBDCs in maintaining financial stability, suggesting that CBDCs could offer a more secure and stable form of currency during financial crises, diminishing the likelihood of bank runs and instilling confidence in the financial system.
- (Kim & Kwon, 2019) explore the consequences of CBDCs on financial stability using a monetary general equilibrium model. They find that introducing deposits in central bank digital currency accounts would diminish the availability of private credit from commercial banks. As a result, this reduction in credit supply would elevate nominal interest rates and diminish the reserve-to-deposit ratio of commercial banks. Such shifts may have adverse implications for financial stability, potentially increasing the likelihood of bank panics where commercial banks face shortages of cash reserves to fulfill depositor demands.
- (Mancini-Griffoli et al., 2018) suggested that CBDC could potentially heighten operational risks within the payment system, increase the risk to financial integrity, and raise the funding costs for deposit-taking institutions, potentially leading to a decrease in financial stability.
- (Chen & Siklos, 2022) investigated the potential effects of CBDC on inflation and financial stability, revealing that while CBDC might not necessarily result in elevated inflation, it could amplify risks related to financial instability.

Banking

- (Infante et al., 2023) examined the introduction of a CBDC may potentially impact the stability of the banking system by inducing competitive behaviour among banks, posing risks of disintermediation, and altering credit availability dynamics.
- (Kumhof & Noone, 2018) suggest that the implementation of CBDC would impact the scale of banks' balance sheets, private credit availability, and the provision of liquidity. Other researches suggests that CBDCs have the potential to disrupt the traditional banking sector by diminishing the demand for commercial bank deposits, potentially prompting a restructuring of the financial industry.
- (Keister & Monnet, 2022) suggested that implementing a CBDC system could diminish the maturity transformation activities of private banks. However, they argue that it would also streamline the process for policymakers to monitor and address issues with weak banks promptly, potentially enhancing financial stability as a result.

International spillover

- (Bech et al., 2020) investigate the international spillover effects of CBDC issuance, highlighting how the introduction of CBDCs by one country might affect the monetary policies and currency stability of other nations. This underscores the necessity for coordination among central banks.
- (Ferrari et al., 2022) conducted a study on the implications of introducing a CBDC for open economies. Their findings suggest that the presence of a CBDC increases the transmission of shocks across international borders, thereby strengthening international linkages. However, the degree of this impact largely depends on the specific design of the CBDC, and it can be substantially reduced if the CBDC incorporates particular technical features. They have suggested that the adoption of CBDC system could potentially magnify the international transmission of shocks and bolster international connections.

Financial inclusion

- (Foster et al., 2021) examined that the adoption of a CBDC has the potential to accelerate financial inclusion among marginalized communities. This can be achieved by facilitating access to the central bank digital currency through fintech agents who offer wallets, enabling economically disadvantaged individuals to circumvent the high fees imposed by traditional banks and mobile money providers.
- (Mancini-Griffoli et al., 2018) suggest that for CBDC to drive financial inclusion, it must be appealing as a viable substitute for traditional forms of currency. They further argue that in countries with a large informal sector and low reluctance to use formal financial services, the demand for CBDC may not be substantial.

Central Banks view CBDC as a tool to enhance monetary policy by expanding the monetary system and improving payments. CBDCs issuance aims to reduce the cost of issuing central bank money and increase seigniorage income. While it won't change existing monetary policy frameworks, the shift in payment flows could impact the transmission of monetary policy. Additionally, CBDCs offer the potential to promote financial inclusion and efficiency in payment systems, further bolstering central banks' objectives in modernizing the financial landscape.

5. Exploration of CBDC around the globe

According to the Atlantic Council (2023), 130 countries which collectively represent 98 percent of global GDP, have been examining the prospects of the potential implementation of CBDCs. Eleven countries, mostly small Caribbean states, have launched CBDCs. Another 21 have begun pilot projects, including India, China, Australia and Sweden. There are currently 12 cross-border ongoing wholesale CBDC projects across the globe.

The below table summarizes the current status of CBDCs in various countries and outlines the motivations behind their launch.

Table 3. The status of CBDCs Among Countries across the globe

Country Name	Project Name	CBDC Status	Use Case	Timeline	Motivations for Launching CBDC
The Bahamas	Sand Dollar	Launched	Retail	Launched October 2020	Financial inclusion, security against illicit activities
Jamaica	JAM-DEX	Launched	Retail	Rolled out July 2022	Reduce cash storage/handling costs, financial inclusion
Mexico	Digital peso	Development	Retail	Completion expected 2025	Financial inclusion, expand access to banking
Guatemala	iQuetzal	Research	Undecided	Research ongoing, no firm launch date	Evaluate feasibility

Country Name	Project Name	CBDC Status	Use Case	Timeline	Motivations for Launching CBDC
Haiti	Digital Gourde	Development	Retail, Wholesale	Proof of concept presented May 2022	Financial inclusion, combat money laundering
Anguilla	D-Cash	Launched	Retail	Launched March 2021	Financial inclusion, improve anti-money laundering measures
Canada	Digital Canadian Dollar	Development	Retail, Wholesale	Research ongoing, public consultation launched Nov 2022	Improve efficiency, explore potential benefits
United States	Digital Dollar	Development	Retail, Wholesale	Research ongoing, no firm launch date	Evaluate potential benefits, address concerns
Ecuador	Dinero electrónico	Canceled	Retail	Launched 2014, canceled 2017	Failed due to low trust, lack of adoption
Brazil	Digital Real	Development	Retail	Pilot program planned 2023, launch 2024	Modernize economy, promote innovation, financial inclusion
Peru	N/A	Research	Retail, Wholesale	Report released April 2023, launch decision pending	Improve financial stability, financial inclusion
Paraguay	N/A	Research	Undecided	Research group established December 2021	Monitor international initiatives, understand implications
Chile	N/A	Research	Retail	Decision on CBDC by year-end 2022	Address fintech challenges, explore potential benefits
Argentina	digital peso	Research	Undecided	No priority for CBDC issuance, explore digital technologies	-
Trinidad and Tobago	N/A	Research	Undecided	Pilot program decision expected soon	Financial inclusion, financial security, efficiency
South Africa	Project Khokha	Pilot	Wholesale	Feasibility study underway, no decision on retail CBDC	Improve transaction speed, efficiency

Country Name	Project Name	CBDC Status	Use Case	Timeline	Motivations for Launching CBDC
Bhutan	Digital Ngultrum	Development	Retail, Wholesale	September 2021 - Present	Financial inclusion, increase efficiency
Saudi Arabia	Project Aber	Pilot (completed)	Wholesale	2019 - 2020	Cross-border efficiency, explore DLT
Turkey	Digital Turkish Lira	Pilot	Retail	September 2020 - Present	Reduce cash usage, improve digitalization
India	Digital Rupee	Pilot	Retail, Wholesale	2019 - Present	Financial inclusion, reduce cash usage
Russia	Digital Ruble	Pilot	Retail, Wholesale	2020 - Present	Reduce dependence on USD, improve financial infrastructure
United Arab Emirates	Digital Dirham	Pilot	Retail, Wholesale	October 2022 - Present	Improve financial resilience, cross-border efficiency
Australia	eAUD	Pilot	Retail, Wholesale	November 2020 - Present	Improve cross-border payments, explore use cases
Bahrain	Digital Dinar (EDinar)	Development	Wholesale	Early 2020 - Present	Test CBDC functionality, explore cross-border payments
Thailand	Digital baht	Pilot	Retail, Wholesale	2020 - Present	Financial inclusion, enhance financial stability
China	e-CNY	Pilot	Retail, Wholesale	2017 - Present	Improve payment systems, financial inclusion
South Korea		Pilot	Retail	April 2020 - Present	Enhance payment system, financial inclusion
Japan	Digital Yen	Pilot	Retail	October 2020 - Present	Improve payment efficiency, address cash dependency
Singapore	Project Ubin	Pilot	Wholesale	2016 - Present	Improve cross-border payments, explore DLT

Country Name	Project Name	CBDC Status	Use Case	Timeline	Motivations for Launching CBDC
Kazakhstan	Digital Tenge	Pilot	Retail	May 2020 - Present	Improve financial inclusion, explore DLT
Malaysia	Project Dunbar	Pilot	Wholesale	In June 2021, BNM indicated interest in piloting a wholesale CBDC, but no immediate plans for retail CBDC.	Explore potential benefits of a CBDC
Mauritius	N/A	Development	Retail, Wholesale	Announced pilot by end of 2023	Financial inclusion, financial security, efficiency
Eswatini	N/A	Research	Retail, Wholesale	In midst of a four-phase study	Examine use cases of a CBDC
Botswana	N/A	Research	Undecided	Studying possibility of introducing a CBDC	Unclear
Namibia	N/A	Research	Undecided	Considering a Namibian CBDC, will publish consultation paper	Unclear
United Republic of Tanzania	N/A	Research	Undecided	Announced plans for CBDC in November 2021, taking cautious approach	Provide safer alternative to cryptocurrencies
Rwanda	N/A	Research	Undecided	Research to conclude by December 2022	Lay groundwork for innovation, streamline financial system
Uganda	N/A	Research	Undecided	Conducting preliminary study in 2022	Unclear
Kenya	Digital Shilling	Research	Retail	No priority for CBDC in short-medium term	Unclear
Central African Republic	N/A	Research	Undecided	Exploring common CBDC with other members	Unclear

Country Name	Project Name	CBDC Status	Use Case	Timeline	Motivations for Launching CBDC
Nigeria	e-Naira	Launched	Retail	Launched October 2021, Phase 2 aims for 8 million users	Financial inclusion, improve accountability, facilitate remittances
Chad	N/A	Research	Undecided	Exploring common CBDC with other members	Unclear
Ghana	E-cedi	Pilot	Retail	Pilot testing began in 2022	Increase access to financial services, improve payment systems

5.1 Map of CBDC phase of exploration

Below is a CBDC exploration map sourced from the Atlantic Council's CBDC Tracker, offering a detailed overview of the progress and developments in Central Bank Digital Currency initiatives worldwide.

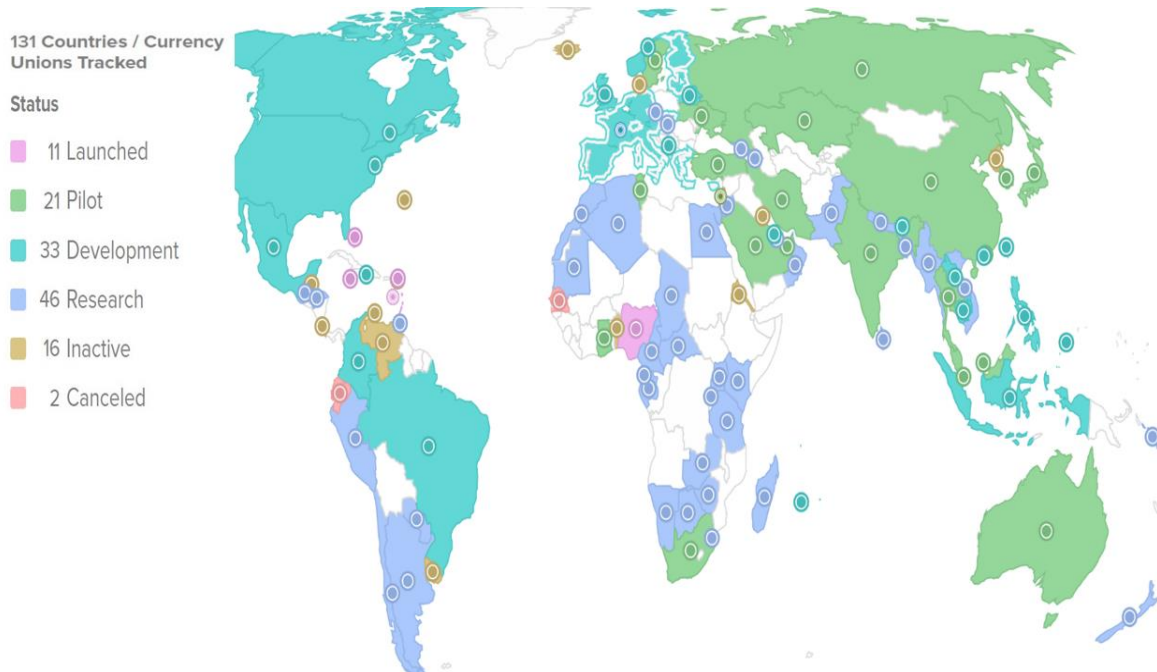


Figure 4: Map of CBDC phase of exploration. (Source: [Central Bank Digital Currency Tracker - Atlantic Council](#))

The exploration of CBDC has emerged as a crucial area of focus for numerous central banks worldwide, driven significantly by the surge in private money and the growing prevalence of digital payments. However, the practical implementation of CBDC has encountered substantial challenges, encompassing technological, economic, social, political, environmental, and ethical dimensions. Addressing these

multifaceted challenges is imperative for the effective integration and sustained success of CBDC within the complex landscape of modern finance.

6. India and digitalization

In recent years, India's payment landscape has seen remarkable growth and innovation. This surge is propelled by government initiatives, smartphone proliferation, and the rise of innovative fintech companies. The emergence of numerous payment systems, platforms, and a diverse range of payment products and services catering to various consumer groups, including individuals, businesses, and corporations, illustrates the robust growth and inclusivity of India's digital payment ecosystem.

India has experienced a notable upswing in digital payments, emerging as one of the highly sought-after markets for the embrace of digital transaction methods with its population exceeding 1.4 billion. The government's push for 2,500 crore digital transactions in the 2017-18 Union Budget using Unified payment interface, Unstructured Supplementary Service Data, Aadhar Pay, Immediate Payment Service, and debit cards reflected a significant step towards promoting digital payments and reducing reliance on cash. Furthermore, India's dedication to digitalization is evident through a range of strategic campaigns and initiatives focused on promoting technological adoption and enhancing digital literacy.

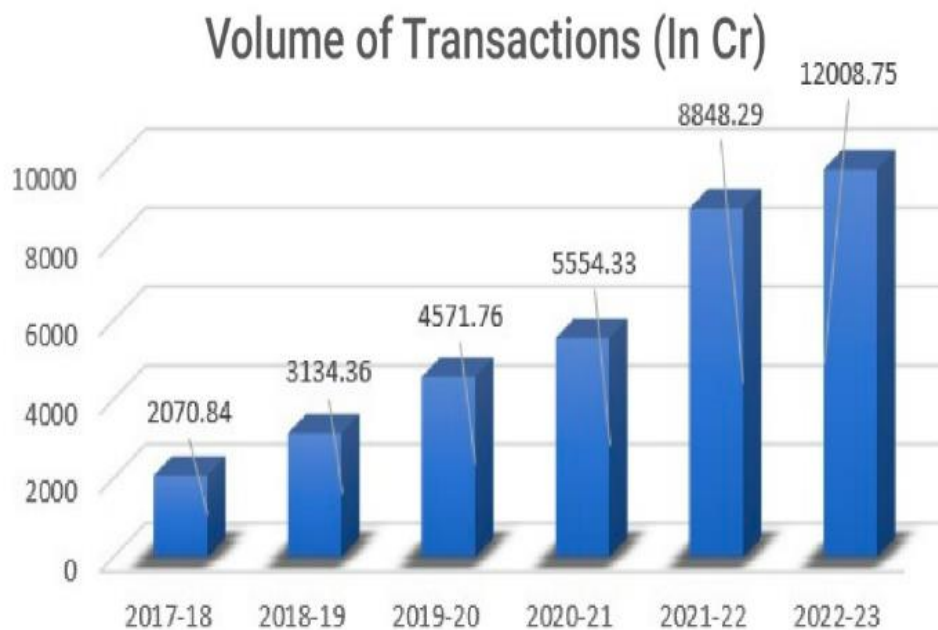


Figure 5: Year on Year growth for Digital Payments in India from the year 2017 till 2023
 (Source: <https://www.nic.in/blogs/digital-payments-driving-the-growth-of-digital-economy/>)

The country has launched multiple digital campaigns and programs aimed at propelling digitalization, fostering technological adoption, and bolstering digital literacy across its population. Initiatives like Digital India, Make in India, and Startup India aim to boost digital technologies in sectors like healthcare, education, and agriculture, fostering a supportive environment for startups. India's Jan Dhan, Aadhar, and Mobile (JAM Trinity) and Pradhan Mantri Jan-Dhan Yojana (PMJDY) bank inclusion program acted strong game-changers for Digital India. Together, they've empowered millions, plugged subsidy leaks, and fuelled cashless payments. The launch of the Unified Payments Interface (UPI), facilitating real-time

inter-bank transactions, and the Bharat Interface for Money (BHIM) app, streamlining the digital transaction process, stand out as key initiatives driving this expansion

In 2016, India embarked on a transformative journey towards digital payment systems, instigated by the Modi government's decision to demonetize the 500 & 1000 Rupee banknotes. This move, aimed at curbing issues related to black money, corruption, and terrorism funding, sought to restrict the circulation of cash within the nation (Kumar et al., 2021). The demonetization policy in India not only had a notable impact on the country's economy but also spurred the rapid growth of digital payments.

The State of India's Digital Economy Report, 2024, conducted by the Indian Council for Research on International Economic Relations (ICRIER), suggests that India's level of digitalization surpasses that of certain developed nations such as the United Kingdom, Germany, and Japan, as measured by their overall digitalization levels.

6.1 Role of UPI

UPI launched in 2016 by the National Payments Corporation of India (NPCI) has emerged as a driving force in India's digital payment landscape, fundamentally reshaping how financial transactions are conducted and propelling the nation towards a cashless economy. Its remarkable success can be attributed to a combination of user-friendly features and government backing.

UPI has emerged as a game-changer in India's digital payments ecosystem, revolutionizing the way transactions are conducted and paving the way for a cashless economy. NPCI's emphasis on a strong technology foundation and an extensive network of payment service providers (PSPs) has made UPI one of the safest global payment methods.

The recent partnership with France for use of UPI as digital mode of payment, UPI's presence has expanded beyond India, including ties with countries such as Singapore, the United States, Australia, Canada, Hong Kong, Oman, Qatar, Saudi Arabia, the United Arab Emirates, the United Kingdom and now Sri Lanka. While the Government of India collaborates with other nations for UPI expansion, other key participants should expedite the integration of these countries' payment systems with UPI for a seamless customer experience and increased transaction volumes. As UPI expands globally, its growth is expected to rise.

Furthermore, the recent collaborations underscore the growing recognition of UPI's reliability and security on the global stage. As more nations embrace UPI as a digital mode of payment, its presence will continue to expand, fostering greater financial connectivity and facilitating cross-border transactions. It is imperative for stakeholders to prioritize the integration of international payment systems with UPI to capitalize on its momentum and ensure seamless cross-border transactions for users worldwide. As UPI cements its position as a leading digital payment solution, its impact on shaping the future of global finance is poised to grow exponentially.

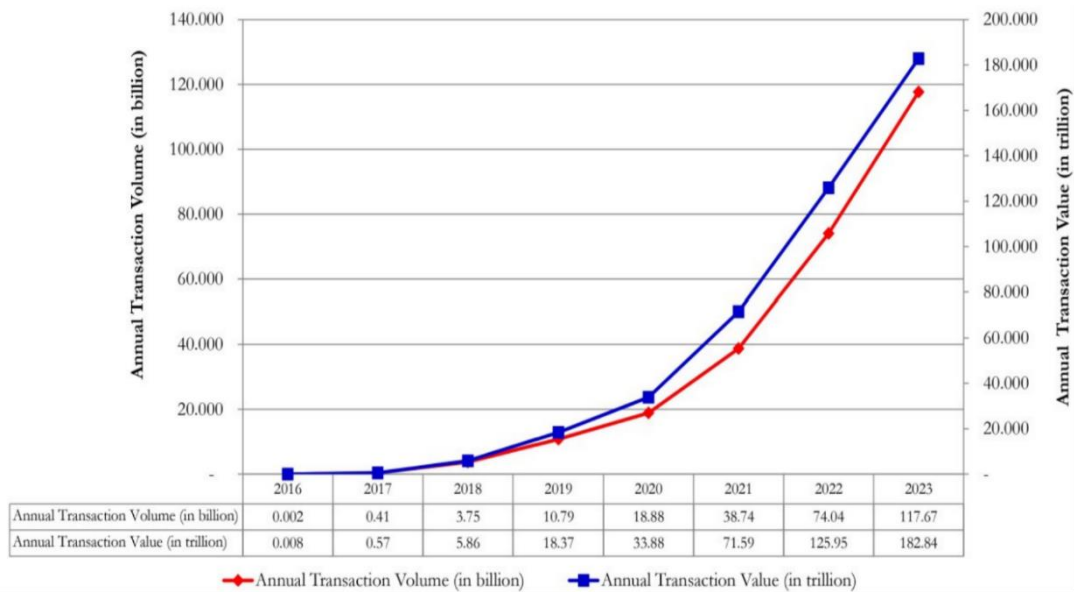


Figure 6: the UPI journey in India (Annual transactions volume and value, yearwise 2016- 2023 (source: Ramesh Srivatsava Arunachalam)

India is witnessing a notable increase in digital payments, propelled by the widespread adoption of UPI and various digital platforms like mobile wallets, banking cards, Paytm, PhonePe, BHIM, among others, alongside the rising prevalence of smartphones. Despite challenges such as the digital divide and data privacy concerns, the trajectory indicates a promising journey toward a more inclusive, efficient, and potentially cashless economy.

7. Digital rupee – The Central Bank Digital Currency of India

Acknowledging the dynamic global advancements in the realm of CBDCs, the Reserve Bank took a proactive step by establishing an Internal Working Group (WG) in October 2020. This group was specifically formed to conduct a thorough study on the intricate design and implementation architecture necessary for the potential introduction of CBDCs in India. In line with these strategic initiatives, the e-Rupee, or digital Rupee, has been envisioned as a groundbreaking endeavour.

As defined by the RBI, CBDC represents legal tender issued in digital form by the central bank and is exchangeable at par with physical currency. It is accounted for as a liability on the central bank's balance sheet. The RBI has introduced the Digital Rupee, a digital form of the Indian Rupee also called 'e-Rupee'. e-Rupee maintains the same denomination concept as physical notes and coins but in a digital format, with each e-Rupee holding the same value as a regular rupee. Every e-Rupee is assigned a distinct serial number, much like traditional physical notes. Stored within a local wallet on the user's smartphone, these digital currencies can be exchanged similarly to physical cash, utilizing the digital rupee application provided by their respective bank.

This digital currency aspires to redefine payment systems by offering a solution that is not only sophisticated but also simple, ensuring the highest standards of security. More significantly, it is designed to be an inclusive financial instrument, providing a seamless and convenient payment system that caters to the diverse needs of all segments of society. This inclusivity extends to those who have been traditionally underserved, granting access to a secure and modern financial solution for individuals without access to conventional banking services.

7.1 Pilot Projects of CBDCs in India

Aligned with global trends, RBI initiated pilot programs for Central Bank Digital Currencies (CBDCs) within the country. The wholesale CBDC pilot, commencing in November 2022, involved the collaboration of nine prominent banks, including the State Bank of India, Bank of Baroda, Union Bank of India, HDFC Bank, ICICI Bank, Kotak Mahindra Bank, Yes Bank, IDFC First Bank, and HSBC.

Simultaneously, a retail CBDC pilot was launched in December 2022, initially featuring the State Bank of India, ICICI Bank, YES Bank, and IDFC First Bank across four cities, as specified by the RBI. As the program progressed, additional participation was witnessed from Bank of Baroda, Union Bank of India, HDFC Bank, and Kotak Mahindra Bank, expanding the engagement with users. Notably, by June 2023, the retail pilot program achieved remarkable milestones, surpassing one million users and involving 262,000 merchants.

													(₹ Crore)		
Year	₹ 0.50 paise	₹ 1 Notes	₹ 2 Notes	₹ 5 Notes	₹ 10 Notes	₹ 20 Notes	₹ 50 Notes	₹ 100 Notes	₹ 200 Notes	₹ 500 Notes	₹ 2000 Notes	Total e₹- Retail	e₹- Whole- sale	Total e₹	
2022-23	0.01	0.04	0.06	0.12	0.15	0.23	0.39	0.83	1.16	2.71	-	5.70	10.69	16.39	

Source : Reserve Bank of India.

Figure 7: e₹ in Circulation: e₹ - RETAIL AND e₹ - WHOLESALE (2022- March 2023)

At the end December 2023, an impressive milestone has been reached with the onboarding of 4 million customers into the CBDC ecosystem with ten lakh transaction. e-Rupee proves particularly impactful in advancing digital transactions, especially in regions with restricted internet connectivity. Anticipating its transformative potential, we envision the e-Rupee to not only set a global trend but also play a pivotal role in facilitating frictionless cross-border payments, positioning it as a beacon of innovation on the international stage.

The RBI governor, during the Monetary Policy Committee review meeting on February 8, 2024, outlined proposals to enhance the CBDC-R pilot. These enhancements aim to introduce programmability and offline functionality to the digital currency system. Programmability will allow various users, including government agencies and corporates, to customize CBDC-R payments for specific purposes such as welfare benefits or business expenditures. Features like setting validity periods and geographical restrictions will add further control. Additionally, the introduction of offline functionality will enable transactions in areas with poor internet connectivity, with testing planned for both proximity and non-proximity-based solutions. These proposed enhancements signify a strategic move towards increasing flexibility, control, and accessibility in digital payments, addressing the diverse needs of users across different regions of India.

7.2 The Fusion of CBDC and UPI

The central bank is committed to substantially boost the utilization of CBDCs among the Indian population. In July 2023, daily transactions for retail Central Bank Digital Currency (CBDC) were averaging around 18,000, slightly below the ambitious goal of achieving one million daily transactions by

the end of 2023. In an effort to boost the utilization of CBDCs, RBI is actively endorsing interoperability with the UPI through a QR code system. Interoperability refers to the technical capability that allows a payment system to seamlessly work alongside other payment systems. It enables providers and participants of various systems to conduct, clear, and settle payment transactions across different systems without needing to engage in multiple systems. The interoperability between UPI and the digital rupee ensures that all UPI QR codes are compatible with CBDC apps.

Initially, during the launch of the pilot for the retail digital rupee, e₹-R users were required to scan a designated QR code for transactions. With the interoperability of these systems, payments can be conducted using a unified QR code. The compatibility of UPI and CBDC guarantees smooth transactions between customers and merchants, eliminating the necessity to switch between various digital platforms. Currently embraced by 13 banks, the interoperability program is slated to expand, with the RBI aiming to enlist the participation of 20-25 banks. The widespread utilization of UPI as a payment method, coupled with its interoperability with CBDC, will accelerate the acceptance and usage of the digital rupee. As UPI has gained widespread acceptance, being integrated into over 70 mobile apps and accessible through more than 50 million merchants. The interoperability with Digital Rupee is strategically designed to streamline transactions, offering individuals and businesses a convenient means to engage in various financial transactions using digital currency. By interoperability users of the Digital Rupee can effortlessly settle everyday expenses, such as groceries and medications, by simply scanning any UPI QR code at merchant establishments and merchants do not require a separate QR code for Digital Rupee, as CBDC payments can seamlessly be accepted using their existing infrastructure.

The RBI Deputy Governor T. Rabi Sankar commented on the success of UPI in the fintech sector in January 2024, stating that it has become a global model. He also noted significant progress in the adoption of e-rupee, exceeding the milestone of 1 million transactions in a day with the UPI interoperability on December 27, 2023. Earlier, in July 2023, Deputy Governor Sankar had set a target for the central bank to achieve 1 million CBDC transactions per day by the end of the same year.

The popularity of UPI has been instrumental in facilitating digital transactions for small businesses and street vendors, contributing to greater financial inclusion. Recent enhancements, including features like 'Conversational Payments' supported by an AI-powered system, offline transactions, and the integration of credit lines with UPI, further enhance its versatility. Additionally, 'UPI One World' extends the capability for foreign nationals visiting India to conduct payments through the UPI system.

The synergy between CBDC and UPI is anticipated to also diminish the dependence on cash transactions, leading to heightened transaction efficiency and transparency. This integration is perceived as a transformative force within the digital currency ecosystem, underscoring a steadfast commitment to hastening the shift towards a more cashless economy. UPI-CBDC interoperability aims to advance Retail Digital Rupee adoption. The ultimate goal is to create a more efficient, transparent, and inclusive financial ecosystem that benefits all segments of society. Furthermore, the integration of CBDC and UPI stands as a testament to the adaptability and innovation within the financial sector, showcasing the potential for technology to revolutionize traditional banking systems. As this synergy continues to evolve, it exemplifies a collaborative effort towards modernizing financial infrastructure and fostering economic growth in an increasingly digital world.

8. Conclusion

This conceptual paper concludes that the transition towards a cashless society in the digital era is

significantly shaped by the introduction of Central Bank Digital Currencies (CBDCs) as a catalyst for financial innovation and digital transformation. As central banks continue to explore and implement CBDC initiatives, it is essential to address the challenges and opportunities associated with their adoption, ensuring that they serve as a catalyst for positive change in the global financial ecosystem. It is essential to recognize that CBDC is still in its developing stages, and its journey towards becoming universally accepted central bank-backed money requires continued research, experimentation, and public awareness. Continued research and collaboration will be a key to unlock the full potential of CBDCs and realizing their transformative impact on the economy and society as a whole. The Digital Rupee pilot program in India, with its integration with the UPI, exemplifies a strategic approach towards achieving a cashless economy, promoting efficiency, transparency, and financial inclusion.

CBDCs are expected to play a pivotal role in shaping the future of global financial systems. For future research, it is recommended to delve deeper into the specific challenges faced by countries with unique economic and social conditions during the implementation of CBDCs. Additionally, exploring the long-term economic and societal impacts of CBDC adoption and their potential role in shaping international trade and monetary power dynamics would contribute to a more comprehensive understanding. As research progresses, more insights will emerge, necessitating a collaborative effort between policymakers, economists, and technologists to navigate the complexities and ensure a smooth transition into this new era of digital finance.

Furthermore, as CBDC initiatives gaining momentum globally, it becomes imperative to establish robust regulatory frameworks to address concerns regarding privacy, cybersecurity, and monetary policy transmission mechanisms. Proactive collaboration between central banks, regulatory authorities, and industry stakeholders will be essential in mitigating risks and fostering trust in these digital currencies.

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