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Central Bank Digital Currency (CBDC) – Transformation of India's Payment System and Adaptability Survey

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ABSTRACT

The concept of currency in India is fundamentally based on trust. This trust is established through a central authority, namely the Reserve Bank of India (RBI), which is responsible for printing, issuing, and circulating currency notes in the country. In addition to traditional currency, there is also a digital form of currency backed by the RBI, designed for transactions, lending, and value storage. This is known as Central Bank Digital Currency (CBDC). Specifically, India's CBDC is called as E-Rupee (e₹). This paper presents a conceptual study of the CBDC, exploring the underlying technologies and their potential to transform India's payment system. It emphasizes that the CBDC is not intended to replace the existing monetary system; rather, it serves as an additional component. Furthermore, a survey on digital payment behaviour is conducted to examine the adaptability of this system

Keywords: Digital currency, E-Rupee (e₹), Central Banking Digital Currency (CBDC), Blockchain Technology, Smart contract.

INTRODUCTION

The evolution of the barter system led to various forms of currency, including coins, paper money, plastic money, and electronic money. Currently, the future is leaning towards Central Bank Digital Currency (CBDC), with India preparing to launch its own Digital Rupee (e₹).Emerging in the 1990s, CBDC has been adopted by many countries using blockchain technology, which features Distributed Ledger Technology (DLT), cryptography, consensus mechanisms, decentralization, and smart contracts. Its key attributes include immutability, transparency, and interoperability. India's CBDC initiative considers Economic, Social, Technological, Legal, and Environmental factors (PESTLE).

HISTORICAL GLIMPSE OF THE MONEY SYSTEM

The history of money dates back to ancient times, beginning with the practice of bartering, where people exchanged goods and services directly. However, as societies grew more complex, bartering became inefficient, and the need for a standardized medium of exchange emerged. Early civilizations began using precious metals like gold and silver, which were valuable, durable, and easy to carry. These metals eventually became the first forms of money, with coins being minted to ensure uniformity and ease of use.The next major development in the money system was the introduction of paper money in China during the Tang Dynasty (618-907 AD). This innovation, which made transactions more convenient and portable, gradually spread to other parts of the world. Over the centuries, the money system continued to evolve, with the rise of banking, credit, and the use of checks. In the 20th century, the introduction of digital payment methods, credit cards, and mobile banking reshaped financial transactions. Today, the rise of digital currencies like Bitcoin and blockchain technology represents the latest transformation in the history of money, offering decentralized alternatives to traditional banking systems.

RESEARCH GAPS

Research on the impact of varying CBDC designs on financial stability particularly in diverse economic contexts, it's stability in long run are severely lacking. The motive is to track the interaction between CBDC and existing financial systems. Hence the study was undertaken.

REVIEW OF LITERATURE

Raphael Auer, Philipp Haene, and **Henry Holden (2021)** in their Bank for International Settlements (BIS) paper about **"Multi-CBDC arrangements and the future of cross-border payments"** says, Filling the gap of inefficiency using

technology cross-border payments is observed.

Prakhar Mathur and **Biswajit Mohanty (2021)** their research paper **"Central Bank Digital Currency: A Literature Review"**. This review provides an overview of the existing literature on CBDC, including its historical background, conceptual framework, and policy implications.

Maria Chiara Cavalleri and **Dominik Wied (2021)** their paper **"Central Bank Digital Currencies: Recent Developments and Future Prospects".** This review examines the recent trends in CBDC research and their implications for financial innovation, monetary policy, and international cooperation.

John Williams (2021) review paper **"Central Bank Digital Currency: The Case for the Federal Reserve"**. This review argues that CBDC can enhance the efficiency and inclusiveness of the payment system while maintaining the stability and credibility of the central bank.

Anna Kepinska and **Aniket Kate (2020)** their review paper"**Central Bank Digital Currency: An Overview of the Literature"**. This review surveys the key issues in CBDC research, including its design features, implementation challenges, and policy implications.

STATEMENT OF THE PROBLEM

India's current monetary system requires greater efficiency and enhancement. The introduction of new technologies can facilitate these improvements. Additionally, a basic understanding of digital currency among the population is necessary, so awareness must be created.

OBJECTIVES

- To overview the evolution of CBDC and detail its key functions.
- To study the digital payment behavior and adoption progress of CBDC based on a survey.

SCOPE OF THE STUDY

This study examines the implementation of digital currency through Central Bank Digital Currency (CBDC), emphasizing its importance for the financial system. It thoughtfully explores the potential benefits of reducing transaction costs and enhancing financial inclusion, while also considering critical aspects such as monetary policy, privacy, and security.

SAMPLE SIZE

The primary data is obtained by collecting responses through questionnaires from 121 respondents.

METHODOLOGY

Research methodology for CBDC involves both quantitative and qualitative approaches, depending on the research objectives and the data available. Quantitative research is used to analyze data on the usage patterns, costs, benefits, and risks associated with CBDC. This can involve the collection of data from surveys, experiments, or simulations to measure the impact of CBDC on different variables, such as transaction volumes, costs, or financial inclusion. Qualitative research is used to understand the attitudes, beliefs, and perceptions of stakeholders toward CBDC. This can involve the use of focus groups, interviews, or case studies to explore the opinions of consumers, businesses, regulators, or central banks on different aspects of CBDC, such as privacy, security, or usability. The data was analysed using statistical methods such as simple percentage analysis and chi-square.

LIMITATIONS OF THE STUDY

As sampling taken was Random sampling, it might not be necessary to represent the actual population of a particular locality. The survey was circulated through Google survey forms, that require an Internet connection. Thus, this study is limited to Internet users only.

CBDC

Central Bank Digital Currency (CBDC) is a digital representation of currency that is issued and backed by a central bank. This innovative form of money is designed to coexist with traditional physical

currencies, such as cash and bank deposits. CBDCs leverage blockchain technology or other forms of distributed ledger technology to ensure transparency, security, and data integrity. The implementation of CBDCs can offer numerous advantages, including enhanced efficiency in transactions, reduced costs, and improved access to financial services, promoting greater financial inclusion. In India, CBDCs are categorized into two main types: wholesale (W-e₹) and retail (R-e₹).

History

1990 - The launch of Avant developed by Nokia created a digital currency revolution in Finland. This was designed as a secure and convenient way for consumers to make electronic payments, without debit and credit cards. It was successful in Finland, but ultimately failed to gain widespread due to lack of international support.

1996 - The micropayment project of the Czech Republic in 1996, was named the Q Czechia project. This Q Czechia was one of the first micropayment systems in Europe. Users can purchase these Q tokens with cards and bank transfers, and those tokens can be used in making micropayments for things like articles, games, and other online content. It failed, but this was a ground breaking achievement in the development of micropayment systems.

2009 - This concept of CBDC took over several years, But the attention from several central banks worldwide was fully derived from this revolutionary invention "BITCOIN". In 2009 an anonymous person by the name of Satoshi Nakamoto created this Bitcoin, The world's first decentralized blockchain technology digital currency. Bitcoin gets its hype on 2020 - 2021 where it gets its all-time high price. Currently, the CBDC adopts blockchain technology for its fundamentals.

2014 - This year the popularity of digital currencies gained. But the serious attention of the currency wasn't until 2014 that the idea of a CBDC gained serious attention when the Bank of England published a research paper topic. The paper examined the potential benefits and challenges of CBDC, including the potential impact on monetary policy, financial stability, and the wider economy.

2015 - In 2015, The bank of Canada began exploring the possibility of CBDC. The bank got in-depth knowledge and launched research projects to investigate the feasibility of CBDC. At the same time, the International Monetary Fund (IMF) and World Bank began to study the potential impact of CBDC on financial stability, cross-border payments, and financial inclusion. This year is a turning point where the CBDC concept is more seriously considered.

2018 - 2018 the Bank of International Settlements (BIS) published reports on CBDCs. The technical and practical considerations of the CBDC and its flaws are also identified and studied.At that time. The report was also published with consideration of valuable insights like scalability, interoperability, and privacy. This report played a significant role in shaping the research around CBDC.

2020 - The People's Bank of China launched a pilot program for its digital currency. It was named Digital Currency Electronic Payment (DCEP). The pilot project was rolled out in several cities, including Shenzhen, Suzhou, and Chengdu. This DCEP system is designed to replace physical cash with digital currency that can be used for daily transactions. It was a success with millions of transactions and positive feedback from users. Since The Pilot launch, China has continued to develop and expand the DCEP system with plans to gradually roll it out across the country and integrate it into the wider global financial system.

2022 - India launches its digital currency. On November 1, 2022 Digital rupee wholesale (e-W)

trials in the wholesale market with the settlement of secondary market transactions in government securities as its sole new case. It was more efficient by eliminating the collateral to degree settlement risk, settlement in Central Bank money, and low transaction cost. Followed by (e-R) retail segment of digital currency was launched on December 1, 2022, to a closed user group (CUG) of participating customers and merchants.

2023 - February 2023 In India, the users were 50,000 with 7.7 lakhs transactions, and these pilot versions will be carried through 2023 with extending users and cities. In addition to this, on July 2023 the RBI Deputy Governor T.Rabi Shankar stated increasing the transaction to 10 Lakh per day by the year end. Currently's stands at 5000 - 10000 transactions per day.

Technology

The CBDC is a combination of blockchain, cryptography, and traditional banking system. Blockchain provides Distributed Ledger Technology (DLT), Cryptography used for the encryption and decryption protocols in the distributed ledger, and Traditional banking systems combine all together as a real working mechanism.

Use Cases for India

Programmable Money: The money with a programmable function can be spent only for specific purposes. This can control corruption and the reserve of funds in black currency vaults.

Cross Border remittance: Digital Rupee can be used not only for domestic settlements but can also enable cross-border transactions in an efficient, fast, and secure way for all kinds of customers.

Offline functionalities: This function has the same properties as physical cash but in a digital way without a network connection. The payments can be done using NFC, or integrated sim cards. Currently, this is in the initial stage of development.

PESTLE (Pros & Cons)

POLITICAL

Pros

Government Control: With the help of CBDC, the RBI can directly influence on the interest rate and money supply. It can enhance the Monetary Policy effectively.

Restrain Black Economy: CBDC can assist in dampening prohibited financial activities and tax dodging due to its traceability.

Cons

Misemployee and Monitoring concerns: Lack of proactive regulations leads to exploit financial privacy and freedom by the central bank and government due to political interference.

ECONOMIC

Pros

Financial Expansion: CBDC can access services for the financial inclusion of underbanked and unbanked populations, that leads to economic development.

Cost Adequate: This can facilitate cost-effectiveness and improve the efficiency of payment systems for both Corporate and Individuals.

Cons

Influencing banks: This might lead to disintermediation that may affect the profitability and lending activities of commercial banks due to cold storage funds in CBDC wallets.

SOCIAL

Pros

Financial Empowerment: CBDC could entitle individuals to manage their finances further without intermediaries and assist in elevating financial literacy.

Security and Accessibility: To validate effortlessly and provide more trustworthy transactions for individuals in the lack of a formal financial system.

Cons

Privacy Factors: As it is a developing technology if it in case not properly managed leading to data privacy breaches.

TECHNOLOGICAL

Pros

Efficient: It is well planned with time management, faster transactions, Offline and Cross - Border payment compatibility, and overall enhancement for the traditional system.

Fintech Growth: CBDC can provide a foundation stone for revolutionary developments in the financial technology space.

Cons

Infrastructure Factor: The development of a new ecosystem for this technology requires significant investment.

LEGAL

Pros

The legal aspect of CBDC can provide amendments to revise Anti-Money Laundering (AML), Know-Your-Customer/Know-Your-Client (KYC), and counterfeiting regulations.

Cons

There are heavy challenges in implementing new regulations for cross-border settlements.

ENVIRONMENTAL

Pros

Reducing Carbon Footprints: The factors affecting the environment due to physical currency manufacturing and transporting can be controlled.

Cons

Energy Consumption: The infrastructure for the technology needs more energy and leads to the consumption of natural resources usage beyond.

ANALYSIS

The following data are collected from the respondents through Google Forms. A total of 121 respondents expressed their opinions which can be overviewed in this survey.

Payment Preference

Table 1: Analysis of Monthly Bills, Merchant Payments, and Petrol Bunk Payments

CATEGORIES	Monthly Bills		Merchant Shop		Petrol Bunk	
PREFERENCE	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Cash Payments	32	26.4	27	22.3	48	39.7
Digital Payment	**60**	**49.6**	**73**	**60.3**	**50**	**41.3**
Net banking	15	12.4	8	6.6	10	8.3
Debit Cards	10	8.3	10	8.3	8	6.6
Credit Cards	4	3.3	3	2.5	5	4.1
TOTAL	121	100.0	121	100.0	121	100.0

Source: Primary data

From the above table 1, it is examined that most of the respondents prefer Digital Payment for all three categories. Digital Payment is the most preferred mode across all categories, with the highest adoption at Merchant Shops (60.3%), followed by Monthly Bills (49.6%) and Petrol Bunks (41.3%). Cash Payments are most commonly used at Petrol Bunks (39.7%), compared to Monthly Bills (26.4%) and Merchant Shops (22.3%), indicating that people still rely on cash for fuel transactions. Credit Cards are the least preferred payment method, with the lowest usage at Merchant Shops (2.5%) and slightly higher at Monthly Bills (3.3%) and Petrol Bunks (4.1%). Net Banking sees the highest adoption for Monthly Bills (12.4%) but lower usage at Merchant Shops (6.6%) and Petrol Bunks (8.3%). Debit Cards have relatively consistent but low usage across all categories (8.3%, 8.3%, and 6.6%, respectively). Overall, digital transactions dominate, while cash remains relevant, particularly for fuel purchases, and credit cards have the least adoption. Thus CBDC also comes under the Digital Payment method.

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CHI-SQUARE TEST

Chi-square is a statistical test used to determine if there is a significant association between two categorical variables. It compares the observed frequencies of data with the expected frequencies, assuming that there is no association between the variables. If the difference between the observed and expected frequencies is large, then the chi-square value will be large, indicating a significant association between the variables. The test can be used for hypothesis testing or to evaluate goodness-of-fit between observed and expected frequencies.

Preference mode of paying monthly bills and gender

Chi–square analysis is used to determine whether there is a significant association between "Preference mode of paying monthly bills and Gender".

P value 5%

H0: There is no relationship between preference mode of paying monthly bills and gender.

H1: There is relationship between preference mode of paying monthly bills and gender.

Null hypothesis is less than .05, it is rejected.

Alternative hypothesis is more than 0.5, it is accepted.

TABLE 2 - Preference Mode of Paying Monthly Bills and Gender

Crosstab						
	Preference mode of paying monthly bills					
GENDER	Cash payment	Digital payment	Net banking	Debit Card	Credit Card	Total
Male	17	35	5	3	4	**64**
Female	15	25	10	7	0	**57**
Total	**32**	**60**	**15**	**10**	**4**	**121**

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.682[a]	4	**.070**
Likelihood Ratio	10.284	4	.036
Linear-by-Linear Association	.123	1	.726
N of Valid Cases	121		

Source: Primary data

INTERPRETATION

Table 2 inferred that significant P > 0.05, hence the null hypothesis is not rejected and it is concluded that there is no association between gender and preference mode of paying monthly bills.

Preference mode of paying in merchant shops and gender

Chi–square analysis is used to determine whether there is a significant association between "Preference mode of paying in merchant shops and Gender".

P value 5%

H0: There is no relationship between preference mode of paying in merchant shops and gender.

H1: There is relationship between preference mode of paying in merchant shops and gender.

Null hypothesis is less than .05, it is rejected.

Alternate hypothesis is more than 0.5, it is accepted.

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TABLE 3 - Preference Mode of Paying in Merchant Shops & Gender

Crosstab						
GENDER	Preference mode of paying in the merchant shop					
	Cash payment	Digital payment	Net banking	Debit Card	Credit Card	Total
Male	14	41	3	4	2	**64**
Female	13	32	5	6	1	**57**
Total	**27**	**73**	**8**	**10**	**3**	**121**

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.982[a]	4	**.739**
Likelihood Ratio	1.992	4	.737
Linear-by-Linear Association	.206	1	.650
N of Valid Cases	121		

Source: Primary data

INTERPRETATION

Table 3 inferred that significant P > 0.05, hence the null hypothesis is not rejected and it is concluded that there is no association between gender and preference mode of paying in merchant shops.

Preference mode of paying in petrol bunks and gender.

Chi–square analysis is used to determine whether there is a significant association between "Preference mode of paying in petrol bunks and Gender".

P value 5%

H0: There is no relationship between preference mode of paying in petrol bunks and gender.

H1: There is relationship between preference mode of paying in petrol bunks and gender.

Null hypothesis is less than .05, it is rejected.

Alternative hypothesis is more than 0.5, it is accepted.

TABLE 4 - Preference Mode of Paying in Petrol Bunks & Gender

Crosstab						
Gender	Preference mode of paying in the petrol bunk					
	Cash Payment	Digital payment	Net banking	Debit Card	Credit Card	Total
Male	21	33	2	4	4	**64**
Female	27	17	8	4	1	**57**
Total	**48**	**50**	**10**	**8**	**5**	**121**

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.902[a]	4	**.028**
Likelihood Ratio	11.340	4	.023
Linear-by-Linear Association	.654	1	.419
N of Valid Cases	121		

Source: Primary data

INTERPRETATION

Table 4 inferred that significant P < 0.05, hence the null hypothesis is rejected and it is concluded that there is association between gender and preference mode of paying in merchant shops.

FINDINGS

Network Issue

The network is a crucial factor that significantly impacts digital payments in our daily lives. We can evaluate the frequency of network issues on a scale of 5: (usually; often; sometimes; rarely; never). According to a survey, the majority of respondents (53.7 percent) experience network issues sometimes while conducting online transactions. In these cases, the Offline Payment System (OPS) can serve as a solution. The Central Bank Digital Currency (CBDC) incorporates the OPS function, which is currently in the development phase.

Offline Payment System (OPS) Rating

The rating for OPS is categorized on a Scale of 5, (Very good; Good; Acceptable; Poor; Very Poor).From that, it is observed the ideology of OPS gets a positive response, the majority 33.1% & 32.2% of respondents rated it as Good & Very good.

Digital Payment without a Bank Account

The survey on digital payments without a bank account utilized a 5-point Likert scale, with responses ranging from Strongly Agree to Strongly Disagree. Results showed that 35.5% of respondents agreed with the concept, while 31.4% remained neutral. Central Bank Digital Currency (CBDC) resembles physical currency and allows transactions without a bank account, ensuring that "my money is in my control."

SUGGESTIONS

Four suggestions were presented to respondents, ordered by preference.

1. The first and most favoured was the role of CBDCs in combating black money and counterfeit currency. Thanks to their blockchain technology and cryptography, CBDCs eliminate duplication risks. They also enable the Central Bank (RBI) to monitor all online transactions through a distributed ledger system, though offline transaction monitoring remains a concern.
2. The second suggestion highlighted a fully digitalized money system, which could reduce currency printing costs and mitigate risks associated with physical currency damage.
3. The third suggestion is to innovate the monetary system by implementing Central Bank Digital Currency (CBDC), which serves as programmable money for cross-border payments, offline transactions, and real-time payments.
4. The fourth suggestion notes that less than 10% of people believe no changes are necessary in the current monetary system.

   The Online payment without bank account survey reveals that most of the respondents agreed with the system. As CBDC has the key feature of currency notes it doesn't need a bank account to transact, which means "My money is my control".

In the cross-border payment survey, most of the respondents have friends and family members abroad. They have the preference to make cross-border payments. The CBDS's other key feature is the cross-border functionality, in which we can transact international payments without a bank. This is also in the initial stages of development.

CONCLUSION

The paper, survey on the Digital Transformation of payment system using Central Bank Digital Currency (CBDC’s) reveals a growing interest and acceptance of CBDC’s among individuals and businesses. Many respondents view CBDC’s as a more efficient and secure way to conduct transactions, believing they could enhance financial inclusion and provide better access to unbanked populations. However, there are concerns about potential risks and challenges

associated with CBDCs, including issues of privacy and security, as well as their potential impact on the traditional banking system. Overall, while more education and awareness about CBDC's are needed, the survey indicates a willingness to embrace this new form of currency, provided it is implemented responsibly and transparently.

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