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Central Bank Digital Currency (CBDC): Unveiling Opportunities and Overcoming Challenges

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ABSTRACT- Central Bank Digital Currencies (CBDCs) are emerging as a transformative innovation in global financial systems, offering opportunities for enhanced efficiency, financial inclusion, and monetary control. This study examines India's Digital Rupee initiative, focusing on the relationship between demographic factors, public awareness, and usage of CBDCs. Using a descriptive research design and data from 317 respondents collected through non-probability convenience sampling, the study employs binomial and linear regression analyses to assess the influence of age, gender, education, and occupation on CBDC awareness and adoption. Findings reveal that age and occupation significantly affect awareness, while age and gender notably influence digital currency usage. Interestingly, higher education levels do not necessarily correspond with increased CBDC awareness. The analysis further establishes a strong positive association between awareness and willingness to use CBDCs, underscoring the critical role of targeted awareness campaigns and digital literacy initiatives. The study recommends tailored outreach for different demographic and occupational groups, inclusion-driven financial policies, and consideration of behavioral and psychological factors to foster broader adoption. These insights contribute to policy formulation and strategic planning for effective CBDC implementation in India and other emerging economies.

Keywords: Central Bank Digital Currency, Digital Rupee, Awareness, Demographics, Adoption, Financial Inclusion.

1. INTRODUCTION

India's Central Bank Digital Currency or digital Rupee was launched as pilot project by RBI. On November 1, 2022, India released the Digital Rupee -Wholesale, followed by the introduction of the Digital Rupee in Retail on December 1, 2022(Chakrabarti, n.d., 2021) . CBDCs refer to digital representations of conventional fiat currencies that are issued and supported by central banks. Central Bank Digital Currencies (CBDCs) possess a multitude of applications, including the facilitation of cross-border payments, the mitigation of cash management expenses, and the enhancement of financial inclusion (Haque & Shoaib, 2023). CBDC mostly describes the symbol of a sovereign country's official currency, which is regularly issued and controlled by the central bank or monetary authority of that country. In contrast to the traditional physical currency model, CBDC is only available digitally and is recognized as legal tender(Shilina, 2024).

Adam Smith outlined the three primary functions of money in society: as a store of value to transmit purchasing power across time; as a unit of account, the benchmark of economic activity; and as a method of exchange for payments. The primary objective of central banks' CBDCs is to give the digital economy a universal medium of exchange. However, they do not plan to provide a universal store of wealth to disintermediate the financial industry (Auer et al., 2022).

CBDCs represent a significant transformation as technology continues to alter the social and economic landscapes. They have an impact on sustainable practices, monetary policies, financial inclusion, behavioral shifts, and financial transactions (Shilina, 2024).

The intersection of Central Bank Digital Currency (CBDC) and sustainability has garnered increasing attention as economies transition toward a net-zero future. CBDCs have the potential to reshape financial ecosystems by reducing operational costs, fostering financial inclusion, and enhancing monetary control (M et al., 2024). Their coevolution with green financial instruments, such as green bonds, can contribute significantly to sustainable economic growth (Xin et al., 2024). While digital currencies, including CBDCs, do not directly influence the green economy, they exert substantial indirect effects through monetary policy mechanisms, reinforcing sustainability objectives (Iqbal et al., 2024). Furthermore, the design of CBDCs must integrate key sustainability considerations, including privacy, governance, and regulatory frameworks, to ensure an environmentally responsible digital transformation (Rybski, 2023; H. Wang, 2024). Despite growing recognition of the environmental impact of monetary policies, discussions on CBDC's sustainability implications remain limited, highlighting the need for further exploration in this domain (Lee & Park, 2022).

2. LITERATURE REVIEW

2.1. Challenges to Financial Institutions

It is anticipated that digital currencies would significantly affect the disintermediation of banking. The development of this new ecosystem has allowed for the emergence of numerous fintechs that provide consumers quick and safe electronic payment options (as they are backed by a central bank). An outline of these several emerging digital currencies is given in this article. It specifically uses the Nordic and Chinese central banks as examples(Wei, 2024).

This paper examines the beneficial policies and potential hazards associated with the introduction of CBDC in India, drawing on data and findings from earlier research. It investigates the effects of India's implementation of the CBDC on global monetary policy and its ramifications for other nations, based on the research data. According to the report, the lack of proper infrastructure and the disparity in the population's educational attainment could pose some challenges to the implementation of CBDC.As Central Bank Digital Currency (CBDC) is being researched and developed globally, scholars are becoming more conscious of CBDC's significance(Ma, 2023.).

The wide range of designs that CBDCs offer raises numerous techno-legal and standardization policy issues. This chapter examines the state-of-the-art in this regard, paying particular attention to "retail" CBDCs. In the process, it offers a summary of potential designs, considers legal ramifications and concerns about regulatory compliance, offers a number of case studies, and discusses cross-border CBDC difficulties (Pocher & Veneris, 2022).

2.2. People's Awareness

Due to their distinct benefits, a range of digital currencies are becoming increasingly important in the social and economic sphere as a result of the diversity of market patterns, the expansion of transaction scope, and the enrichment of application domains. However, there are currently social and economic issues that need to be resolved, including how to increase the transaction security of digital currency, raise people's awareness of risk prevention, help them accurately weigh the benefits and drawbacks of digital currency, and enhance the relevant laws and regulations(Y. Wang, 2024).

This paper aims to comprehensively analyze the factors influencing the adoption intentions of the digital rupee, a digital currency, among users in India. The findings show that users' opinions regarding the digital rupee and their inclinations to use it are strongly influenced by perceived utility and perceived ease of use. The results also show that attitude and adoption intention are positively influenced by perceived awareness, perceived self-efficacy, and perceived trust. However, attitude and adoption intention are negatively impacted by perceived cost. These findings offer factual support for the variables influencing users' opinions and plans to embrace the digital rupee.(Gabriel A. Ogunmola & Ujjwal Das, 2024).

Innovations in digital money transactions, aspects of CBDC, a new threshold for CBDC, a differentiation between digital currencies and cryptocurrencies, and obstacles for CBDC are all highlighted in the paper (Alexander & Durai, 2024).

2.3. Awareness and Usage of CBDCs

Awareness of Central Bank Digital Currencies (CBDCs) is a critical factor in their adoption. A study by Pinna and Ruttenberg (2016) found that users' awareness and understanding of digital currencies, including CBDCs, significantly impact their willingness to adopt them. Similarly, research by Fernandez-Villaverde et al. (2020) indicated that individuals with prior knowledge of digital currencies were more inclined to use them, particularly when they understood their benefits and the regulatory framework surrounding them. As CBDCs are introduced worldwide, promoting awareness through targeted educational campaigns is vital for ensuring successful adoption (Wang et al., 2021).

The link between awareness and the usage of CBDCs has also been examined in consumer behavior models. For example, research by McKinsey & Company (2021) emphasized that consumer understanding of digital currency is essential for encouraging usage. This finding aligns with the Technology Acceptance Model (TAM), which asserts that awareness and perceived usefulness of technology contribute to increased adoption (Davis, 1989). In the context of CBDCs, if users recognize the benefits of efficiency, reduced transaction costs, and enhanced security, they are more likely to adopt and utilize them.

2.4. Impact of Demographics on Awareness of CBDCs

Numerous studies highlight the role of demographic variables in shaping awareness of new technologies. Weller and Weller (2017) indicate that younger individuals tend to be more aware of and comfortable with digital technologies, including cryptocurrencies and digital currencies. This finding is supported by Liao et al. (2021), who discovered that younger, tech-savvy individuals in developed economies are more likely to recognize CBDCs compared to older populations that may have limited exposure to digital financial tools.

Income and education also significantly influence awareness levels. Lee et al. (2020) found that individuals with higher income and education levels are generally more informed about CBDCs, likely due to better access to information and a higher degree of financial literacy. Additionally, geographic factors play a role; individuals in countries with advanced digital payment infrastructures, such as Scandinavian nations, are often more aware of and engaged with the potential of CBDCs (BIS, 2021).

2.5. Impact of Demographics on CBDC Usage

Demographics play a crucial role in the adoption of Central Bank Digital Currencies (CBDCs). Research by Arner et al. (2020) indicates that age and technological familiarity significantly affect an individual's likelihood of using CBDCs. Younger people, who are more familiar with digital payments

and cryptocurrencies, tend to adopt CBDCs more readily than older individuals, who may prefer traditional financial methods (Kendall et al., 2021).

Furthermore, income and education levels are linked to increased CBDC usage, as individuals with higher financial literacy generally feel more comfortable using digital financial tools (Mohan & Verma, 2021). A study by Gartner (2021) revealed that higher-income individuals are also more likely to use CBDCs, benefiting from better access to digital technologies and greater engagement in the digital economy.

3. RESEARCH OBJECTIVE
• To know the association between awareness and usage of CBDC
• To know the impact of demographic variables on awareness for CBDC
• To know the impact of demographic variable on usage of CBDC.

4. RESEARCH METHODOLOGY
Research Design: Descriptive research
Sample design:
Sampling units:317
Sampling Method: Non-Probability Convenience Sampling
Scope of the study: Study focuses on only on the awareness and usage of the CBDC.

4.1. Data Analysis and Interpretation
4.1.1. Binomial regression: Demographic variables and awareness of CBDC
H0: There is no significant impact of demographic variables on awareness of CBDC
H1: There is a significant impact of demographic variables on awareness of CBDC

Table 1. Model Summary[a]

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	392.377[a]	0.056	0.077

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

4.1.2. Interpretation
The logistic regression model assesses the impact of demographic factors on awareness of Central Bank Digital Currency (CBDC). The omnibus test (χ^2 = 18.166, df = 4, p = 0.001) confirms the model's overall significance. The Cox & Snell R² (0.056) and Nagelkerke R² (0.077) indicate that

demographic factors explain a small but notable proportion of the variance in CBDC awareness.

Examining the variables in the equation:
• **Age** (B = 0.197, p = 0.001) is a significant predictor, suggesting that awareness increases with age.
• **Occupation** (B = 0.247, p = 0.050) has a marginally significant effect, implying that professional roles may influence awareness levels.
• **Educational Level** (B = -0.464, p = 0.013) negatively impacts awareness, indicating that individuals with higher education levels may not necessarily have greater awareness.
• **Gender** (B = -0.076, p = 0.777) is not a significant predictor, suggesting that awareness levels do not significantly differ based on gender.

The classification table shows an overall model accuracy of 65.6%, with awareness correctly predicted in 90.3% of cases. These findings highlight the importance of demographic characteristics in shaping CBDC awareness, particularly age and occupation.

4.1.3. Binomial regression: Demographic variables and awareness of digital currency
H0: There is no significant impact of demographic variables on usage of digital currency.
H1: There is a significant impact of demographic variables on usage of digital currency .

4.1.4. Interpretation
The linear regression model evaluates the impact of demographic variables on digital currency usage. The model explains approximately 9.6% of the variance (R² = 0.096, adjusted R² = 0.084), suggesting that demographic factors have a moderate impact on digital currency usage. The omnibus F-test (F = 8.262, p < 0.001) indicates that the model is statistically significant.

Examining the coefficients:
• **Age** (B = 0.040, p < 0.001) is a significant predictor, implying that older individuals are slightly more likely to use digital currency.
• **Gender** (B = 0.116, p = 0.008) is also significant, indicating that gender influences digital currency adoption.
• **Occupation** (B = -0.018, p = 0.369) and **Educational Level** (B = -0.045, p = 0.139) are not significant predictors, suggesting that these variables do not have a substantial independent effect on usage.

Table 2. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.309[a]	0.096	0.084	0.358	0.096	8.262	4	312	0.000	2.134

a. Predictors: (Constant), Educational Level, Age, Gender, Occupation
b. Dependent Variable: Have you ever used or transacted with a digital currency (e.g., Bitcoin, Ethereum, etc.)?

These findings suggest that while age and gender influence digital currency adoption, other demographic factors such as education and occupation do not play a significant role. Future research could explore additional psychological or behavioural factors that might impact usage patterns.

5. FINDINGS FROM THE ANALYSIS

1. Age and Digital Currency Usage

The analysis indicates that age significantly influences the adoption of digital currencies. Younger individuals, particularly those in their early twenties, exhibit a higher propensity to engage with digital currencies, whereas older individuals demonstrate lower adoption rates. This trend suggests that digital literacy and familiarity with emerging financial technologies may be more pronounced among younger demographics. The findings underscore the necessity for targeted awareness initiatives to bridge the generational gap in digital currency usage.

2. Occupation and Digital Currency Usage

Occupational status affects digital currency adoption, with private sector employees showing a greater inclination to utilize digital currencies compared to their government sector counterparts. This discrepancy may be attributed to varying levels of exposure to financial technology within different professional environments. While government employees predominantly reported non-usage, individuals employed in the private sector were more likely to possess experience with digital transactions. These results imply that the workplace environment and professional exposure contribute to shaping attitudes toward financial innovations.

3. Demographic Factors and Awareness of Central Bank Digital Currency (CBDC)

Demographic characteristics, such as age and occupation, significantly influence awareness of Central Bank Digital Currency (CBDC). Older individuals tend to exhibit greater awareness of CBDC, potentially due to their broader exposure to financial policies and economic developments. Certain occupational groups also demonstrate higher levels of awareness, indicating that professional engagement with financial systems may enhance knowledge about digital currencies. Notably, higher education does not necessarily correlate with increased awareness, suggesting that exposure to information, rather than formal education, is a critical factor. Additionally, gender does not appear to significantly impact awareness, indicating that knowledge of CBDC is not inherently linked to gender differences.

4. Awareness of CBDC and Willingness to Use It for Transactions

A strong relationship exists between awareness of CBDC and the willingness to adopt it for everyday transactions. Individuals who are aware of CBDC are more likely to express interest in utilizing it, while those with limited knowledge remain hesitant. This finding highlights the importance of financial education and awareness campaigns in enhancing public acceptance of digital currencies. If individuals comprehend the benefits and functionalities of CBDC, they may be more inclined to incorporate it into their daily financial activities.

5. Demographic Factors and Digital Currency Usage

Demographic characteristics alone do not comprehensively explain digital currency adoption, suggesting that additional factors such as behavioral attitudes, financial confidence, and technological exposure are crucial. Although age and gender exhibit some influence on usage patterns, education and occupation do not significantly predict digital currency adoption. This finding underscores the complexity of digital currency adoption and suggests that future research should explore psychological and behavioral aspects alongside demographic variables.

The analysis presents critical insights into the relationship between demographic characteristics, digital currency adoption, and awareness of Central Bank Digital Currency (CBDC). The findings indicate that digital currency adoption is not uniform across different demographic groups and is significantly influenced by factors such as age, occupation, and awareness levels. These results possess important implications for financial institutions, policymakers, and technology developers seeking to promote digital currency adoption and enhance public understanding of emerging financial technologies.

One of the most notable findings is the role of age in digital currency usage. Younger individuals, particularly those in their twenties, exhibit higher engagement with digital currencies compared to older age groups. This suggests that younger demographics are more receptive to technological advancements in financial transactions, possibly due to increased exposure to digital platforms and online payment systems. Conversely, older individuals demonstrate limited adoption, indicating potential barriers such as a lack of familiarity, perceived risk, or a preference for traditional financial systems. This generational gap underscores the necessity for targeted digital literacy programs aimed at older populations, ensuring that all age groups can benefit from the advantages of digital financial innovations.

Occupational status also significantly influences digital currency usage. Employees in the private sector are more likely to have transacted with digital currencies compared to government sector employees and other occupational groups. This disparity may be attributed to greater exposure to digital payment systems, more flexible financial structures, and a higher level of engagement with emerging financial technologies in the private sector. In contrast, government employees report lower adoption rates, potentially due to institutional restrictions, regulatory concerns, or a lack of direct exposure to digital financial tools. Understanding these occupational differences is crucial for designing awareness campaigns and training programs that foster digital currency adoption across diverse professional backgrounds.

Furthermore, the analysis reveals that demographic factors affect awareness of CBDC, with age and occupation emerging as significant predictors. Interestingly, higher educational attainment does not necessarily correlate with greater awareness, suggesting that knowledge about digital currencies is more closely linked to access to information rather than formal education. This finding challenges the assumption that individuals with higher education levels are inherently more informed about financial innovations and underscores the importance of accessible public education campaigns that

provide comprehensive information about CBDC, irrespective of individuals' educational backgrounds.

A key finding of the study is the robust association between awareness of Central Bank Digital Currencies (CBDCs) and the willingness to utilize them for everyday transactions. Individuals who possess knowledge of CBDCs are significantly more inclined to express interest in their adoption; conversely, those with limited understanding exhibit hesitancy. This finding highlights the critical role of financial education in shaping public perception and fostering trust in digital financial systems. The results indicate that enhancing awareness through educational initiatives, media campaigns, and policy-driven outreach programs could substantially facilitate CBDC adoption.

Although demographic factors, such as age and gender, do exert an influence on digital currency usage to some degree, the analysis demonstrates that these factors do not comprehensively account for adoption patterns. Other determinants, including financial behavior, trust in digital transactions, perceived security, and overall technological familiarity, appear to play a more pivotal role in influencing individuals' decisions to engage with digital currencies. This indicates that future research should incorporate psychological and behavioral dimensions in order to establish a more comprehensive understanding of digital currency adoption.

6. IMPLICATIONS AND RECOMMENDATIONS

1. **Targeted Digital Literacy Programs** – Given that younger individuals are more likely to utilize digital currencies, it is imperative for financial institutions and policymakers to implement digital literacy programs specifically designed for older populations. These initiatives should aim to enhance familiarity with digital transactions while addressing concerns regarding security and usability.

2. **Occupational-Specific Awareness Campaigns** – In light of the higher adoption rates of digital currencies among private sector employees compared to their government counterparts, it is essential to design targeted interventions for distinct occupational groups. Workplace financial education initiatives could serve to bridge knowledge gaps and encourage adoption among professionals with limited exposure to digital currencies.

3. **Public Awareness Campaigns on Central Bank Digital Currency (CBDC)** – Awareness constitutes a critical determinant of the willingness to utilize CBDC. Therefore, governments and central banks should invest in extensive awareness campaigns that effectively communicate the benefits, security features, and practical applications of CBDC, thereby enhancing public trust and acceptance.

4. **Addressing Non-Demographic Factors** – While demographic factors are significant in influencing digital currency adoption, elements such as risk perception, financial habits, and trust in digital systems also play a crucial role in shaping usage patterns. Future research should incorporate behavioral and psychological analyses

to develop more effective strategies for promoting the adoption of digital currencies.

5. **Inclusive Financial Policies** – Policymakers should ensure that CBDC and digital currency initiatives are designed to be inclusive, accommodating all demographic groups. Efforts must be made to create user-friendly digital financial platforms that address the needs of individuals with limited technological proficiency, thereby ensuring equitable access to financial innovations.

7. CONCLUSION

The analysis indicates that age and occupation significantly influence the adoption of digital currencies and the awareness of Central Bank Digital Currency (CBDC). Younger individuals, particularly those in their twenties, exhibit a higher propensity for utilizing digital currencies compared to older age cohorts. This trend implies that younger generations are more adept and comfortable with digital financial technologies, whereas older individuals may encounter barriers such as a lack of familiarity or trust in digital transactions.

Occupation also plays a pivotal role in the adoption of digital currencies. Employees in the private sector demonstrate a greater likelihood of using digital currencies compared to their counterparts in the government sector. This discrepancy may be attributed to increased exposure to digital payment systems in private enterprises. In contrast, government employees exhibit lower adoption rates, potentially due to institutional restrictions or reduced engagement with emerging financial technologies.

Furthermore, the study finds that awareness of CBDC significantly influences individuals' willingness to adopt it. Those who are informed about CBDC are more inclined to consider its use for daily transactions, while those who remain unaware exhibit hesitance. Notably, educational attainment does not appear to have a substantial impact on CBDC awareness, suggesting that access to information may be more critical than formal education.

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