DIGITAL TRANSFORMATION OF PUBLIC MONEY: A COMPARATIVE ANALYSIS OF THE ROLE OF CENTRAL BANK DIGITAL CURRENCIES

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Abstract
The digital transformation of public money driven by the development and adoption of central bank digital currencies (CBDC), represents a major development in contemporary monetary systems. This paper provides a qualitative comparative analysis of selected international CBDC initiatives with the aim of assessing their impact on payment system efficiency, monetary policy transmission and financial inclusion. The central research question concerns how CBDCs, as a digital extension of sovereign money, can contribute to a more efficient, secure and accessible payment system while preserving the fundamental characteristics of public money. The study is based on a structured review of secondary sources and applies a consistent comparative framework across selected jurisdictions, including China, the European Union, Sweden, Nigeria and the Bahamas. The analysis evaluates CBDC models using common criteria: policy objectives, implementation model, technological design as well as observable outcomes. The findings emphasize that CBDCs can enhance transaction efficiency, increase financial inclusion and strengthen monetary policy transmission mechanisms. However, these benefits are accompanied by significant challenges, including cybersecurity risks, privacy concerns as well as the need for international regulatory coordination. The paper contributes by clarifying the multidimensional nature of CBDC impact and by providing a more structured comparative framework linking empirical cases with theoretical implications. The results highlight that successful CBDC implementation depends on context-specific design choices, supported by robust regulatory and technological foundations.
Keywords: Central bank digital currency (CBDC), public money, digital transformation, monetary policy, financial innovation.
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1. INTRODUCTION

Central banks play a crucial role in maintaining monetary and financial stability, while ensuring broad access to safe and efficient payments. Traditionally, they provide central bank money through cash for the public and reserve accounts for banks, enabling secure transactions across the economy. However, the digitalisation of payments and the decline in cash usage, accelerated by events such as the COVID-19 pandemic, are transforming how people transact. To adapt, central banks are exploring a new form of money, Central Bank Digital Currency (CBDCs), which could complement traditional cash and offer a secure, efficient means of digital payment for the public (Bank for International Settlements, 2020).

The concept of CBDCs widely discussed in the monetary economics and financial innovation literature (Auer et al., 2020; BIS, 2021; World Bank, 2021; IMF, 2022), is increasingly recognized as a transformative instrument in the digitalization of public money. CBDC is a safe and liquid asset reducing the number of financial intermediaries and the settlement risk. In a CBDC framework, end users would hold a direct liability of the central bank, similar to holding cash, while the central bank would likely play a significant role in designing, establishing and operating the associated infrastructure and system (Reslow, Söderberg, & Tsuda, 2024).

CBDCs carry profound implications for monetary policy, payment system efficiency and financial inclusion (Fan, 2022; Armelius et al, 2020; Opare & Kim, 2022). World Bank (2021) emphasizes that CBDCs can substantially improve financial inclusion by offering secure and low-cost payment services to underserved populations, while the International Monetary Fund (2022) highlights their role in broadening economic participation and fostering resilience in both advanced and emerging economies. Fan (2022) documents how China's Digital Yuan has advanced to large-scale trials, clearly improving payment efficiency, whereas Sveriges Riksbank (Armelius et al, 2020) notes that Sweden's e-Krona responds to the challenges of an increasingly cashless society. Similarly, Bergara and Ponce (2018) show that Uruguay's e-Peso confirmed the feasibility of CBDCs in improving access to financial services, especially among the unbanked.

At the same time, Kiff et al. (2020) emphasize that the introduction of CBDCs amplifies both cybersecurity vulnerabilities and risks to user privacy, while Carstens (2021) stresses that robust international regulatory coordination is essential to prevent jurisdictional fragmentation and ensure coherent global standards. Bindseil (2020) and Keister & Sanches (2022) warn that CBDCs might trigger disintermediation by redirecting deposits from commercial banks to central banks, thereby altering traditional credit allocation. These concerns shape the central research problem of this study: how CBDC design and implementation can

advance the digital transformation of public money while balancing their benefits with the regulatory, technological and financial-stability risks involved?

Although the body of literature on CBDCs has grown rapidly, important gaps remain. Opare and Kim (2022) point out the scarcity of empirical evaluations of CBDC adoption, while Gertler and Karadi (2023) stress that the long-term implications for monetary policy transmission and financial stability are not yet sufficiently understood. Chaum, Grothoff and Moser (2021) emphasize that the social and political implications of diminished financial privacy under CBDC regimes require much deeper analysis. These gaps justify the need for a comprehensive study that integrates theoretical perspectives, empirical evidence and policy considerations.

In this paper, impact is defined across three analytical dimensions, derived from the existing body of literature and grounded in the main issues examined by researchers:

- payment system efficiency (cost, speed, accessibility),
- monetary policy transmission (control, liquidity management, transparency),
- financial inclusion (access to financial services for underserved populations).

The central research question is therefore refined as follows:

How do different CBDC designs affect monetary policy transmission and financial inclusion across jurisdictions?

To address this question, the paper adopts a structured comparative approach, moving beyond a purely descriptive literature review. It systematically evaluates selected CBDC initiatives using a consistent set of analytical criteria, allowing for clearer cross-country comparison and stronger analytical conclusions.

The aim of this paper is to analyze the role and impact of CBDCs in the ongoing digital transformation of public money, with a focus on their potential to improve monetary policy transmission, strengthen payment system efficiency and promote financial inclusion. The subject of research is the design, implementation form and implications of CBDCs, while the geographic scope encompasses both advanced and developing economies, thus enabling a comparative assessment. The implications of this research are manifold. At the theoretical level, the study contributes to a deeper conceptual and analytical understanding of digital money within contemporary monetary systems. From a policy perspective, the study offers grounded insights to central banks and regulatory authorities in navigating the delicate balance between fostering financial innovation and safeguarding macroeconomic as well as systemic stability. At the practical level, the findings yield insights for financial institutions and market participants as they adapt their operations, strategies and infrastructures to the transformative dynamics introduced by CBDCs.

The structure of the paper is organized to ensure a coherent progression of the argument. The literature review provides a critical examination of academic and institutional contributions on CBDCs, highlighting both the opportunities they present and the challenges they entail. The methodology section delineates the qualitative research design and data sources underpinning the analysis. This is followed by a comparative examination of selected national cases, which situates the study within diverse empirical contexts. The subsequent analysis and results section synthesizes the principal findings, while the discussion addresses unresolved regulatory dilemmas and broader questions of systemic stability. Finally, the conclusion outlines its theoretical, policy and practical implications.

2. LITERATURE REVIEW

The literature on CBDCs encompasses a broad range of topics, from technical design and implementation challenges to economic and policy implications. Academic contributions have investigated the foundational theories underpinning digital currencies alongside their prospective operational roles in present-day monetary systems. Early contributions to this discourse emphasized the capacity of CBDCs to advance financial inclusion by providing secure and accessible digital payment infrastructures to populations historically excluded from formal banking systems. In this regard, Ghosh and Sharma (2021) argue that CBDCs hold the potential to substantially reduce transaction costs while simultaneously extending access to financial services for marginalized groups, thus positioning them as critical instruments for narrowing structural gaps in economic participation.

2.1. Regulatory and Operational Considerations

The regulatory landscape for CBDCs is complex and rapidly evolving. Scholars emphasize that successful implementation requires a coordinated regulatory framework addressing not just technological factors but also broader economic, fiscal, legal and policy considerations (BIS, 2021; Mancini-Griffoli et al., 2018). Chapman et al. (2020), alongside recent contributions from Auer, Cornelli and Frost (2020), underscore the necessity of proactive measures to strike a balance between innovation and financial stability, suggesting that clear regulatory standards and rigorous oversight mechanisms are critical for mitigating systemic risks. In a similar vein, Carstens (2021) underscores that effective international regulatory coordination is indispensable for mitigating the risks of regulatory arbitrage and for securing coherence in cross-border CBDC frameworks.

Furthermore, the interplay between retail and wholesale CBDC models adds additional complexity to regulatory and operational frameworks. Recent analyses by Adrian and Mancini-Griffoli (2021) and Bindseil (2020) illustrate that some jurisdictions are exploring a "two-tier" approach, where central banks first issue CBDCs to commercial banks or regulated payment providers, which then distribute them to the public. This model, advocated by Bindseil and Panetta (2020), promises to minimize risks associated with direct central bank-citizen interactions, such as operational bottlenecks, cybersecurity vulnerabilities and potential banking sector disintermediation. Thus, ongoing empirical research and pilot studies (e.g., Sand Dollar in the Bahamas; digital Yuan in China, as examined by Fan, 2022) offer practical insights into how various regulatory frameworks can effectively accommodate innovation while maintaining system stability.

Benefits of CBDCs

CBDCs are praised in recent scholarly discussions for several potential financial and societal benefits. One significant advantage highlighted by researchers is the enhancement of payment system efficiency. CBDCs, operating on advanced digital platforms, can facilitate near-instantaneous, low-cost transactions, significantly improving the speed, reliability and security of domestic and cross-border payments (BIS, 2021; Auer & Böhme, 2020; Adrian & Mancini-Griffoli, 2021). Empirical evidence from Fan's (2022) study of the Digital Yuan in China and from the Riksbank's (2020) e-Krona pilot report demonstrates that CBDC trials have already yielded significant efficiency improvements, most notably in transaction speed and cost reduction. Another notable benefit of CBDCs lies in their capacity to modernize monetary policy frameworks.

Recent research by Bordo and Levin (2017) and Dyson and Hodgson (2017) argues that the digital infrastructure inherent in CBDC systems enables central banks to conduct monetary policy operations more directly and transparently, potentially reducing dependence on conventional policy tools such as interest rate adjustments and quantitative easing. Further elaboration by Engert and Fung (2020) points to programmable features within CBDCs that could enable targeted policy measures, such as precise economic stimulus distribution during financial crises.

Moreover, CBDCs are increasingly regarded as powerful tools for enhancing financial inclusion. Scholars, including Barontini and Holden (2019) and Ozili (2022), emphasize CBDCs' potential to bridge significant gaps in financial service accessibility, particularly in developing economies where traditional banking infrastructure remains sparse or inadequate. CBDCs offer previously unbanked populations the opportunity to participate in digital financial ecosystems, facilitating access to savings, payments and credit-building opportunities (World Bank, 2021; Demirgüç-Kunt et al., 2022). Empirical analyses further reinforce this view, identifying positive correlations between CBDC initiatives and increased financial inclusion metrics across multiple case studies, including initiatives in the Bahamas (Sand Dollar) and Nigeria (eNaira) (IMF, 2022; Opare & Kim, 2022).

Current literature reveals a multifaceted landscape where the functional gains of CBDCs are balanced by inherent risks. The theoretical contributions largely circle around two themes: the potential for enhancing the efficiency of monetary transactions and the inherent risks posed to traditional financial systems by digital disruption. Although centralized digital currencies hold the promise of significant economic transformation, they require careful calibration of technology, policy and regulation to ensure that they fulfill their potential without destabilizing existing financial structures.

Risks and Challenges

Despite these advantages, CBDCs come with a variety of significant risks and challenges that must be carefully addressed. Several studies highlight the potential for increased financial volatility associated with CBDC issuance, noting that improper management of liquidity and issuance dynamics could compromise monetary policy effectiveness (Agur, Ari, & Dell'Ariccia, 2022; Kumhof & Noone, 2018). As argued by Fernández-Villaverde et al. (2021), the destabilizing effects of CBDC-related volatility are most pronounced during crises, when deposit flight from commercial banks into CBDCs threatens to exacerbate liquidity shortages and magnify systemic vulnerabilities.

Bindseil (2020) and Keister & Sanches (2022) warn that the integration of CBDCs into existing financial ecosystems poses serious risks of bank disintermediation, as depositors may reallocate funds from commercial banks to central bank accounts, thereby destabilizing the traditional model of financial intermediation. Niepelt (2020) and Brunnermeier and Niepelt (2019) further argue that such a reallocation could significantly constrain banks' lending capacity and credit provision, with adverse consequences for economic growth and financial stability. In response to these risks, Adrian and Mancini-Griffoli (2021), alongside the Bank for International Settlements (2021), emphasize the urgent need for new regulatory and operational frameworks capable of managing transitional disruptions and safeguarding systemic resilience.

Cybersecurity represents another critical risk associated with the introduction and operation of CBDCs. According to Kiff et al. (2020) and Lagarde (2021) digital currencies heighten vulnerabilities to cyber threats, including hacking, fraud and large-scale data breaches. Central banks would therefore face substantial operational and reputational risks unless robust cybersecurity protocols and resilient technological infrastructures are implemented (Auer & Böhme, 2020; Bossu et al., 2020).

Allen et al. (2020) and Chaum, Grothoff and Moser (2021) contend that privacy constitutes one of the most pressing concerns in current academic and policy

debates on CBDCs, cautioning that their implementation could substantially expand governmental surveillance capacities and thereby erode financial anonymity. Garratt and van Oordt (2021), as well as European Central Bank (2020), highlight the persistent tension between transparency and privacy, emphasizing that policymakers must carefully balance the imperatives of regulatory oversight with the protection of individual rights to financial confidentiality.

Reslow, Söderberg and Tsuda (2024) explain that in a CBDC setting—particularly in the context of retail CBDCs—end users would directly hold a central bank liability, like holding cash, while the central bank would likely play a major role in designing and operating the system. They argue that such an arrangement could enhance the efficiency of cross-border payments by reducing costs, settlement risks and intermediary dependence. Nonetheless, they acknowledge that some design and policy considerations also apply, at least indirectly, to potential wholesale CBDC models. The authors emphasize that despite these advantages, significant challenges remain, including interoperability between jurisdictions, regulatory alignment and the risk of currency substitution in smaller economies.

The following table summarizes the key features, benefits and risks associated with CBDC implementations in various national contexts:

Table 1. Overview of CBDC Features, Benefits and Risks

Feature	Benefits	Risks/Challenges
Digital Representation of Fiat	Increased liquidity and accessibility	Volatility impacting monetary policy transmission
Payment Efficiency	Lower transaction costs and faster settlement times	Cybersecurity vulnerabilities and data privacy risks
Financial Inclusion	Expanded financial inclusion for unbanked populations	Potential exclusion due to uneven digital infrastructure
Regulatory Framework	Enhanced transparency in policy implementation	Regulatory integration and operational disruptions
Cross-Border Payment Capability	Reduced costs and dependency on correspondent banks; Increased speed of transactions	Complex international coordination

Source: Author's compilation

Table 1 presents a synthesized view of the primary features of CBDCs as identified in the literature, highlighting both the significant benefits and the challenges that need further regulatory and technological interventions.

3. METHODOLOGY AND DATA COLLECTION

This study employs a qualitative research methodology primarily based on an extensive literature review. The research strategy involves systematically gathering secondary data from scientific articles, technical reports, institutional publications and government documents published over the past decade. The selection criteria emphasized the relevance of each source to the central theme of CBDCs implementation, monetary policy and financial inclusion. Data were collected from multiple academic databases, focusing on studies that analyze the digital transformation of public money through CBDCs. Emphasis was placed on sources that provided empirical evidence, detailed case studies and theoretical models related to the subject matter.

The analytical framework for this research is based on thematic synthesis and comparative analysis. The paper qualitatively reviews the literature and compares international CBDC initiatives to assess their effects on monetary policy transmission, financial inclusion, payment system efficiency and emerging regulatory challenges within the broader digital transformation of public money. Each theme was then examined in detail to extract insights on both the benefits and challenges posed by CBDCs. The analysis also considered the specific context of various countries, highlighting differing approaches to CBDC implementation and the unique challenges encountered across regions.

Figure 1. CBDC Adoption Process Flow

Figure 1 depicts the sequential steps a central bank might follow to deploy a CBDC, highlighting the importance of each phase in ensuring a stable and efficient digital monetary system.

3.1. Comparative analysis

The analysis that follows examines the evolution and institutional design of CBDCs initiatives across a selected group of countries that are currently implementing or piloting such digital monetary instruments. The selected cases were chosen to capture variation across advanced and emerging economies, as well as different stages of CBDC development (pilot, live and design phases), allowing for a meaningful comparison of implementation models, policy priorities and observed outcomes.

Each case is analyzed using the following standardized criteria:

1. Policy objectives
2. Implementation model
3. Technological approach
4. Measurable outcomes (e.g. adoption, efficiency gains where available)
5. Key risks and challenges.

By comparing national contexts, objectives and implementation approaches, the analysis highlights both common patterns and distinctive national trajectories. Drawing on a wide range of scholarly and policy literature, complemented by illustrative case studies, the study seeks to provide comprehensive insights into the policy rationales, developmental pathways and key factors that shape the progress of contemporary CBDCs experiments.

Table 2. Comparative Analysis of CBDCs Implementations

Country / Union	CBDC Name / Status	Main Objective(s)	Implementation Model	Outcomes	Key Challenges
China (PBoC)	Digital Yuan (e-CNY) - Advanced Pilot	Payment efficiency, monetary control, digital competitiveness	Two-tier retail model via banks and telecoms	Large-scale use in cities; tested for cross-border trade	Privacy concerns, user surveillance, platform dominance -Alipay/WeChat
Sweden (Riksbank)	e-Krona - Pilot	Prepare for cashless society, resilience	Retail token-based pilot, intermediated access	Positive test feedback; raised public trust debates	Requires legal support; slow political momentum
European Union (ECB)	Digital Euro - Design/Consultation	Digital euro sovereignty, offline payments, privacy	Retail CBDC; intermediated via banks/PSPs	Legislative proposal (2023); privacy-by-design commitment	Harmonizing regulation across EU; bank disintermediation concerns
United Kingdom (BoE)	Digital Pound ("Britcoin") - Consultation	Future-proof money, innovation, competitiveness	Retail CBDC; intermediated model	Completed public consultation; next phase of development	Public trust, integration with fintech sector
Uruguay	e-Peso - Completed Pilot	Financial inclusion, digital payments	Direct issuance via mobile wallets	Pilot showed success with	Limited scalability; infrastructure constraints

				unbanked communities	
Nigeria	e-Naira - Live	Financial inclusion, modernize public payments	Central bank issues via banks; wallet-based	Uptake among unbanked; promoted via social programs	Low adoption due to awareness gaps and trust
Bahamas	Sand Dollar - Live	Reach remote islands, reduce cash dependency	Retail CBDC via mobile wallets	Improved access in outer islands	Internet connectivity, user education
Ghana	e-Cedi - Pilot	Foster innovation, inclusion	Hybrid access (banked/unbanked)	Strong institutional support	Digital infrastructure development needed
Brazil	Real Digital - Pilot	Wholesale innovation, tokenized assets	DLT-based wholesale CBDC pilot	Sandbox projects with success	Legal framework for smart contracts
India	Digital Rupee - Pilot (Retail + Wholesale)	Payment modernization, resilience	RBI pilot with phased retail + wholesale rollout	Interbank clearing and retail wallet integration ongoing	Privacy safeguards and scaling
France (Banque de France)	Wholesale CBDC - Pilot	Improve financial market infrastructure	Token-based settlement of securities	Collaborated with MAS, Banque Centrale de Tunisie	No retail focus; integration with ECB
Switzerland (SNB)	Project Helvetia (Wholesale)	Test interbank clearing and DLT	Wholesale-only, via SIX Digital Exchange	Successful cross-border pilots	Not planning retail; legal clarity needed
Norway (Norges Bank)	No official name - Test phase	Digital resilience, future cash alternative	Exploring token and account-based pilots	Technical success in test environments	Public perception, legislative gaps
Lithuania (Bank of Lithuania)	LBCOIN - Pilot (2020)	DLT innovation, public education	Blockchain-based semi-retail experiment	Pioneer in Eurozone; limited rollout	Not scalable; ended as proof-of-concept

Source: Author's compilation based on data from Atlantic Council (CBDC Tracker, 2024), BIS (Auer et al., 2023), ECB (2023), IMF (2023)

In light of the preceding review, the thematic synthesis that follows critically examines the main comparative dimensions of CBDC initiatives, underscoring areas of strategic convergence as well as contextual specificities distinguishing global and European approaches.

Table 3. Thematic Synthesis: Key Comparative Dimensions of CBDC Implementation

Dimension	Global Trend	European Approach	Examples
CBDC Type	Mostly retail (plus some wholesale)	Retail focus with exceptions (France, Switzerland)	Retail: China, Nigeria, ECB, Sweden; Wholesale: France, SNB
Implementation Model	Two-tier or hybrid (banks + wallets)	Two-tier with intermediaries prioritized	China, ECB, UK, India
Technology	Distributed Ledger Technology (DLT) (often private), mobile-based wallets	DLT trials + privacy-focused programmable platforms	Bahamas (mobile), France (blockchain), ECB (offline + privacy)
Financial Inclusion	Strong goal in Global South	Not primary driver in EU; more focus on innovation, monetary sovereignty	Nigeria, Ghana, Uruguay vs ECB, Sweden
Legal Readiness	Often lacking, developing post-launch	Emphasis on pre-launch legislative framework	ECB, UK conducting legal consultation phases
Public Communication	Varies (low in Nigeria, high in EU)	Strong focus on stakeholder involvement	ECB, BoE public consultations; Bahamas public education

Source: Author's synthesis based on data from selected central bank reports (e.g., PboC 2022, Riksbank 2020, ECB (2023) and IMF (2023))

Global development of central bank digital currencies (CBDCs) shows two broad directions: a diverse, experimentation-driven approach across the world and a more structured, regulation-focused approach in Europe. Most countries concentrate on retail CBDCs, while only a few explore wholesale versions. Europe follows this same pattern, with the digital euro conceived primarily as a retail instrument, complemented by a small number of wholesale experiments in countries such as France and Switzerland.

A key feature of nearly all CBDC projects is the two-tier or hybrid model, in which the central bank issues the digital currency but does not interact directly with users. Instead, commercial banks and licensed payment providers operate digital wallets, perform customer verification and provide payment services. This arrangement allows the central bank to preserve monetary control while relying on existing financial infrastructure and avoiding disruption to the banking system. It also enables a competitive ecosystem of wallet providers, supporting innovation without centralizing operational responsibilities.

Technologically, many global pilots deploy Distributed Ledger Technology (DLT). Distributed Ledger Technology (DLT) is a method of record-keeping in which data is stored simultaneously across many connected computers rather than in a single central database. This creates a system where all participants share the same information and any change must be collectively verified, increasing security and reducing the risk of manipulation. DLT enables faster and more reliable transaction processing and makes the system more resilient to technical or operational failures. Europe engages with DLT more cautiously, testing its potential while prioritizing privacy, security, programmability and offline functionality for the digital euro.

Motivations for CBDC adoption likewise diverge: countries in the Global South often seek to expand financial inclusion, while European authorities focus on strategic autonomy, system resilience and regulatory clarity. Correspondingly, Europe invests heavily in pre-launch legal frameworks and extensive public communication, contrasting with more variable communication strategies found elsewhere.

In summary, although global CBDC experiments are varied and technologically adaptive, Europe pursues a structured, privacy-oriented model grounded in the two-tier distribution system and carefully evaluated technological choices such as private DLT and secure mobile-based wallets.

3.2. Bosnia and Herzegovina: A Brief Overview

Bosnia and Herzegovina is examined within the same comparative framework applied to other jurisdictions in order to ensure analytical consistency and comparability of findings. In this context, the potential introduction of a central bank digital currency would primarily aim to enhance cross-border payment efficiency and strengthen integration with European financial systems, particularly in light of developments related to the digital euro. The most feasible approach would involve a two-tier retail model, in which the central bank issues the digital form of sovereign money, while intermediaries such as commercial banks and licensed payment providers facilitate distribution and user access.

From a technological standpoint, such an arrangement would likely rely on mobile-based solutions, supported by a high degree of interoperability to ensure compatibility with international payment infrastructures. Expected benefits include faster and more cost-effective remittance flows, along with broader improvements in payment system efficiency as well as accessibility. At the same time, these developments could contribute to the gradual modernization of the financial sector and support greater participation in formal financial services.

However, several structural and behavioral constraints may limit the effectiveness of such an initiative.

These include the population's strong preference for cash in everyday transactions, relatively low levels of trust in digital financial instruments, and potential implications for financial stability arising from shifts in deposit allocation. As a non-euro area economy with close economic ties to the European Union, Bosnia and Herzegovina would benefit from improved cross-border transactions and regulatory alignment with European standards. Nevertheless, challenges related to cybersecurity, data protection and the potential impact on bank intermediation remain significant. Impact on bank intermediation refers to the potential shift of deposits from commercial banks to central bank digital currency accounts, as households and firms may prefer holding risk-free central bank liabilities. This reallocation can reduce banks' funding base, increasing their reliance on more expensive or volatile sources of financing. As a result, banks may face constraints in credit creation, which could weaken their traditional role in financial intermediation and affect overall lending to the real economy. The magnitude of this impact depends on CBDC design features, such as holding limits, remuneration policies and the role assigned to intermediaries.

Consequently, adoption is likely to be gradual and concentrated in specific use cases, particularly international transfers and business-related payments, while cash would continue to play a dominant role in daily economic activity.

4. RESULTS AND DISCUSSION

The comparative analysis of CBDCs initiatives demonstrates significant variation in strategic objectives, implementation models and policy frameworks across jurisdictions. Emerging economies (e.g., Nigeria, Bahamas, Ghana, Uruguay) tend to prioritize financial inclusion and improved access to payment infrastructures, whereas advanced economies (e.g., European Union, Sweden, Switzerland) emphasize resilience, monetary sovereignty and innovation within established financial systems. This prioritization is based on the level of development of these countries, demonstrating that the implemented model should be tailored to the specific characteristics of each country.

Implementation models also reveal a global divergence. Many countries adopt two-tier structures, where central

banks issue CBDCs through intermediaries such as commercial banks and payment service providers, to mitigate risks of disintermediation and operational overload. Conversely, selected pilots (e.g., Uruguay's e-Peso, Bahamas' Sand Dollar) experimented with direct issuance, showing benefits for inclusion but also scalability and infrastructure constraints.

Technological choices are similarly diverse. While several global South initiatives rely on mobile-based wallet solutions to address inclusion gaps, European pilots emphasize DLT and privacy-preserving programmable features. This contrast underscores different policy priorities: accessibility and adoption in developing contexts versus trust, privacy and stability in advanced jurisdictions.

The comparative synthesis yields three principal clusters of findings. First, with respect to monetary policy implications, CBDCs demonstrate considerable potential to enhance the transmission of monetary policy by enabling real-time monitoring and management of money flows. Empirical evidence from China's e-CNY and India's digital rupee pilots suggests improvements in transparency and transaction speed; however, these advances are tempered by concerns over financial volatility and the potential for destabilizing liquidity shocks.

Second, regarding financial inclusion and payment efficiency, experiences in the Bahamas, Nigeria and Uruguay underscore CBDCs' capacity to broaden access for previously unbanked populations by reducing transaction costs and promoting the widespread use of mobile wallets. In contrast, the primary rationale within advanced economies such as the EU and Sweden is not inclusivity but rather payment system modernization, efficiency gains and preparedness for a predominantly cashless society.

Third, in terms of operational and regulatory challenges, the analysis reveals cross-cutting risks across jurisdictions, notably cybersecurity vulnerabilities, threats to data privacy and the potential disintermediation of the banking sector. European initiatives exhibit a greater degree of legal and regulatory preparedness, as reflected in the ECB's legislative proposals and the UK's consultative processes. By comparison, many pilots in the Global South have advanced without fully developed legal frameworks, thereby generating uncertainties concerning long-term scalability, systemic integration and institutional resilience.

The results suggest that CBDCs are not a monolithic policy instrument but a context-dependent innovation shaped by distinct socio-economic priorities. For the global South, CBDCs represent a tool for financial democratization, extending digital payment access and supporting development agendas. However, adoption has been uneven, constrained by infrastructure, public trust and digital literacy gaps.

In contrast, European and advanced economy approaches frame CBDCs as a means of safeguarding monetary sovereignty, enhancing systemic resilience and preparing for a cashless society. This orientation demands strong legal frameworks and an emphasis on privacy-by-design, reflecting political sensitivities about state surveillance.

A central dilemma cutting across cases is the balance between innovation and stability. While CBDCs can enhance transparency, efficiency and inclusion, they simultaneously raise risks of bank disintermediation, cybersecurity breaches and erosion of privacy. These trade-offs underline the necessity of robust regulatory coordination at both national and international levels.

5. CONCLUSION

The digital transformation of public money driven by central bank digital currencies (CBDCs) represents a structural shift in the architecture of monetary systems. This study has shown that the impact of CBDCs is multidimensional, primarily manifesting through improvements in payment system efficiency, the strengthening of monetary policy transmission mechanisms and the potential expansion of financial inclusion. Comparative evidence across jurisdictions confirms that these effects are neither uniform nor automatic, but contingent on specific design and policy choices.

The findings indicate that CBDCs can significantly reduce transaction costs and increase payment speed, particularly in cross-border contexts, while also enhancing transparency and control within monetary policy frameworks. At the same time, their role in advancing financial inclusion is more pronounced in emerging economies, whereas in advanced economies the emphasis shifts toward system resilience, monetary sovereignty and innovation. These results underscore that CBDCs are not a homogeneous instrument, but a context-dependent policy tool shaped by differing socio-economic priorities and institutional environments.

However, the analysis also highlights a set of persistent trade-offs. Gains in efficiency and control are accompanied by risks related to cybersecurity, data privacy and the potential disintermediation of the banking sector. In particular, shifts in deposit allocation toward central bank liabilities may weaken banks' intermediation capacity and affect credit provision, thereby introducing new dimensions of financial stability risk. These challenges point to the necessity of carefully calibrated design features, including intermediated distribution models, holding limits and robust regulatory frameworks.

Despite the absence of a universal implementation model, certain convergences are evident across jurisdictions, notably the predominance of two-tier architectures, ongoing experimentation with distributed ledger technologies and an increasing emphasis on

privacy-preserving design. These elements suggest the gradual emergence of global standards, albeit adapted to national contexts and policy objectives.

In the case of Bosnia and Herzegovina, the analysis suggests that a gradual and intermediated introduction of a retail CBDC represents the most feasible pathway. Given the country's currency board arrangement, strong reliance on cash and close economic integration with the European Union, the primary benefits would arise from improved cross-border payment efficiency and alignment with European financial infrastructures. Policy priorities should therefore focus on targeted use cases, particularly international transactions and public-sector payments, where efficiency gains are most evident and adoption barriers relatively low.

Overall, while CBDCs present substantial opportunities for modernizing public money, their successful implementation depends on balancing innovation with financial stability. For policymakers, the central challenge lies not in whether to adopt CBDCs, but in how to design them in a way that aligns with national economic structures while addressing the broader risks inherent in the digital transformation of monetary systems.

REFERENCES

1. Adrian, T., & Mancini-Griffoli, T. (2021). *A new era of digital money*. International Monetary Fund. https://www.imf.org/external/pubs/ft/fandd/2021/06/online/digital-money-new-era-adrian-mancini-griffoli.htm
2. Agur, I., Ari, A., & Dell'Ariccia, G. (2022). Central bank digital currencies: The implications for monetary policy. *Journal of Economic Perspectives, 36*(4), 123–144. https://doi.org/10.1016/j.jmoneco.2021.05.002
3. Allen, S., et al. (2020). *Design choices for central bank digital currency: Policy and technical considerations*. Bank of Canada. DOI 10.3386/w27634 https://www.nber.org/papers/w27634
4. Armelius, H., Guibourg, G., Levin, A. T. & Söderberg, G. (2020). *The rationale for issuing e-krona in the digital era.* Sveriges Riksbank Economic Review, 2020:2, pp. 6-18. https://www.riksbank.se/globalassets/media/rapporter/pov/artiklar/engelska/2020/200618/2020_2-the-rationale-for-issuing-e-krona-in-the-digital-era.pdf
5. Auer, R., & Böhme, R. (2020). The technology of retail central bank digital currency. *BIS Quarterly Review*. https://www.bis.org/publ/qtrpdf/r_qt2003j.pdf
6. Auer, R., Cornelli, G., & Frost, J. (2020). *Rise of central bank digital currencies: Drivers, approaches and technologies* (BIS Working Papers No. 880). https://www.bis.org/publ/work880.htm
7. Bank for International Settlements. (2020). *Central bank digital currencies: Foundational principles and core features* (Other Papers No. 33). bis.org/publ/othp33.pdf
8. Bank for International Settlements. (2021). *CBDCs: System design and interoperability*. https://www.bis.org/publ/othp42.htm
9. Barontini, C., & Holden, H. (2019). *Proceeding with caution: A survey on central bank digital currency* (BIS Papers No. 101). https://www.bis.org/publ/bppdf/bispap101.pdf
10. Bergara, M., & Ponce, J. (2018). Central Bank Digital Currency: Uruguay's e-Peso project. Do We Need Central Bank Digital Currency? Economics, Technology and Institutions. https://iris.unibocconi.it/bitstream/11565/4014058/1/Masciandaro%20SUERF%20book%20+%20SUERF%20book%20chapter.pdf
11. Bindseil, U. (2020). *Tiered CBDC and the financial system* (ECB Working Paper No. 2351). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3513422
12. Bindseil, U., & Panetta, F. (2020). *Central bank digital currency remuneration in a world with low or negative nominal interest rates* (ECB Occasional Paper No. 247). https://cepr.org/voxeu/columns/central-bank-digital-currency-remuneration-world-low-or-negative-nominal-interest
13. Bordo, M., & Levin, A. (2017). *Central bank digital currency and the future of monetary policy* (NBER Working Paper No. 23711). https://doi.org/10.3386/w23711
14. Bossu, W., et al. (2020). *Legal aspects of central bank digital currency: Central bank and monetary law considerations* (IMF Working Paper No. 2020/242). https://www.imf.org/en/publications/wp/issues/2020/11/20/legal-aspects-of-central-bank-digital-currency-central-bank-and-monetary-law-considerations-49827
15. Brunnermeier, M., & Niepelt, D. (2019). On the equivalence of private and public money. *Journal of Monetary Economics, 106*, 27–41. https://www.sciencedirect.com/science/article/abs/pii/S0304393219301229
16. Carstens, A. (2021). *Digital currencies and the future monetary system*. Bank for International Settlements. https://www.bis.org/speeches/sp210127.htm
17. Chaum, D., Grothoff, C., & Moser, T. (2021). *How to issue a central bank digital currency* (SNB Working Paper No. 3/2021). https://www.snb.ch/en/mmr/papers/id/working_paper_2021_03
18. Chapman, J., et al. (2020). *Token-based central bank digital currencies*. Bank of Canada. https://www.bankofcanada.ca/wp-content/uploads/2023/02/sdp2023-4.pdf
19. Demirgüç-Kunt, A., et al. (2022). *Global Findex Database 2021: Financial inclusion, digital payments and resilience*. World Bank.

https://www.researchgate.net/publication/362424422_The_Global_Findex_Database_2021_Financial_Inclusion_Digital_Payments_and_Resilience_in_the_Age_of_COVID-19
20. Dyson, B., & Hodgson, G. (2017). *Digital cash: Why central banks should start issuing electronic money*. Positive Money. https://positivemoney.org/publications/digital-cash/
21. European Central Bank. (2020). *Report on a digital euro*. https://www.ecb.europa.eu/pub/pdf/other/Report_on_a_digital_euro~4d7268b458.en.pdf
22. European Central Bank. (2020). *Exploring anonymity in central bank digital currencies* (ECB Occasional Paper No. 236). https://www.ecb.europa.eu/press/intro/publications/pdf/ecb.mipinfocus191217.en.pdf
23. European Central Bank. (2023). *Digital euro project – Legislative proposal*. https://www.ecb.europa.eu/paym/digital_euro/html/index.en.html
24. Engert, W., & Fung, B. (2020). *Central bank digital currency: Motivations and implications*. Bank of Canada. https://www.bankofcanada.ca/wp-content/uploads/2017/11/sdp2017-16.pdf
25. Fan, Y. (2022). China's digital yuan: A case study in retail CBDC implementation. *Journal of Payments Strategy & Systems.* https://www.imf.org/en/-/media/files/news/seminars/2022/sti-digital-money/china/6-hans-fan.pdf
26. Fernández-Villaverde, J., Sanches, D., Schilling, L., & Uhlig, H. (2021). Central bank digital currency: Central banking for all? *Review of Economic Dynamics, 41*, 225–242. https://doi.org/10.1016/j.red.2020.12.004
27. Garratt, R., & van Oordt, M. (2021). *Privacy and CBDC design* (Bank of Canada Staff Working Paper No. 2021-30). https://businessdatascience.nl/publication/167492/privacy-as-a-public-good-a-case-for-electronic-cash
28. Gertler, M., & Karadi, P. (2023). *Monetary policy transmission in the age of digital currency* (NBER Working Paper No. 31005). https://www.nber.org/system/files/working_papers/w31005/w31005.pdf
29. Ghosh, S., & Sharma, A. (2021). *CBDCs and financial inclusion*. https://papers.ssrn.com/sol3/Papers.cfm?abstract_id=3599475
30. International Monetary Fund. (2022). Kahn, C., Singh, M., & Alwazir, J. *Digital money and central bank operations* (IMF Working Paper No. 22/85). https://www.imf.org/en/-/media/files/publications/wp/2022/english/wpiea2022085-print-pdf.pdf
31. International Monetary Fund. (2023). *Central bank digital currency global developments report*. https://www.imf.org/en/Publications/fintech-notes
32. Keister, T., & Sanches, D. (2022). Should central banks issue digital currency? *Review of Economic Studies, 89*(5), 2524–2556. https://academic.oup.com/restud/article-abstract/90/1/404/6561552
33. Kiff, J., et al. (2020). *A survey of research on retail central bank digital currency* (IMF Working Paper No. 2020/104). https://www.imf.org/en/publications/wp/issues/2020/06/26/a-survey-of-research-on-retail-central-bank-digital-currency-49517
34. Kumhof, M., & Noone, C. (2018). *Central bank digital currencies: Design principles and balance sheet implications* (Bank of England Staff Working Paper No. 725). https://doi.org/10.2139/ssrn.3180713
35. Lagarde, C. (2021). *The future of money*. European Central Bank. https://www.ecb.europa.eu/press/inter/date/2020/html/ecb.in201130~ce64cb35a3.en.html
36. Mancini-Griffoli, T., et al. (2018). *Casting light on central bank digital currency* (IMF Staff Discussion Note No. 18/08). https://www.imf.org/en/publications/staff-discussion-notes/issues/2018/11/13/casting-light-on-central-bank-digital-currencies-46233
37. Niepelt, D. (2020). Monetary policy with CBDC. https://cepr.org/publications/dp15457
38. Opare, E. A. and Kim,K. (2020). A Compendium of Practices for Central Bank Digital Currencies for Multinational Financial Infrastructures. *IEEE Access*, vol. 8, pp. 110810-110847, DOI: 10.1109/ACCESS.2020.3001970
39. Ozili, P. (2022). Digital Financial Inclusion. DOI: 10.1108/978-1-80262-605-620221015.
40. People Bank of China. (2022). https://www.boc.cn/en/
41. Reslow, A., Söderberg, G., & Tsuda, N. (2024). *Cross-border payments with retail central bank digital currencies: Design and policy considerations* (Fintech Notes No. 2024/002). International Monetary Fund. https://doi.org/10.5089/9798400272035.063
42. Sveriges Riksbank. (2020). *E-krona pilot report*. https://www.riksbank.se/en-gb/payments--cash/e-krona/
43. Armelius, H., Guibourg, G., Levin, A. T. & Söderberg, G. (2020). *The rationale for issuing e-krona in the digital era.* Sveriges Riksbank Economic Review, 2020:2, pp. 6-18. https://www.riksbank.se/globalassets/media/rapporter/pov/artiklar/engelska/2020/200618/2020_2-the-rationale-for-issuing-e-krona-in-the-digital-era.pdf
44. World Bank. (2021). *Central bank digital currencies for cross-border payments: A roadmap*. https://documents1.worldbank.org/curated/en/369001638871862939/pdf/Central-Bank-Digital-Currencies-for-Cross-border-Payments-A-Review-of-Current-Experiments-and-Ideas.pdf