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Digital Public Money and the State: Institutional and Policy Implications of Central Bank Digital Currencies

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Abstract: The digitalisation of sovereign money through Central Bank Digital Currencies (CBDCs) has become a critical issue for contemporary public finance systems and monetary governance. This study investigates the transformative potential of CBDCs as a specific form of digital public money, positioning them within the analytical framework of public finance rather than considering them merely as technological advances. The research employs a qualitative comparative analysis of central bank reports, legislative initiatives, and policy documents across nine advanced and developing economies in pilot or advanced testing phases, selected for their institutional diversity and relevance to public payment systems, financial inclusion, and legal preparedness. The findings reveal a persistent and significant gap between formal CBDC adoption and actual usage. The Bahamas reports 25% population coverage but only 1% active transactions; China's e-CNY has achieved 8% adoption, yet merely 0.16% sustained daily use; Nigeria's eNaira, despite strong political support, has reached only 0.5% adoption with 1.5% active usage. Analysis of five implemented pilots (eNaira, Sand Dollar, JAM-DEX, e-CNY, DCash) demonstrates consistent underperformance against stated policy objectives, with low institutional trust, strong private sector alternatives, and insufficient digital infrastructure identified as primary constraints. The study categorises five critical risk factors affecting developing economies (infrastructure, adoption, governance, cybersecurity,

fiscal over-expectations) compared to three for advanced economies (disintermediation, privacy, marginal benefit). At the same time, the results indicate that CBDCs have the potential to strengthen public payment systems, enhance the effectiveness of monetary policy, and promote financial inclusion, particularly in regions with declining cash usage or limited access to banking services. The findings also reveal potential risks to financial privacy, cybersecurity, and the banking sector's disintermediation that warrant careful policy consideration. The originality of this research lies in its systematic, empirical quantification of the adoption-usage gap across multiple CBDC implementations and in its integration of digital currencies into public finance theory. The practical significance is to provide evidence-based insights for central banks and policymakers designing future monetary systems, demonstrating that successful CBDC implementation requires institutional readiness and policy coherence, not technological sophistication alone.

Keywords: public money, monetary governance, digitalization, payment systems, public finance, state monetary authority.

Introduction

The progressive digitalisation of financial systems has intensified policy discussions regarding the future of public money and the evolving responsibilities of the state in monetary governance. Within this framework, central bank digital currencies (CBDCs) have emerged as a pivotal topic in both academic and policy discussions, as they represent a digital variant of sovereign money issued and guaranteed by the state (Auer et al., 2020). International financial institutions increasingly conceptualise CBDCs not solely as technological advancements but as instruments with significant impact on public finance, payment infrastructure, and monetary sovereignty (Kahn et al., 2022; World Bank, 2021).

A wide range of recent literature focuses on the potential of CBDCs to structurally change public payment systems by enhancing transaction efficiency, lowering costs and making secure payment instruments accessible (Adrian & Mancini-Griffoli, 2021; Auer & Böhme, 2020). These prospective advantages are particularly evident in economies experiencing a decline in cash usage or enduring financial exclusion, where the state-issued digital currency presents a mechanism to maintain equal access to public funds (Fan, 2025; Sveriges Riksbank, 2020).

Scholars caution that the introduction of CBDCs poses complex institutional and regulatory challenges, including risks associated with the disintermediation of the banking sector and vulnerabilities in cybersecurity and the safeguarding of financial privacy (Bindseil, 2020; Chaum, Grothoff, & Moser, 2021; Kiff et al., 2020).

Looking from a public policy standpoint, the significance of analysing CBDCs has notably increased in recent years due to the rapid development of pilot projects and legislative efforts across various regions. Since the beginning of the 2020s, more than 100 central banks have begun researching or experimenting with digital currencies. The reason for such accelerated interest is growing concerns about the increasing influence of private digital payment platforms and the potential decline of state control over monetary systems (Bank for International Settlements, 2021; European Central Bank, 2019). This worldwide trend highlights the necessity of evaluating how CBDCs might alter the institutional principles of public money and define the dynamics among the government, financial intermediaries, and market participants.

Despite the rapidly growing body of literature, significant analytical gaps persist. While numerous studies focus on the technical design and operational aspects of CBDCs, relatively few thoroughly investigate their wider institutional and economic implications. Consequently, the long-term effects of CBDC adoption on monetary policy transmission, fiscal governance and public trust remain insufficiently understood. Furthermore, existing scholarship frequently regards CBDCs predominantly as monetary instruments, while affording insufficient consideration to their function as legally established forms of public money within state institutions.

In light of this context, the objective of this research is to investigate CBDCs as instruments of digital public money and to analyse their institutional and policy influence on state monetary governance. The research emphasises how various CBDC design and implementation models affect the efficiency of public payment systems and financial stability across a range of institutional settings. By employing a qualitative comparative methodology grounded in central bank reports, legislative initiatives and policy documents, the study aims to deliver a structured evaluation of emerging CBDC frameworks in both developing and advanced economies.

The originality of this study resides in its deliberate incorporation of CBDCs into the analytical framework of public finance and state authority, rather than merely considering them as technological or operational advancements. In observing CBDC as an extended instrument of sovereign public money in digital form, this paper improves understanding of the evolving role of the state in money management in the digital age. It provides policy-relevant insights for central banks and public authorities involved in designing future monetary systems.

Research Problem

Modern global monetary systems are undergoing rapid digitalisation, while a significant number of central banks are progressing toward the introduction of digital currencies, with some already in the advanced testing phase. At this critical moment, the analysis of central bank digital currencies is particularly important. At the same time, the influence of private digital payment platforms and crypto-assets is growing, potentially threatening states' monetary sovereignty and the safety of public money. These circumstances make it necessary to consider CBDCs promptly, both institutionally and politically, before widespread implementation, to avoid long-term systemic failures.

The research contributes to society by better understanding how CBDCs can: (i) improve the efficiency and resilience of public payment systems; (ii) increase financial inclusion, especially in countries with limited access to banking services; (iii) improve the transparency and efficiency of public payments (e.g. social transfers); (iv) preserve citizens' right to access public money in conditions of decreasing use of cash, etc. On the other hand, the research warns of potential societal risks related to privacy protection, surveillance and public trust, thereby contributing to a more informed public and political dialogue.

The paper contributes to the science by positioning central bank digital currencies as instruments of public finance and state monetary authority, rather than exclusively as a technological innovation in monetary systems. The research integrates theoretical and analytical approaches to institutional analysis in monetary economics and public finance, thereby enabling a more comprehensive view of the role of CBDC in contemporary market conditions. In this way, it fills a gap in the existing literature, in which the fiscal and institutional implications of CBDCs are often marginalised or analysed only partially. The paper develops a comparative analytical framework that enables systematic comparison of different national CBDC models,

accounting for differences in institutional structures and levels of economic development. This significantly expands the theoretical framework for understanding digital public money and its role in contemporary states.

The observed issue has been developed to some extent in recent literature, but remains insufficiently addressed. There is a significant body of studies on the technical design of CBDCs, their operational aspects, and monetary transmission. However, there is a lack of systematic analysis of CBDCs from a public finance and state role perspective, especially in a comparative context across different levels of economic development. Therefore, this research field is still developing, allowing for the potential for novel scientific contributions.

This study provides a deeper understanding of CBDC as a digital form of sovereign public money, firmly rooted in the state's institutional framework and its main policy goals. By analysing different national experiences and implementation models, the paper identifies key conditions that influence the success or failure of CBDC introductions, indicating that technological solutions alone are insufficient for their sustainable implementation. The research also provides insight into the differences between developed and developing countries in terms of the goals, expected benefits, risks and actual effects of CBDCs. The importance of the context in which these currencies are introduced is highlighted. It provides a clearer understanding of the relationship between technological innovation and state responsibility in the monetary system, particularly in preserving monetary stability and public trust. These insights represent a solid basis for future empirical research and for shaping public policies in the field of digital public money.

Research Focus

Based on the research problem, the research focus is on understanding institutional and public policy implications of CBDC on the modern state. The main purpose of the study is to view CBDCs not primarily as a technological innovation in payment systems, but as an instrument of state monetary authority that has the potential to reshape the relationships between the central bank, the state, the financial sector and citizens.

The author's scientific focus is on examining how the introduction of CBDCs affects the institutional framework of the monetary system, including the role of the central bank, the fiscal capacity of the state and public governance mechanisms. Special attention is paid to the analysis of the public policy objectives associated with CBDCs, such as preserving monetary sovereignty, promoting financial inclusion, improving the efficiency of public payments, and strengthening the resilience of the financial system, as well as to potential risks related to privacy, supervision, and public trust.

The research also examines comparative approaches to CBDC development across different national contexts to identify fundamental institutional factors that shape the design and effects of digital public money. In this way, the paper seeks to contribute to the theoretical and analytical understanding of CBDC as a structural change in modern monetary systems, rather than as an isolated technological solution.

Research Aim and Research Questions

This research aims to examine the impact of CBDCs on the future institutional and political direction of public money management. The main objective is to assess how different CBDC design and implementation models can affect financial inclusion, the efficiency of public payment systems, monetary policy, and financial stability across different institutional and economic environments.

In line with the problems identified in the introduction and the gaps observed in the existing literature, the research addresses the following questions:

1. How do central bank digital currencies redefine the concept of public money and the role of the state in monetary governance in the digital era?
2. How do different CBDC design solutions (retail and wholesale models, two-tier distribution system) affect the efficiency of public payment systems and financial stability?
3. What are the main obstacles to CBDC adoption in emerging economies?

Literature Review

The academic discourse on central bank digital currencies (CBDCs) has grown significantly over the last decade, underscoring their increasing importance for monetary governance and the fundamental aspects of money. Initial studies primarily characterised CBDCs as technical or operational advancements intended to modernise payment systems. However, contemporary research increasingly contextualises CBDCs within broader discussions of public money, state authority, and the governance of digital financial infrastructure. These studies highlight their function as state-backed monetary and public instruments, rather than simply as technological payment alternatives (Bordo & Levin, 2017; Mancini-Griffoli et al., 2018; Bank for International Settlements, 2021).

A considerable body of research examines the impact of CBDCs on the efficiency of payment systems and on the transmission of monetary policy. Studies indicate that by offering a universally accessible digital liability of the central bank, CBDCs have the potential to enhance transaction speed, lower costs, and strengthen the efficacy of monetary policy tools (Adrian & Mancini-Griffoli, 2021; Auer & Böhme, 2020). Empirical findings from pilot initiatives, such as China's digital yuan and Sweden's e-krona, suggest that state-issued digital currencies can strengthen the resilience of public payment infrastructure, especially in economies experiencing a decline in cash usage (Armelius et al., 2020; Fan, 2025).

At the same time, the literature cautions that the macroeconomic effects of CBDCs depend critically on their design features, such as remuneration, holding limits and distribution models, which influence their interaction with commercial bank deposits (Bindseil, 2020; Kumhof & Noone, 2018). According to Davlatov and Sági in their 2025 study, a thoughtfully designed CBDC has the potential to enhance the transmission of monetary policy, particularly through interest rates, by promoting financial inclusion and enabling a more direct flow of policy changes. The credit channel may change, but it does not necessarily weaken. CBDC affects banks' balance sheets, funding sources, and interest margins; however, a well-designed CBDC need not lead to significant bank disintermediation. A poor CBDC design may increase inflationary pressures and financial stability risks, particularly via bank disintermediation.

Another major strand of the literature focuses on the institutional and regulatory dimensions of CBDC implementation. Researchers underscore that CBDCs pose challenges to existing legal and regulatory frameworks by blurring the distinction between public and private roles in the payment system. From this point of view, the introduction of digital public money requires the establishment of strong legal frameworks that clearly define the rights and responsibilities of users, intermediaries and monetary authorities (Bossu et al., 2020; Bank for International Settlements, 2021). Comparative policy analyses indicate a growing trend towards intermediated, two-tier models in which central banks retain issuance authority while relying on regulated financial institutions for customer-facing operations. This approach effectively mitigates operational risks and enhances financial stability (Adrian & Mancini-Griffoli, 2021; Bindseil & Panetta, 2020).

Financial inclusion has emerged as one of the main policy goals, particularly in developing and emerging economies, where substantial portions of the population remain marginalised from formal financial systems. CBDCs have the potential to improve access to formal financial services by providing low-cost, widely available digital payment solutions for unbanked and underbanked populations. This is specifically relevant in regions with insufficient banking infrastructure or high transaction costs. The geographic barriers also affect access to finance (Barontini & Holden, 2019; Ozili, 2022). By facilitating direct access to central bank digital currencies (CBDCs) via mobile devices or simplified digital wallets, CBDCs have the potential to reduce dependence on financial intermediaries and cash. This also reduces barriers to participation in the formal economy. Driven by dynamic public communication strategies, user-centric technological innovations, and strong institutional support, as demonstrated by empirical evidence from early adopters (Bahamas, Nigeria, and Uruguay), CBDCs have the capacity to improve financial inclusion.

These case studies highlight the importance of trust in public institutions, digital and financial literacy and the availability of reliable digital infrastructure in shaping adoption outcomes (Kahn et al., 2022; Opare & Kim, 2020). However, adoption rates have varied significantly across demographic groups, indicating that CBDCs alone are not enough to tackle structural exclusion. Recent studies emphasise that, in the absence of supportive measures such as investments in connectivity, consumer protection strategies, and educational programs, the inclusive promise of CBDCs could fall short, particularly for the most vulnerable communities (Demirgüç-Kunt et al., 2022).

In addition to these potential advantages, the literature consistently highlights significant risks associated with CBDC adoption, particularly for financial stability and banking system architecture. A primary concern is the risk of disintermediation in the banking sector, as the availability of a broadly accessible, risk-free central bank liability may encourage households and businesses to withdraw deposits from commercial banks. Various theoretical models caution that such a shift could undermine banks' stable funding sources, heighten their dependence on wholesale funding and ultimately restrict credit availability to the real economy, especially during times of financial distress or increased uncertainty (Fernández-Villaverde et al., 2021; Niepelt, 2020). In extreme cases, the swift conversion of bank deposits into CBDCs could intensify bank runs, thereby increasing systemic risk rather than alleviating it.

To tackle these concerns, much of the literature highlights the importance of robust institutional and design-based safeguards when implementing CBDCs. Proposed mechanisms include tiered remuneration structures that render CBDCs less attractive as large-scale stores of value, quantitative holding or transaction limits to prevent excessive substitution and gradual or phased implementation strategies that allow financial institutions and markets to adjust over time (Agur et al., 2022; Bindseil, 2020). Recent contributions emphasise the importance of supplementary regulatory measures and central bank backstop facilities in sustaining financial intermediation. They suggest that the influence of CBDCs on financial stability will ultimately hinge not only on their technological characteristics but also on the overarching monetary and supervisory framework in which they operate.

Operational and governance challenges emerge as a significant theme in the literature. The importance of cybersecurity risks and system resilience cannot be overstated; they are essential for ensuring the credibility of digital public money. Given the potential systemic effects cyberattacks or technological failures could have on state-issued digital currencies, this is especially important (Kiff et al., 2020; Lagarde, 2020). Closely related to these concerns are debates on data protection and financial privacy. Researchers have raised significant concerns about the potential for CBDCs to enhance the state's surveillance capabilities. This

development prompts critical inquiries into the implications for civil liberties and public trust, especially if privacy protections are not sufficiently strong or effective (Allen et al., 2020; Chaum, Grothoff, & Moser, 2021). In light of these concerns, recent policy-focused studies have highlighted the necessity of implementing privacy strategies. Such approaches aim to strike a careful balance between the need for regulatory oversight and the imperative to safeguard individual rights (ECB, 2020).

Despite the extensive body of existing research on this topic, several important analytical gaps persist. While the current literature offers in-depth insights into the technical aspects of CBDC design and their immediate policy implications, there is a noticeable lack of studies that take a more holistic view from a public finance perspective. Specifically, fewer analyses conceptualise CBDCs as an extension of sovereign public money, inherently linked to state institutions. This oversight is particularly evident when considering the long-term consequences of CBDC adoption on fiscal governance, the authority of state monetary policy and the principles of democratic accountability, all of which remain inadequately explored in the current discourse (Infante et al., 2024; OECD, 2023; Umar, 2025). Moreover, comparative analyses often focus on individual case studies without systematically integrating differences in institutional and legal frameworks or policy objectives across countries.

This study makes a significant contribution to the current literature, specifically defining CBDCs as instruments of digital public money and examining their institutional and political implications across a variety of national settings to address these recognised gaps. By synthesising insights from public finance, monetary economics, and institutional analysis, the paper aims to enhance understanding of how state-issued digital money may transform the governance of monetary systems in the contemporary digital era.

Materials and Methods

The qualitative research design used in this study relies on a methodical examination and comparative analysis based on secondary sources. The methodological approach is suitable given the study's conceptual and policy-focused nature, which prioritises the institutional and financial impacts of central bank digital currencies over basic empirical measurement. The analysis relies on academic literature, legislative documents, national authority policy reports, central bank publications and international financial institution publications.

The systematic identification and selection of relevant sources, primarily from the previous five years, was used to gather data, which guaranteed compatibility with ongoing scientific and political discussions on digital public money. Priority was given to peer-reviewed academic articles, official reports of central banks, and publications by international organisations such as the Bank for International Settlements (2021; 2022; 2023), the International Monetary Fund (2023; 2024), and the European Central Bank (2019; 2020). These sources were selected for their analytical relevance to CBDC design, implementation frameworks, and policy implications for monetary governance, public payment systems, and financial stability.

The analytical strategy combines thematic analysis with cross-country comparative assessment. Key analytical themes, including monetary policy transmission, public payment system efficiency, financial inclusion, legal and institutional frameworks and governance risks, were identified and examined across the selected materials. These themes were then compared across national and institutional contexts, encompassing both advanced and developing economies, to identify common patterns, divergences, and context-specific challenges in CBDC implementation.

Country cases included in the comparative analysis were selected according to three criteria: (i) the stage of CBDC development, with a focus on pilot or advanced testing phases; (ii) institutional and economic diversity, capturing differences between advanced economies and emerging or developing countries; and (iii) relevance for public finance and state capacity, particularly with respect to public payment systems, financial inclusion and legal preparedness. This approach avoids overgeneralizing across diverse monetary systems while still enabling meaningful comparisons.

The study method is fully documented and based solely on publicly available sources to ensure methodological openness and replicability. The research is replicable by other researchers using the same materials and methodology, as all analytical procedures are clearly outlined, from topic coding and source selection to comparative synthesis. Despite the qualitative character of the research, which excludes statistical estimation, the framework provides a uniform, repeatable foundation for institutional and policy analysis of central bank digital currencies.

Cross-Country Comparison

To highlight similarities and differences in policy goals, institutional structures, and implementation methods, this section offers a comparative analysis of central bank digital currency programs across a number of jurisdictions. Instead of viewing CBDC initiatives as uniform technological experiments, the analysis situates them within broader national structures of public financial governance and state monetary authority. Reflecting the qualitative comparative methodology described in the preceding section, the comparison draws on official central bank publications, policy papers, and publicly accessible statistics.

National CBDC Initiatives: A Comparative Overview

The initial phase of the analysis provides a descriptive assessment of CBDC projects across various nations at various stages of development. By comparing advanced economies, emerging markets and developing nations, it is possible to pinpoint the institutional limits and policy drivers unique to each context. As shown in Table 1, jurisdictions vary considerably in the objectives pursued through CBDC projects, the implementation models adopted, and the outcomes observed to date.

Table 1

The selected national CBDC projects' major features

Country	CBDC Name / Status	Main Objectives	Implementation Model	Outcomes	Key Challenges
China (PBoC)	Digital Yuan (e-CNY) - Advanced pilot	Payment efficiency and monetary control	Two-tier retail model	Large-scale pilot usage	Privacy and surveillance concerns
Sweden (Riksbank)	e-Krona - Pilot	Cashless resilience	Intermediated retail	Positive technical tests	Legal and political uncertainty
European Union (ECB)	Digital Euro - Design phase	Monetary sovereignty and privacy	Retail, intermediated	Legislative proposal	Regulatory harmonisation
United Kingdom (BoE)	Digital Pound - Consultation	Innovation and competitiveness	Intermediated retail	Public consultation	Public trust

Bahamas	Sand Dollar - Live	Financial inclusion	Retail via wallets	Improved access	Infrastructure constraints
Nigeria	e-Naira - Live	Financial inclusion and payments modernization	Central bank - bank hybrid	Limited uptake	Trust and awareness
Uruguay	e-Peso - Completed pilot	Financial inclusion and digital payments	Direct issuance	Successful pilot	Scalability
Brazil	Digital Real - Pilot	Wholesale innovation	DLT-based wholesale	Sandbox success	Legal framework
Switzerland (SNB)	Project Helvetia - Pilot	Financial market infrastructure	Wholesale only	Interbank settlement	Legal clarity

Source: Author's creation, from central bank reports, BIS and IMF releases

Despite this diversity, many common designs emerge. Retail CBDCs are prioritised over wholesale applications in most countries, reflecting a focus on public payment systems and access to central bank funds. Two-tier intermediary distribution models are prevalent, in which central banks issue digital currency but depend on regulated financial institutions or payment service providers for distribution and customer relations. Differences are more pronounced with respect to legal readiness, technological choices and the extent of public communication.

Analysis of the Institutional and Policy Aspects OF CBDC initiatives

The second phase of the analysis takes a thematic approach, focusing on key aspects common across CBDC projects to provide a national-level overview. These dimensions include the type of CBDC, institutional implementation models, technological choices, policy objectives related to financial inclusion, and the degree of legal preparedness.

As shown in Table 2, there is a clear difference between European and global approaches. European initiatives place a higher premium on system resilience, regulatory consistency and monetary sovereignty, whereas financial inclusion and payment accessibility are emphasised in many rising and developing nations. In both cases, there is a convergence toward intermediary distribution models and a cautious approach to technology experimentation.

Table 2

A comparative analysis of the main features of CBDC approaches

Dimension	**Global Trend**	**European Approach**	**Illustrative Examples**
CBDC Type	Predominantly retail	Retail with limited wholesale pilots	China, Nigeria, France, Switzerland
Implementation Model	Two-tier or hybrid	Two-tier and bank-intermediated	ECB, UK, India
Technology	Mobile wallets and DLT	Privacy-focused platforms and offline functionality	Bahamas, ECB
Financial Inclusion	Central policy objective	Secondary objective	Nigeria, Ghana
Legal Readiness	Often ex post	Strong ex ante framework	ECB, UK
Public Communication	Uneven	Structured consultation	BoE

Source: Author's creation based on reports from the central banks and international organisations

The comparative analysis across various countries shows two main policy paths: a generally experiment-driven strategy across several regions and a more organised, regulated plan in Europe. Although retail applications of CBDCs are the main focus in both environments, wholesale uses remain limited to a few targeted pilot programs, particularly in France and Switzerland. The widespread use of intermediary, two-tier distribution models that protect the central bank's issuing authority is a common institutional feature. At the same time, they still rely on commercial banks and licensed payment service providers for consumer-facing operations. In addition to technological choices, there is also a diversity of national strategies. Several worldwide pilots are actively implementing distributed ledger technologies, whereas European programs are more cautious, placing a greater emphasis on privacy protection and system security.

These technological and institutional disparities highlight different policy objectives: advanced economies prioritise monetary sovereignty, systemic resilience and regulatory clarity. At the same time, developing countries tend to view CBDCs as tools for financial inclusion. At the same time, legal and institutional preparedness varies considerably, with European projects placing stronger emphasis on ex ante legislative frameworks and structured public communication.

Results

The results of the qualitative comparative analysis reveal several consistent patterns in the design, implementation and policy objectives of central bank digital currency (CBDC) initiatives across countries. Despite significant differences in economic development, institutional capacity and legal frameworks, a number of convergent features can be identified across CBDC models, governance arrangements and anticipated policy outcomes.

One of the key takeaways from recent research is the prevailing trend in CBDC implementation. In most places studied, CBDCs are set up as two-tier systems. This means that while the central bank holds the exclusive power to issue the currency, regulated financial institutions and payment service providers handle the distribution and customer interactions. This approach is seen in both advanced and developing economies, reflecting a common goal: to maintain financial stability while bringing public money into the digital age. On the other hand, completely direct single-tier models are rather uncommon and mostly confined to small pilot initiatives.

The analysis also shows that retail CBDCs are at the forefront of ongoing policy experiments, whereas wholesale CBDC projects have a more restricted scope. Projects with a retail focus seek to improve public payment systems, increase resiliency in a cashless society and potentially encourage financial inclusion. In contrast, wholesale CBDCs are mainly utilised to settle transactions between banks and to structure financial markets, without any direct relation to households or non-financial businesses. This distinction highlights the ongoing emphasis on making digital central bank money accessible to the public, rather than just focusing on efficiency in wholesale markets.

Table 3 summarises quantitative indicators on the adoption and use of CBDCs in observed regions. Although there have been initial launches, retail CBDCs have shown limited adoption rates and minimal active use. Developed economies are predominantly focusing on wholesale CBDCs, which do not directly impact retail payment systems or tax compliance.

Table 3

Adoption and use of CBDC in selected countries

Country and CBDC Name	CBDC Type	Adoption rate (% of population)	Active Usage Indicator (%)	Estimated Transaction Volume	Main Sources
Bahamas (Sand Dollar)	Retail (launched)	25.0	1.0	≈10^6	Central Bank of The Bahamas; IMF (2023)
Nigeria (eNaira)	Retail (launched)	0.5	1.5	≈10^6–10^7	Central Bank of Nigeria; BIS (2023)
China (e-CNY)	Retail (large-scale pilot)	8.0	0.16	≈10^9	PBoC; IMF (2024)
Jamaica (Jam-Dex)	Retail (launched)	7.0	2.0	≈10^6	Bank of Jamaica; Atlantic Council
India (e-Rupee - pilot)	Retail (pilot)	0.5	0.2	≈10^8	Reserve Bank of India; BIS
France (Wholesale CBDC)	Wholesale (pilot)	0.05	0.05	≈10^5	Banque de France; BIS
Switzerland (Project Helvetia)	Wholesale (pilot)	0.05	0.05	≈10^5	Swiss National Bank; BIS
United Kingdom (Digital Pound - pilot)	Retail (pilot)	0.1	0.1	≈10^6	Bank of England; HM Treasury

Source: Author's creation based on reports from the central banks and international organizations

Data is collected from the IMF, BIS and official central bank publications. Retail CBDC adoption rates remain quite low, as developed economies are largely focusing on wholesale CBDC pilots, with little penetration into the retail sector.

When it comes to technology, some interesting patterns are emerging. Most CBDC projects tend to use centralised or permissioned architectures, often incorporating elements of distributed ledger technology. In developing economies, mobile wallet solutions are particularly popular, as they aim to make financial services more accessible to unbanked populations. In advanced economies, greater emphasis is placed on system resilience, interoperability with existing payment infrastructures and the development of offline payment functionalities. In different regions, technology choices are often influenced more by institutional needs than by a genuine desire to innovate.

When it comes to policy goals, there's a noticeable divide between advanced and developing economies. In many developing and emerging countries, CBDCs are primarily seen as tools to boost financial inclusion and enhance government payment systems, such as social transfers and other state payments. On the other side, advanced economies tend to focus more on protecting monetary sovereignty, ensuring that people still have access to central bank (public) money and maintaining the stability of their existing financial systems. These differences highlight the varying priorities and levels of financial development across different regions.

The analysis also uncovers some common governance challenges that come with implementing CBDCs. Protecting privacy and managing data are important issues all around the world, but the way organizations deal with these matters varies significantly. Although certain projects are developed with a focus on privacy, the degree of transactional anonymity is frequently constrained. Also, concerns regarding cybersecurity,

operational resilience, and legal clarity, often arise in official documentation and policy assessments. These issues are particularly significant in regions where CBDC initiatives are advancing without an established regulatory landscape.

Main Obstacles in Emerging Economies

According to the presented qualitative comparative analysis, the approach of developing and emerging economies to CBDCs is shaped by significantly different institutional and structural conditions than those of developed economies. In these countries, CBDCs are primarily understood as instruments for payment system modernisation and financial inclusion, rather than as tools for monetary independence or to increase financial market efficiency.

The study's main conclusion suggests that structural constraints significantly hinder the effective adoption and use of retail central bank digital currencies in developing countries, despite their early introduction and strong political support.

The lack of adequate digital infrastructure is the first barrier. In many emerging nations, poor broad internet availability, unsteady power sources and insufficient access to smartphones hinder the effectiveness of CBDCs, particularly in rural regions. Even though mobile wallets offer promising solutions, inadequate connectivity and unreliable technology still hinder widespread acceptance, as seen in examples such as the Bahamas and Nigeria.

Secondly, having a lack of knowledge about finances and digital tools restricts how many people use these options. Findings indicate that CBDCs do not guarantee increased participation in the official financial system. In settings with little trust in digital financial services and where people don't fully grasp digital currency, usage rates remain low even after they become available. Data from countries that started using them first show that, while campaigns to raise awareness and easy access to technology are important, they alone are not enough to sustain long-term use.

Third, weaknesses in institutions and governance create ongoing difficulties. In many developing nations, efforts related to CBDC have advanced more quickly than the necessary legal and regulatory systems. The lack of thorough prior legislation, clear rules for consumer protection, and efficient data management systems, decreases public confidence and raises worries regarding privacy and accountability. These institutional flaws are especially important in situations where trust in public institutions is already weak.

Finally, the study reveals low scalability and active usage, even when formal acceptance rates are considerable. Although statistics may indicate early success, analysis shows that actual transaction volumes and levels of active engagement are minimal, indicating a gap between the proactive approach and complete economic integration of CBDCs.

Possibilities and prospective benefits

In spite of these difficulties, the results also point out various structural opportunities for developing and emerging countries to introduce and implement CBDCs.

The potential for spillover impacts is one significant chance. Developing economies are less dependent on payment channels compared to advanced nations, which are deeply rooted in conventional banking and payment systems. This makes it easier for CBDCs to align with mobile payment systems and government

transfer programs. As a result, a faster shift toward digital solutions without having to incur additional costs updating the current banking networks is enabled.

An additional benefit is observed in the needs of populations without adequate access to banking services. CBDCs provide a means of accessing central bank money without requiring a comprehensive relationship with commercial banking. This feature is particularly important for government-to-person (G2P) payments and social transfers. Provided that the appropriate institutional conditions are established, CBDCs have the potential to increase efficiency and transparency

The findings also imply that CBDCs can enhance state capacity in public payments, particularly in regions where cash-based systems are prevalent. CBDCs can enhance the efficiency of government payments and reduce transaction costs associated with cash handling. The success of CBDCs in emerging countries depends more on institutional engagement, policy consistency, and public confidence than on technological complexity. This also supports the larger conclusion that CBDCs are fundamentally rooted in governmental institutions rather than being a separate financial innovation.

Table 4

A structured risk matrix by country category

Country Category	Risk	Description of Risk	Likelihood	Potential Impact	Recommended Mitigation Strategies
Developing Economies	Infrastructure Risk	Limited digital connectivity, unreliable electricity supply and uneven smartphone penetration constrain CBDC accessibility and usability.	High	High	Phased rollout; offline CBDC functionality; investment in digital and energy infrastructure; public–private partnerships.
	Adoption and Literacy Risk	Low financial and digital literacy reduces user uptake and sustained usage despite formal availability.	High	Medium-High	Nationwide financial education campaigns; simplified user interfaces; integration with familiar mobile money platforms.
	Institutional and Governance Risk	Weak legal frameworks, limited regulatory capacity and low institutional trust undermine CBDC credibility.	Medium-High	High	Ex ante legal reforms; clear data governance rules; independent oversight; transparency and accountability mechanisms.
	Cybersecurity and Operational Risk	Limited technical capacity increases vulnerability to cyberattacks, fraud and system outages.	Medium	High	Capacity building; reliance on proven technological standards; international technical cooperation; contingency planning.
	Fiscal Over expectation Risk	Overestimation of CBDC effects on tax collection and formalization may	High	Medium	Realistic policy framing; complementary tax and

		lead to policy disappointment.			enforcement reforms; gradual evaluation-based scaling.
Advanced Economies	Disintermediation Risk	Retail CBDCs may weaken commercial bank funding models during stress periods.	Low–Medium	Medium–High	Two-tier CBDC architecture; holding limits; non-remunerated or tiered remuneration structures.
	Privacy and Political Risk	Public concern over surveillance and data misuse may generate political resistance.	Medium	Medium	Privacy-by-design architecture; legal safeguards; strong communication strategies.
	Limited Marginal Benefit Risk	Highly efficient existing payment systems reduce the incremental benefits of retail CBDCs.	High	Medium	Focus on wholesale CBDCs; tokenized settlement; cross-border payment efficiency rather than retail substitution.

The risk matrix by country category, presented in Table 4, shows that risks associated with CBDCs vary significantly across countries. Developing economies tend to struggle with structural and institutional challenges, while advanced economies are more concerned with political and economic factors as well as the potential for marginal benefits.

In Table 5, we can observe the performance assessment of early CBDC pilots across different countries.

Table 5

CBDC initiatives and the failure to achieve stated objectives

CBDC Pilot	**Main Objective**	**Operational Constraints**	**Outcome**
eNaira (Nigeria)	Financial inclusion, reduce cash use	Low trust in government, weak incentives for banks, poor UX, forced adoption attempts backfired	Very low adoption; mainly symbolic
Sand Dollar (Bahamas)	Inclusion across remote islands, payment resilience	Limited merchant acceptance, smartphone & connectivity gaps, low user engagement	Active but marginal usage
JAM-DEX (Jamaica)	Increase financial inclusion, digital payments	KYC barriers, limited everyday use cases, users cash out incentives	Adoption driven by subsidies, not organic
e-CNY (China)	Payment system control, reduce private platform dominance	Strong private alternatives (Alipay/WeChat), limited incentives to switch, privacy concerns	Large pilot scale, weak daily use
DCash (ECCU)	Cross-border payments, regional integration	Technical outages, governance complexity, low public awareness	Temporarily suspended; trust damaged

As we can see from Table 5, CBDCs tend to underperform in environments characterised by low trust, strong private alternatives, and limited engagement from banks and merchants.

In summary, the results suggest that CBDC initiatives are characterised by a high degree of institutional dependency. Design choices, policy objectives, and implementation are harmonised with existing monetary systems, traditional legal frameworks, and public sector capacities. The creation of CBDCs reflects a range of national approaches that share basic structural features but differ in policy and governance mechanisms, with particular emphasis on differences in countries' levels of development.

Discussion

Through a comparative institutional lens, the current study advances the discussion while remaining generally consistent with the body of work on CBDCs. Previous research has emphasised that CBDCs are most likely to be implemented in intermediated, two-tier monetary systems to maintain financial stability and prevent the massive disintermediation of commercial banks (Bindseil, 2020; Brunnermeier & Niepelt, 2019). This hypothesis is supported by the cross-national comparison offered in this article, which shows that CBDC programs are more prevalent in mediated retail models in a variety of institutional settings. This outcome supports the idea that CBDs are being developed to enhance, rather than substitute, the existing banking infrastructure.

Previous studies that have focused on the high priority of retail CBDCs over wholesale applications are also consistent with earlier analyses. They highlight the importance of modernising the public payment system and of maintaining access to central bank money as key policy objectives (Adrian & Mancini-Griffoli, 2021; Auer & Böhme, 2020). However, the results of this study add nuance to this literature by highlighting systematic differences between advanced and developing economies.

The presented comparative data indicate that monetary sovereignty and system resilience are emphasised more in high-income countries, while financial inclusion is important in developing and emerging economies. This difference has reinforced the call for a more contextually sensitive examination of CBDC policy development (Demirgüç-Kunt et al., 2022; International Monetary Fund, 2023).

From an institutional standpoint, the results align with research that views CBDCs as tools of national public and monetary authorities rather than as mere technological advancements (Bordo & Levin, 2017). This study supports the view that monetary systems change gradually and remain integrated into current regulatory structures, given the high level of institutional dependency observed. The findings support more moderate interpretations that emphasise continuity in change, rather than viewing CBDCs as radical forces that could disrupt the monetary system.

The literature also extensively reflects the governance issues uncovered by the comparative analysis. Frequently highlighted as significant obstacles to the public's acceptance of CBDCs are concerns surrounding data security and privacy (Allen et al., 2020; Chaum, Grothoff, & Moser, 2021). These investigations support the limited transactional anonymity observed in existing CBDC designs, highlighting the tension between regulatory control and individual privacy. Despite some authors claiming that privacy-enhancing technologies can reduce these risks, the current data indicate that institutional trust and legal protections are as important as technical solutions.

However, the results contrast with more optimistic assessments that emphasise the transformative potential of central bank digital currencies (CBDCs) to promote financial inclusion and enhance national capacity. Our comparative evidence suggests that the ability of CBDCs to significantly improve access to financial services and increase the efficiency of government transfers is, at best, only tentatively limited,

despite several studies suggesting this potential (Barontini & Holden, 2019; Ozili, 2022). We see these limitations primarily in the large influence of broader institutional factors, such as digital infrastructure, regulatory capacity, and public trust. Recent empirical analyses that reveal the consequences of inadequate adoption and limited acceptance in the early phases of CBDC implementations support this conclusion (Opare & Kim, 2020; Bank for International Settlements, 2023).

CBDC Development Outlook

The evidence examined in this study suggests that over the next five to ten years, central bank digital currencies are expected to remain heterogeneous across countries, reflecting differences in policy objectives, digital infrastructure, public and monetary governance, and institutional capacity. Despite expectations of convergence towards a single model, the paths of CBDC implementation will certainly diverge in terms of the degree of functional scope and economic relevance.

Regarding emerging and developing economies, over the medium term, retail CBDCs are unlikely to replace cash or popular commercial payment options completely. Given that usage is concentrated in the public sector and policy-relevant institutions, CBDCs are more likely to serve as additional payment methods. Early adopters may see a gradual narrowing of the gap between formal access and active use, but only to the extent that underlying conditions such as dependable infrastructure and trust in public institutions advance concurrently.

Meanwhile, wholesale and hybrid CBDC arrangements are expected to evolve more steadily, even in certain emerging nations, particularly those where cross-border frictions and settlement inefficiencies persist. In this case, CBDCs could have an indirect impact by enhancing the payment system's efficiency and resilience, rather than by directly altering households' or businesses' actions.

CBDCs can be gradually integrated into existing mobile and public digital platforms in locations with supportive digital ecosystems, enabling a steady increase in usage. Nonetheless, this growth is expected to be uneven and contingent upon institutional and financial governance, interoperability, privacy regulations, security and consumer protection. In regions where this compatibility is not achieved, CBDCs could instead remain operational as pilot projects with limited economic significance, leading to formal policy change rather than full implementation. Overall, the evidence suggests that CBDC development in developing countries will be realistic, use-case-oriented, and subject to institutional constraints, reflecting broader structural and state capacities rather than just technological promise.

By situating its conclusions within the existing literature, this research contributes to a more balanced perspective on CBDCs as a digital public money tool. The findings support fundamental theoretical assumptions about financial stability and institutional continuity, while also challenging generalised claims about the benefits of CBDCs across different national settings. In this way, the paper contributes to the body of knowledge by highlighting the crucial role that institutional structure and public administration play in determining the economic and legal consequences of state-issued digital money.

CBDC Implementation Policy Suggestions for Developing Economies

Developing countries should focus on ensuring that digital currencies are compatible with existing policies and institutional frameworks rather than treating them as sophisticated technological tools. Given the ongoing constraints on administrative capacity and digital infrastructure, overly complex or experimental CBDC models risk undermining both efficiency and public trust. Instead, CBDC designs should

emphasise simplicity and compatibility with existing payment systems, while accommodating future growth. Such an approach allows for gradual implementation and reduces operational risk by enabling central banks to arrange digital currency initiatives with broader monetary and financial stability goals.

The preferred approach is a two-tier model that uses current private intermediaries to provide services to consumers. In order to mitigate the risk of bank disintermediation, particularly during periods of financial crises, it is essential to implement clear conversion rules, non-remunerated or tiered remuneration schemes and establish holding limits.

The implementation should be methodically staged and driven by specific use cases. It would be preferable to start with carefully selected applications, such as public-sector payments or government-to-individual transactions, before considering broader retail applications. This sequence enables institutional learning, risk management and gradual trust development. Central banks should also incorporate privacy considerations into the design of CBDCs from the outset, employing data access frameworks that strike a balance between user privacy and legitimate regulatory requirements. To preserve public trust, it is essential to maintain a clear separation among transaction validation, data storage, and law enforcement access.

The state should establish the legal frameworks defining the status of CBDCs as legal tender or public money, and provide legal certainty for consumers and intermediaries. Ex ante legislation is preferable to depending on regulatory discretion, particularly in areas where institutional credibility is lacking.

Close coordination among monetary, fiscal, and supervisory authorities is also necessary for successful CBDC governance, particularly when CBDCs are designed to facilitate social transfers or tax administration. To prevent policy conflicts and accountability gaps, the legal structure should clearly specify the duties and obligations of each institution. Also, consumer protection regulations should be modified to address the unique hazards posed by digital public money, ensuring that CBDCs do not undermine current protections by addressing data privacy and operational robustness.

By offering technical support, capacity development, and country-specific analytical advice, **international financial institutions** may contribute significantly to CBDC projects in emerging economies. Assistance should cover legal frameworks, governance structures, cybersecurity readiness and public relations strategies in addition to technological design.

To avoid fragmentation and minimise the risk of isolated digital currency systems, international organisations should encourage standardisation and interoperability at the multilateral level, particularly for cross-border payments. The formulation of standardised principles for data governance and access criteria is essential to align national CBDC initiatives with overarching global financial stability goals. Furthermore, by sharing implementation experiences and evidence-based assessments of CBDC outcomes, international organisations can promote cross-country exchange, helping nations better align their expectations and policy goals.

When interpreting the findings of this research, it is important to consider its limitations. The analysis is based primarily on publicly available information, including official publications from central banks and international organisations. This limits access to internal policy documents, proprietary data, and operational specifics that could be useful for a more comprehensive evaluation of CBDC design and implementation. Second, the study is qualitative and lacks formal statistical or econometric validation, so the conclusions should be viewed as suggestive rather than causal. Thirdly, the fast-changing nature of CBDC

initiatives introduces temporal constraints, as technological architectures, policy frameworks, and adoption schemes may evolve, potentially diminishing the validity of certain observations over time. Lastly, the analysis's geographic scope is intentionally limited and does not include every region participating in CBDC testing or implementation, which may limit the findings' generalizability across national contexts.

Conclusions and Implications

This study analyses central bank digital currencies from a public finance and institutional perspective, viewing them as significant tools of digital public money integrated into current legal systems. The study shows that CBDC initiatives are more influenced by national policy goals, legal traditions and state capacities than by technological requirements.

The analysis confirms that most current CBDC designs are consistent with existing theoretical expectations about financial stability and institutional continuity, expanding the discussion of the findings relative to previous research. The paper also contributes to the body of knowledge by showing that the goals and governance structures of CBDCs vary significantly across countries, particularly between developed and developing or emerging economies. This comparative perspective supports the idea that CBDCs are more like adaptive policy tools than components of a single, consistent global monetary system.

The findings highlight the state's role in reviving the digitalisation of money from a public finance perspective. Issuing digital central bank obligations to the public has the potential to improve public payment systems, increase the efficiency of government transfers and strengthen monetary sovereignty.

The results indicate that the long-term effects of CBDCs will depend on their integration into transparent and accountable institutional frameworks. While technological solutions may mitigate certain operational challenges, the issues of public trust, legitimacy and democratic oversight remain pivotal to the sustainable adoption of digital public money. In this context, CBDCs should be viewed not merely as financial instruments but also as essential elements of the wider relationships between the state and society within the digital economy.

In summary, this study contributes to the ongoing discourse surrounding central bank digital currencies by integrating economic, public, monetary, legal and institutional perspectives. The paper provides a conceptual and analytical basis for future research into currency management in the digital age. Future research should also prioritise the fiscal applications of CBDCs, encompassing taxation and public expenditure management.

Suggestions for Future Research

Future research on central bank digital currencies (CBDCs) should expand beyond descriptive and conceptual analysis towards empirical research. This has been relatively limited to date, as CBDC initiatives have mostly been in pilot stages with few widespread implementations. Quantitative studies using cross-country or panel data could assess the effects of CBDCs on financial inclusion, payment efficiency, and monetary policy transmission more precisely. This would complement existing qualitative insights and strengthen the evidence base for measures and recommendations.

Further research is also needed on the legal and institutional dimensions of CBDCs, particularly in developing countries. Comparative studies in the area of legal regulation could examine how different jurisdictions are adapting monetary law, data protection and consumer protection frameworks to

accommodate digital public money. Such work would be particularly valuable for identifying legal bottlenecks and best practices to ensure legal certainty and public trust.

An important area of research is certainly the interaction between CBDCs and fiscal governance. Future studies could explore how CBDCs affect tax administration, government transfers, the transparency of public expenditures, and coordination between monetary and fiscal authorities. This line of research is particularly relevant given the growing interest in using CBDCs for payments among governments, individuals, and legal entities.

In addition, greater attention should be paid to social factors, including financial literacy and distributional effects across different population groups. Survey-based research and field experiments could provide insights into the dynamics of adoption and potential inequalities associated with digital public money.

Finally, continued cross-country exchange of experiences facilitated by international institutions could support comparative research and the development of common analytical frameworks, contributing to a more coherent and context-sensitive design of CBDC policies.

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References

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

Agur, I., Ari, A., & Dell'Ariccia, G. (2022). Designing central bank digital currencies. *Journal of Monetary Economics*, *125*, 62–79. https://doi.org/10.1016/j.jmoneco.2021.05.002

Allen, S., Čapkun, S., Eyal, I., Fanti, G., Ford, B., Grimmelmann, J., Juels, A., Kostiainen, K., Meiklejohn, S., Miller, A., Prasad, E., Wüst, K., & Zhang, F. (2020). *Design choices for central bank digital currency: policy and technical considerations* (No. W27634; p. w27634). National Bureau of Economic Research. https://doi.org/10.3386/w27634

Armelius, H., Guibourg, G., Levin, A. T. & Söderberg, G. (2020). *The rationale for issuing e-krona in the digital era.* Sveriges Riksbank Economic Review, 2, 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

Atlantic Council. (2023). *Jamaica's Jam-Dex: Central bank digital currency tracker.* Atlantic Council GeoEconomics Centre. https://www.atlanticcouncil.org/cbdctracker/

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

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

Bank for International Settlements. (2021). *CBDCs: System design and interoperability*. https://www.bis.org/publ/othp42.htm

Bank for International Settlements. (2023). *Blueprint for the future monetary system: improving the old, enabling the new*. Annual Economic Report 2023. https://www.bis.org/publ/arpdf/ar2023e3.pdf

Bank for International Settlements. (2023). Ce*ntral bank digital currencies: A toolkit for policymakers*. BIS Annual Economic Report. https://www.bis.org/publ/arpdf/ar2023e.htm

Bank for International Settlements. (2024). *Project Helvetia: Settlement of tokenised assets in wholesale central bank money*. BIS Innovation Hub. https://www.bis.org/about/bisih/topics/cbdc/helvetia.htm

Bank of England. (2023). *The digital pound: Consultation paper*. Bank of England & HM Treasury. https://www.bankofengland.co.uk/the-digital-pound

Banque de France. (2022). *Wholesale central bank digital currency experiments*. Banque de France. https://www.banque-france.fr/en/financial-stability/financial-stability-mandate/supporting-digital-transformation-financial-sector/wholesale-mnbc

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

Bindseil, U. (2020). Tiered CBDC and the financial system. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3513422

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

Bordo, M., & Levin, A. (2017). *Central bank digital currency and the future of monetary policy* (No. W23711; p. w23711). National Bureau of Economic Research. https://doi.org/10.3386/w23711

Bossu, W., Itatani, M., Margulis, C., Rossi, A. D. P., Weenink, H., & Yoshinaga, A. (2020). Legal aspects of central bank digital currency: central bank and monetary law considerations. *IMF Working Papers*, *20*(254). https://doi.org/10.5089/9781513561622.001

Brunnermeier, M. K., & Niepelt, D. (2019). On the equivalence of private and public money. *Journal of Monetary Economics*, *106*, 27–41. https://doi.org/10.1016/j.jmoneco.2019.07.004

Central Bank of Nigeria. (2023). eNaira: Progress report. Central Bank of Nigeria. https://www.cbn.gov.ng/Paymentsystem/eNaira/

Central Bank of The Bahamas. (2023). *Sand Dollar quarterly economic review.* Central Bank of The Bahamas. https://www.centralbankbahamas.com/publications/main-publications/project-sanddollar-a-bahamian-payments-system-modernization-initiative

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

Davlatov, E., & Sági, J. (2025). The transmission mechanism of monetary policy and central bank digital currency: a new monetary order? *Journal of Central Banking Theory and Practice*, *14*(1), 95–119. https://doi.org/10.2478/jcbtp-2025-0006

Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). *The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19*. The World Bank. https://doi.org/10.1596/978-1-4648-1897-4

European Central Bank. (2019). *Exploring anonymity in central bank digital currencies* (ECB Paper IN FOCUS, Issue No. 4). https://www.ecb.europa.eu/press/intro/publications/pdf/ecb.mipinfocus191217.en.pdf

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

Fan, R., Walker, T. B., & Wright, A. (2025). Central bank digital currency in small open economies. *Latin American Journal of Central Banking*, *6*(2), Article 100151. https://doi.org/10.1016/j.latcb.2024.100151

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

Infante, S., Kim, K., Orlik, A., Silva, A. F., & Tetlow, R. (2024). Retail CBDC: implications for banking and financial stability. *Annual Review of Financial Economics*, *16*(1), 207–232. https://doi.org/10.1146/annurev-financial-082123-105958

International Monetary Fund. (2023). *Central bank digital currency global developments report*. https://www.imf.org/en/Publications/fintech-notes

International Monetary Fund. (2024). *China: Financial sector assessment program-Technical note on digital money.* IMF Country Report. https://www.imf.org/en/Countries/CHN

Kahn, C., Singh, M., & Alwazir, J. (2022). *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

Kiff, J., Alwazir, J., Davidovic, S., Farias, A., Khan, A., Khiaonarong, T., Malaika, M., Monroe, H., Sugimoto, N., Tourpe, H., & Zhou, P. (2020). A survey of research on retail central bank digital currency. *IMF Working Papers*, *20*(104). https://doi.org/10.5089/9781513547787.001

Kumhof, M., & Noone, C. (2018). Central bank digital currencies—design principles and balance sheet implications. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3180713

Lagarde, C. (2020). *The future of money – innovating while retaining trust*. European Central Bank. https://www.ecb.europa.eu/press/inter/date/2020/html/ecb.in201130~ce64cb35a3.en.html

Mancini Griffoli, T., Agur, I., Ari, A., & Martinez Peria, M. (2018). *Casting Light on Central Bank Digital Currencies*. International Monetary Fund. https://doi.org/10.5089/9781484384572.006

Niepelt, D. (2020). *Monetary policy with reserves and CBDC: optimality, equivalence and politics.* CEPR. https://cepr.org/publications/dp15457

OECD. (2023). *Central Bank Digital Currencies (CBDCs) and democratic values.* OECD Business and Finance Policy Papers, OECD Publishing, Paris. https://doi.org/10.1787/f3e70f1f-en.

Opare, E. A., & Kim, K. (2020). A compendium of practices for central bank digital currencies for multinational financial infrastructures. *IEEE Access*, *8*, 110810–110847. https://doi.org/10.1109/ACCESS.2020.3001970

Ozili, P. K. (2022). Digital financial inclusion. In K. Sood, R. K. Dhanaraj, B. Balusamy, S. Grima, & R. Uma Maheshwari (Eds), *Big Data: A Game Changer for Insurance Industry* (pp. 229–238). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80262-605-620221015

Reserve Bank of India. (2023). *Concept note on central bank digital currency*. Reserve Bank of India. https://www.rbi.org.in/scripts/PublicationReportDetails.aspx

Sveriges Riksbank. (2020). *E-krona pilot report*. https://www.riksbank.se/en-gb/payments--cash/e-krona/

Swiss National Bank. (2023). *Project Helvetia III: Wholesale CBDC settlement*. Swiss National Bank Quarterly Bulletin. https://www.snb.ch/en/the-snb/mandates-goals/payment-transactions/projekt_helvetia

Umar, M. (2025). Does CBDC launch increase tax collection? Empirical evidence from China. *Finance Research Letters*, *71*, Article 106486. https://doi.org/10.1016/j.frl.2024.106486

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