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How Central Banks Are Shaping the Future of Digital Currencies

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About the Author

S. Yash Kalash is research director of digital economy at CIGI. He is an expert in strategy, public policy, digital technology and financial services. He has experience in emerging markets across India, MENA (Middle East and North Africa) and the Asia-Pacific and a distinguished track record advising governments and the private sector on emerging technologies. His expertise spans various industries, including fintech, AI and digital assets, and their impact on geopolitics. His career includes key roles at Roland Berger, the Government of India, Adani Group and KPMG, where he spearheaded strategic digital projects, advised clients on their digital assets and AI strategy, and informed policy and regulatory developments. With an M.Sc. in management from Imperial College London and a B.Sc. in international relations and politics from the University of Bath, Yash combines deep strategic insight with strong training, making him a versatile and impactful leader in the field of digital economy.

Executive Summary

This paper examines the accelerating global momentum behind central bank digital currencies (CBDCs), exploring how central banks are responding to the twin pressures of financial digitalization and geopolitical competition. It provides a comprehensive analysis of the motivations driving CBDC development from enhancing payment system efficiency and financial inclusion to preserving monetary sovereignty in the face of private digital currencies. Through a comparative lens, the paper analyzes divergent CBDC models — retail, wholesale and hybrid — adopted across advanced and emerging economies, with particular attention to design features, operational challenges and strategic objectives. It also evaluates multilateral initiatives such as Project mBridge and Project Dunbar, highlighting their potential to transform cross-border payments and recalibrate global financial power. The paper concludes by assessing the key risks of CBDC implementation, including privacy, cybersecurity and financial disintermediation and explores the future trajectory of CBDCs as programmable policy tools within an evolving digital monetary order. The findings underscore that while the path to global CBDC adoption is complex and fragmented, the direction is clear: digital sovereign money is likely to play a central role in shaping the next era of international finance.

Introduction

CBDCs have emerged as a pivotal innovation in the evolving landscape of global finance, presenting a digital alternative to the traditional fiat currency that is fully regulated and issued by central banks. Unlike decentralized cryptocurrencies, such as Bitcoin, which operate independently of government oversight, CBDCs represent a potentially secure, government-backed alternative, positioning them as a crucial tool in the digital financial ecosystem, equipped with regulatory frameworks and the stability traditionally associated with sovereign currency.

The rise of CBDCs has been fuelled by both technological advancements and shifts in the global financial landscape, including the increasing prevalence of digital payments, the rapid development of private digital currencies and the accompanying need for central banks to retain influence over monetary policy in an era of digital currency innovation. Over the past decade, the concept of CBDCs has transitioned from theoretical discussions to active development, with countries pioneering various forms of CBDCs. More than 100 central banks globally are currently exploring, testing or launching CBDCs, signalling an accelerating recognition of their potential to maintain monetary control, enhance transaction efficiency and provide secure alternatives in a fast-evolving digital world (Boar and Wehrli 2021).

This paper explores the trajectory of CBDCs, analyzing where they are likely to head and why their relevance continues to grow in policy discussions worldwide. By examining the unique motivations and objectives behind various national CBDC projects, it aims to provide a comparative analysis of the different approaches adopted by central banks in major economies such as China, the European Union and the United States, as well as in emerging markets where CBDCs could serve critical policy functions. This exploration will delve into the design choices, operational models and regulatory considerations that shape each CBDC project, revealing how national priorities, economic contexts and technological capabilities influence diverse approaches. Through this comparative lens, the paper aims to illuminate the broader implications of CBDCs for global finance, underscoring the likely role of these currencies in the future of financial systems and the monetary landscape.

The Growing Interest in CBDCs

The growing interest in CBDCs is fuelled by a confluence of global trends that underscores the need for central banks to innovate in response to an evolving digital financial landscape. Key drivers behind the CBDC agenda include the rapid digitalization of finance, a process accelerated by the COVID-19 pandemic, which highlighted the vulnerabilities of cash-reliant economies and underscored the urgency for resilient, digital-first

payment systems. The pandemic catalyzed a shift in consumer behaviour toward digital payments, reinforcing the need for central banks to consider digital alternatives to cash that align with the new digital economy. Additionally, the advent and proliferation of private sector digital currencies, such as cryptocurrencies and stablecoins, have introduced formidable competition, raising concerns that without action, central banks may lose influence over payment systems and the broader monetary framework. It is important to note that regulated stablecoins, particularly those backed by central bank reserves, are sometimes viewed as public-private alternatives to CBDCs. However, they remain private liabilities, lacking the monetary policy tools and legal finality that sovereign-issued CBDCs possess.

As financial landscapes transform, the push for financial inclusion and economic resilience has become a pivotal consideration for central banks, especially in developing economies where cash dependency remains high. In such economies, CBDCs represent a promising vehicle for reaching underserved populations, offering access to digital financial services and reducing reliance on physical cash. The push for CBDCs is therefore part of a broader effort to future-proof economies and ensure financial systems are equipped to meet the demands of a digitally driven world, where real-time transactions, efficiency and inclusive access to financial services are increasingly expected.

Central banks are motivated by a range of specific objectives as they consider the development and potential deployment of CBDCs. Financial stability remains a primary concern, as the adoption of CBDCs could provide central banks with a tool to maintain monetary sovereignty in an era of rapid financial decentralization. This is particularly pertinent in the context of decentralized cryptocurrencies, which pose a challenge to traditional financial structures by operating outside the regulatory domain of central banks. By implementing a state-backed digital currency, central banks could mitigate the risks posed by these decentralized assets, maintaining control over the money supply and interest rates, which are essential for economic stability.

Additionally, CBDCs offer the potential to enhance cross-border payment systems. Traditional cross-border payments are often expensive, time-consuming and heavily reliant on intermediary banks. CBDCs could streamline these processes, reducing transaction costs and increasing speed, which is especially valuable in an interconnected global economy where cross-border commerce and remittances play vital roles in economic growth.

CBDCs also hold significant potential for advancing financial inclusion, particularly in regions where access to traditional banking services is limited. A CBDC could provide a secure, accessible digital payment method to individuals without bank accounts, extending the reach of formal financial systems. This could prove particularly beneficial in remote and rural areas, where financial infrastructure is often sparse and digital solutions present a feasible alternative to traditional banking. More so, offline CBDCs — digital currencies operable without constant internet connectivity (Kalash 2024) — offer the promise of enabling digital transactions without constant internet connectivity, which is of particular importance in developing country contexts. Shaktikanta Das, then governor of the Reserve Bank of India, echoed this notion while addressing a session on India's CBDC project at the World Economic Forum when he said that "CBDCs can operate in places where there is no internet; offline payments will become much easier because from my CBDC wallet I can pay money to your wallet" (*Mint* 2024).

The efficiency of payment systems is another motivation driving the development of CBDCs, with central banks aiming to modernize their payment infrastructure in line with technological advancements. In a digital-first world, where instantaneous payments are increasingly the norm, a well-designed CBDC could enhance the speed, security and transparency of transactions, benefiting both individuals and businesses. Furthermore, the changing nature of central banks in the digital age demands an innovative approach to money creation and distribution. By issuing CBDCs, central banks can ensure that they remain relevant in a financial ecosystem where the concept of currency is rapidly evolving.

On the issue of introducing the digital pound, Deputy Governor of the Bank of England Sarah Breeden quipped, "Trust in all forms of money is an absolute necessity" (Breeden 2024). Under this line of thinking, public and political perceptions are instrumental in shaping the discourse around CBDC adoption. Public acceptance is essential for the success of any currency and CBDCs are no exception. Public and political discussions are increasingly emphasizing the

need for privacy, security and autonomy in digital financial systems. A common concern is that a government-backed digital currency could lead to increased surveillance and reduced privacy, as CBDCs would allow governments unprecedented insight into individuals' transaction histories. Ensuring that CBDCs are designed with privacy protections in place will be critical for gaining public trust, as the notion of money itself is redefined in the digital age. Public opinion has also shown significant concern regarding security and the risk of cyber threats, which underscores the need for robust cybersecurity measures in any CBDC implementation. Addressing these concerns will be essential not only for securing public trust but also for ensuring that CBDCs are adopted widely and operate successfully.

The concept of money is undergoing a fundamental shift as digitalization transforms financial systems. Traditional notions of cash and bank accounts are being challenged by a range of digital alternatives, sparking an evolution in how societies perceive, use and value money. This evolution is prompting a re-evaluation of the roles and responsibilities of central banks in the digital age, driving many to recognize CBDCs not simply as a currency but as a foundation for the future of finance. As a result, the global interest in CBDCs is not only unlikely to fade but is expected to intensify as central banks seek to maintain their critical role in an increasingly digital world. This combination of technological trends, evolving public expectations, and central banks' mandates for stability, inclusion and innovation forms the foundation of the global push toward CBDC adoption, setting the stage for their integration into the financial systems of tomorrow.

Different Approaches to CBDCs: A Comparative Analysis

The development of CBDCs has taken diverse paths across the world, with each central bank designing its digital currency based on unique national priorities, regulatory environments and technological infrastructure. These variations in approach reflect the distinct economic, political and social factors that shape the financial systems of each jurisdiction, resulting in CBDC models that differ significantly in their design, intended users and objectives.

The Retail versus Wholesale CBDC Debate and the Evolution of a Hybrid Model

The debate surrounding CBDCs often centres on two primary models: retail and wholesale CBDCs. These models differ fundamentally in terms of their purpose, design and intended users.

Retail CBDCs aim to provide a digital currency option that is as accessible as cash but with the benefits of digital payments. Mustafa Syed, a lead technical researcher on CBDCs at PricewaterhouseCoopers has argued that "developing economies seem keener to develop retail CBDC to enhance payment effectiveness and increase financial inclusion" (Syed 2022). The Sand Dollar of the Bahamas, which is classified as a small island developing state,[1] is a prime example of a retail CBDC project in a developing country context. Launched by the Central Bank of the Bahamas, the Sand Dollar is intended to foster financial inclusion by providing secure, convenient digital payment options, particularly in remote areas where banking infrastructure is limited. The Sand Dollar's implementation reflects a broader trend toward using retail CBDCs to expand access to financial services.

One of the significant advantages of retail CBDCs is their potential to promote financial inclusion, particularly in regions with low banking penetration. Digital currency can provide individuals without bank accounts with access to a secure, state-backed currency that can be used directly for transactions. Retail CBDCs also offer the potential to reduce transaction costs and increase the speed of transactions, making payments more efficient for individuals and businesses. However, retail CBDCs face notable challenges, particularly regarding privacy and security. A system where every digital transaction is recorded could lead to concerns over privacy, and the cybersecurity requirements to protect such a widely accessible digital currency would be substantial. There is also the risk of disintermediation: if individuals choose to hold CBDCs instead of

1 See www.un.org/ohrlls/content/list-sids.

bank deposits, this could reduce liquidity in the commercial banking sector, potentially destabilizing the traditional banking system.

Wholesale CBDCs, by contrast, focus on the interbank market, where they are used exclusively by financial institutions for large-scale transactions and settlement processes, and are often more prevalent in advanced economy contexts where robust and mature interbank systems already exist (Syed 2022). The Banque de France's wholesale CBDC trials and Singapore's Project Ubin illustrate the wholesale model's potential. In France, the central bank has been conducting experiments to assess how wholesale CBDCs could streamline interbank settlements and improve the efficiency of cross-border payments (Banque de France 2021). Singapore's Project Ubin similarly explores how a wholesale CBDC could enhance liquidity and reduce costs in interbank transactions (Bank of Canada and Monetary Authority of Singapore 2019). Wholesale CBDCs are particularly advantageous for high-value, low-frequency transactions that require security and efficiency. They can improve the speed and cost-effectiveness of settlement processes, which are often hampered by complex procedures and multiple intermediaries, especially in cross-border transactions.

Wholesale CBDCs offer advantages in terms of regulatory control and systemic risk management, as they operate within a closed system accessible only to licensed financial institutions. This restricted access limits the potential for disintermediation in the banking sector and helps maintain stability within traditional financial frameworks. However, the scope of wholesale CBDCs is limited to the interbank market, meaning they cannot directly enhance financial inclusion or provide the general public with a digital currency alternative. Additionally, while wholesale CBDCs can improve efficiency within the financial system, they do not address the need for broader payment innovations that benefit the general public.

The differences between retail and wholesale CBDCs reflect the distinct purposes and benefits that each type of digital currency offers. Retail CBDCs are geared toward financial inclusion, convenience and serving the public, whereas wholesale CBDCs focus on the efficiency and security of the interbank settlement process. Central banks are increasingly exploring hybrid CBDC models that combine elements of both retail and wholesale systems to maximize the benefits of each approach.

The hybrid CBDC model seeks to bridge the advantages of both retail and wholesale CBDCs by creating a system that supports central bank-backed digital currency use for both public transactions and interbank settlements. This model allows central banks to cater to public demand for accessible digital currency while preserving the efficiencies that wholesale CBDCs provide within interbank systems. Hybrid CBDCs are designed to enhance inclusivity in the financial system, reduce transaction costs for retail and institutional users and provide an effective way for central banks to manage both monetary policy and payment infrastructure in a digital-first world.

A hybrid model refers to a structural design wherein a CBDC remains a direct liability of the central bank, but private institutions manage distribution and compliance. This is distinct from retail/wholesale functional distinctions, which refer to end-user types and transaction purposes.

In a hybrid model, a central bank issues a digital currency that can be accessed and used by the general public for everyday payments (like a retail CBDC) while maintaining interoperability with the financial sector's interbank processes. Central banks and commercial banks, in this model, work together in a two-tier system. The central bank issues the CBDC and holds the primary authority over its issuance and control, while commercial banks and authorized financial intermediaries distribute the CBDC to the public, manage customer accounts and facilitate transactions. This approach enables a balance between central control and decentralization, whereby commercial banks retain their role in customer relations, financial management and lending activities and central banks oversee currency stability and systemic risk. An interesting example of such a hybrid model is the supposed digital currency Bakong, launched by the National Bank of Cambodia in October 2020 denominated by the Cambodian riel. Since its launch it has recorded 75.5 million transactions, a 180 percent growth compared to the same period in 2023, amounting to KHR 64.9 trillion or approximately US$16.2 billion (up by 140 percent from the previous year) (B2B Cambodia 2024). Makoto Takemiya (2021) from the Japanese CBDC technology firm Soramitsu that helped bring the Bakong to life said in a World Economic Forum report that "This is proof that through a hybrid use of traditional electronic banking and the implementation of

an innovative digital wallet, such as those used in decentralized finance, users of banks as well as underserved citizens stand to benefit."

One key benefit of hybrid CBDCs is the balance that they strike between privacy and transparency. They can be designed to offer anonymous or pseudonymous transactions for small-value transactions, thus protecting users' privacy for day-to-day purchases. At the same time, larger transactions or institutional transfers could have more stringent monitoring and reporting protocols, enabling central banks to enforce anti-money laundering (AML) and counter-terrorism financing (CTF) regulations more effectively. This dual approach could assuage public concerns over privacy and surveillance, ensuring the CBDC's broad public acceptability while maintaining the central bank's ability to monitor and regulate large-scale transactions.

Moreover, hybrid CBDCs present a significant advantage for interbank settlements, especially for cross-border payments. In a hybrid CBDC system, interbank transactions could be executed directly using the CBDC, bypassing traditional correspondent banking networks and reducing the time and cost of international transfers. This could lead to greater efficiency in cross-border transactions, with real-time settlement possibilities that drastically reduce the delays and costs currently associated with international transfers. Furthermore, by enabling cross-border interoperability, a hybrid CBDC model could help standardize and simplify international trade, increasing efficiency for businesses and improving regulatory oversight.

A hybrid CBDC model can also be designed to support programmable money features, which enable central banks to implement policy tools directly through the CBDC. For example, governments could distribute stimulus payments directly to citizens via CBDCs, with programmable features allowing the funds to be spent only on specific types of goods or services or within certain time frames. In a hybrid model, this programmable functionality could extend beyond consumer payments, facilitating policy interventions in the interbank market as well. This capability could give central banks new tools for implementing monetary policy in targeted, precise ways, adapting to economic needs with greater flexibility.

One challenge, however, is the technological and infrastructural complexity that hybrid CBDCs require. Building a hybrid system that is resilient, secure and able to handle high transaction volumes across both retail and wholesale domains requires sophisticated infrastructure, robust cybersecurity and close coordination between central banks, commercial banks and payment service providers. Additionally, ensuring interoperability with existing payment systems, both domestically and internationally, would require considerable collaboration and standardization across jurisdictions, posing a regulatory and technological challenge. This challenge is further compounded by the need to accommodate varying degrees of regulatory oversight and data protection laws across different countries, especially if hybrid CBDCs are to support cross-border payments.

Regional Comparisons

As central banks worldwide embark on the journey toward implementing CBDCs, each jurisdiction has developed a distinct approach shaped by its unique economic priorities, regulatory frameworks, technological capabilities and strategic interests. Understanding the differences in CBDC models across regions is essential for comprehending the global trajectory of digital currencies and the varied motivations driving each country's efforts. While some nations aim to enhance financial sovereignty and maintain control over their monetary systems, others seek to expand financial inclusion or improve the efficiency of domestic and cross-border payments. Moreover, each CBDC program is adapted to local needs, such as addressing cash dependency, improving transaction speed or providing offline payment solutions, with the latter being particularly critical in regions with limited internet connectivity.

The importance of examining these regional differences lies in the broader implications for the international financial system. China's digital yuan, for instance, has implications beyond its domestic use, with the potential to influence global trade patterns and reduce dependence on the US dollar in international transactions. Meanwhile, the European Union and the United States are focusing on maintaining monetary sovereignty and innovating within their advanced financial systems. For emerging economies in Africa and the Caribbean, CBDCs offer a pathway to reduce reliance on cash, improve financial access and stimulate economic participation.

Table 1: Comparative Table of CBDC Models Across Jurisdictions

Jurisdiction	CBDC Name	Model	Design and Key Features	Motivations	Challenges
China	Digital yuan	Retail	Integrated with mobile payments, offline payment capabilities, programmability for targeted use	Financial sovereignty, countering private cryptocurrencies, enhancing financial control, potential for cross-border use	Privacy concerns, risk of government control perception, complex implementation for global trade
European Union	Digital euro	Hybrid (retail with institutional interoperability)	Still in design phase, focused on privacy-preserving features, programmable options under discussion	Innovation in payment systems, monetary sovereignty, countering private digital currency threats	Legal and regulatory frameworks, privacy concerns, ensuring stability
United States	Digital dollar	Retail and wholesale (under study)	Debated within Project Hamilton, considering design with privacy and financial stability in mind	Preserve global reserve currency status, improve domestic payments, protect user privacy	Legislative hurdles, privacy concerns, economic impact of implementation
Sweden	e-krona	Retail	Pilot phase, high accessibility with options for limited offline use	Address cash decline, maintain central bank role in payment systems	Limited adoption, balancing privacy with control, scalability issues
Nigeria	eNaira	Retail	Offline capabilities, accessible via mobile phones, targeted financial inclusion	Financial inclusion, reducing cash dependency, improving transaction efficiency	Infrastructure challenges, low digital literacy, regulatory framework adaptation
Bahamas	Sand Dollar	Retail	Offline functionality, adaptable for remote transactions	Improve access in geographically dispersed areas, reduce cash dependency	Infrastructure in remote areas, regulatory oversight, limited interoperability with global systems

Source: Author.

Table 1 delves into the specific design features, motivations and challenges of CBDCs across various regions, offering a comparative perspective that highlights the complex and diverse landscape of CBDC development globally. Through this geographical comparison, we can gain insights into the multiple objectives CBDCs serve, the technical and regulatory innovations that facilitate them and the international dynamics that may influence their future evolution.

The choice of CBDC model by each country reflects a strategic alignment with its specific economic policies, regulatory priorities and broader geopolitical goals, carrying significant implications for both domestic and international financial landscapes. Countries such as China and the Bahamas, which have chosen retail-focused models, aim to enhance accessibility and secure financial inclusion, with China additionally emphasizing control over digital payments to reinforce financial sovereignty and challenge the global dominance of private cryptocurrencies.

In contrast, the European Union's hybrid model, balancing retail accessibility with institutional interoperability, seeks to foster innovation in the payment system while maintaining monetary sovereignty and limiting reliance on private digital currencies. The European Union's approach signals an effort to create a secure and efficient digital payment ecosystem that aligns with stringent European privacy standards, a priority that will influence how CBDCs are regulated and integrated across EU nations.

Meanwhile, the United States' cautious stance and the ongoing Project Hamilton underscore a concern for preserving the dollar's global reserve status and safeguarding domestic financial stability, showing that any US CBDC will likely be designed to prevent disruptions to existing banking structures. The focus on both retail and wholesale applications within the United States demonstrates a dual objective of reinforcing the dollar's utility in both consumer transactions and high-value financial markets. Sweden's e-krona project illustrates a policy response to a declining cash economy, aiming to secure a public digital currency option without sacrificing privacy or user trust.

In emerging economies such as Nigeria, where the eNaira focuses on financial inclusion, and the Bahamas, where the Sand Dollar addresses geographic challenges, the policy emphasis is on reducing cash dependency, fostering economic resilience and supporting inclusive growth through accessible digital payments. These diverse models reflect distinct priorities, such as financial control, inclusion, privacy and cross-border competitiveness, signalling that CBDCs could reshape monetary policy frameworks, influence international financial norms and redefine the balance between state and private digital currencies globally.

Multilateral CBDC Projects

A defining characteristic of the CBDC ecosystem has been the emergence of multilateral projects. Multilateral CBDC projects represent a critical avenue in the global development of digital currencies, focusing on the harmonization and efficiency of cross-border payments. Led by collaborative efforts from institutions such as the Bank for International Settlements (BIS), these projects aim to address the complex, often inefficient processes that define international payments, which are frequently hampered by high costs, delayed settlement times and intermediary dependencies. By experimenting with interconnected CBDC frameworks, central banks and international financial institutions are pioneering new methods to facilitate direct, secure and rapid transfers between different national currencies, thus transforming the traditional landscape of cross-border financial transactions.

The BIS Innovation Hub has been at the forefront of these efforts, providing a platform for central banks to collectively explore the potential of CBDCs in cross-border contexts. Two notable projects, Project Dunbar and Project mBridge, illustrate the scope and ambition of these multilateral initiatives. Project Dunbar, a collaborative endeavor involving the Reserve Bank of Australia, Bank Negara Malaysia, the Monetary Authority of Singapore, and the South African Reserve Bank, is specifically designed to test the capabilities of multiple CBDCs within a single integrated framework. By enabling direct transactions between central banks without relying on intermediaries, Project Dunbar seeks to reduce transaction costs and enhance the efficiency of cross-border payments. The project has demonstrated that it is possible to create a shared platform where multiple CBDCs can coexist and transact seamlessly, paving the way for a more interconnected global payment infrastructure (BIS Innovation Hub 2022a).

Table 2: Examples of Ongoing Multilateral CBDC Projects

Project Name	Participating Central Banks	Lead Organization	Key Objectives	Design Features	Primary Focus Area
Project Dunbar	Reserve Bank of Australia, Bank Negara Malaysia, Monetary Authority of Singapore, South African Reserve Bank	BIS Innovation Hub	Enable cross-border payments using multiple CBDCs in a single, integrated platform	Multi-CBDC shared platform allowing direct interbank transfers without intermediaries	Reducing costs and enhancing efficiency in cross-border payments
Project mBridge	People's Bank of China, Hong Kong Monetary Authority, Bank of Thailand, Central Bank of the United Arab Emirates (UAE)	BIS Innovation Hub	Test the feasibility of international settlements using multiple CBDCs, bypassing traditional correspondent banking	Real-time, multi-CBDC ledger enabling direct cross-border transactions	Improving speed, cost-effectiveness and reliability in international settlements
Project Helvetia	Swiss National Bank, BIS, SIX Digital Exchange	BIS Innovation Hub	Explore CBDC integration into existing financial infrastructures, focusing on wholesale CBDC for financial institutions	Integration of wholesale CBDC with digital asset infrastructure, distributed ledger technology (DLT)-based settlements	Supporting financial stability and interoperability within digital asset markets
Project Jura	Banque de France, Swiss National Bank, BIS Innovation Hub	BIS Innovation Hub	Conduct cross-border transactions using tokenized assets with dual CBDCs (euro and Swiss francs)	Use of DLT-based platform for simultaneous cross-border payments and security transactions	Increasing efficiency in cross-border securities transactions
Project Aber	Saudi Central Bank, Central Bank of the UAE (Saudi Central Bank and Central Bank of the UAE 2019)		Test the application of a dual-issued CBDC for financial settlements between the two countries	Jointly issued wholesale CBDC for secure interbank payments	Enhancing bilateral payment efficiency and security

Source: Author.

Similarly, Project mBridge — spearheaded by the BIS Innovation Hub in collaboration with the People's Bank of China, the Hong Kong Monetary Authority, the Bank of Thailand and the Central Bank of the UAE — focuses on the application of multiple CBDCs for international settlements. This project aims to create a platform for cross-border transactions that operates independently of traditional correspondent banking models. Through mBridge, participating central banks are testing the viability of a multi-CBDC arrangement that facilitates real-time settlement across borders (BIS Innovation Hub 2022b). Such a framework could significantly reduce the friction and time delays associated with international transfers, presenting a streamlined alternative to the conventional systems that often rely on a web of correspondent banks.

The policy implications of these multilateral CBDC efforts are profound and extend well beyond the technological and operational dimensions, holding transformative potential for international finance, trade and regulatory standards.

One of the most significant policy impacts of successful multilateral CBDC systems would be a reconfiguration of global monetary flows. By enabling direct CBDC-to-CBDC exchanges, these systems reduce the need for intermediary currencies, particularly the US dollar, which has traditionally served as the dominant currency for international transactions. The potential to conduct international trade and settlements in local or regional digital currencies could reduce reliance on the dollar, gradually decentralizing the global financial system and promoting a more multipolar currency environment. This decentralization could empower central banks by affording them greater control over cross-border transactions, exchange rate stability and foreign reserves, potentially leading to a significant shift in global economic power dynamics. It is important to note that Project mBridge has been touted as a major influence on the BRICS Bridge Payment Scheme launched by the BRICS+ nations (Brazil, Russia, India, China, South Africa, and five new members: Egypt, Ethiopia, Iran, Saudi Arabia and the UAE). The mechanism is often considered as an alternative to the current US dollar-led financial and payment system. Thus, in a move possibly motivated by the geopolitical considerations that surround the project, the BIS has unexpectedly announced its departure from the mBridge initiative, leading to speculation about the project's future (Long 2024).

In addition, multilateral CBDC projects are poised to diminish the influence of non-state actors — such as private-sector stablecoin issuers and decentralized financial platforms — in international finance. As public trust in central bank-backed digital currencies grows, the demand for unregulated or privately issued digital currencies in cross-border transactions could decrease, allowing central banks to reassert their authority in the digital payment space. This reassertion could strengthen regulatory oversight and reduce risks associated with financial instability, fraud and illicit activities, as central banks would maintain direct control over digital transactions and be better equipped to enforce compliance with international financial regulations.

Another profound policy implication lies in the establishment of standards for interoperability and regulatory alignment. With each central bank developing unique CBDC models tailored to domestic priorities, international coordination becomes essential to ensure that these currencies can interact seamlessly across borders. Multilateral CBDC projects are pioneering frameworks that set the technical, legal and regulatory standards required for multiple CBDCs to coexist within a single, cohesive ecosystem. This standardization is especially critical given the fragmented global financial landscape and the potential risks of fragmentation if national CBDCs lack interoperability. By setting these standards, multilateral CBDC initiatives can facilitate smoother cross-border transactions, minimize systemic risks and reduce the regulatory uncertainties that could arise from uncoordinated CBDC deployments.

Furthermore, multilateral CBDC projects offer an opportunity to enhance transparency and compliance in cross-border transactions. The centralized ledger and programmable nature of CBDCs allow central banks to incorporate automated compliance features, such as AML and CTF protocols, directly into the digital currency infrastructure. This capability could increase transparency and traceability in international payments, reducing illicit financial flows and ensuring compliance with global standards. In an era where financial crime is increasingly sophisticated and cross-border, this transparency provides central banks and financial regulators with valuable tools to enhance financial security at both the national and international levels.

The intersection of national CBDCs within the multilateral framework also underscores the growing importance of policy collaboration among central banks. While national CBDCs primarily address domestic needs, their use in international trade and finance will inevitably intersect as global commerce demands interoperable systems.

Multilateral CBDC projects are therefore not only experimental frameworks but also early steps toward an integrated global financial infrastructure that aligns the monetary policy and regulatory standards of participating nations. Such alignment could enable central banks to maintain monetary policy independence while benefiting from a unified system that reduces exchange rate volatility, facilitates efficient trade settlements and ensures that national CBDCs remain interoperable in a global context. The success of these multilateral CBDC engagements could pave the way for a new era in international finance, one characterized by reduced dependency on traditional reserve currencies, enhanced regulatory oversight and a robust, interoperable digital currency network capable of supporting global economic integration.

Challenges and Risks in CBDC Implementation

Implementing CBDCs presents a suite of formidable challenges and risks that must be thoroughly addressed for CBDCs to fulfil their intended roles in enhancing financial inclusion, security and efficiency. These challenges span technical and cybersecurity concerns, privacy and data security, economic stability, and legal and regulatory frameworks. Each dimension is critical to ensuring that CBDCs function reliably within national and international financial systems, while safeguarding public trust and protecting against systemic risks.

One of the primary challenges in CBDC implementation is the technical infrastructure required to support a secure, resilient and scalable digital currency. Central banks must develop a robust digital infrastructure capable of handling potentially vast transaction volumes without compromising reliability or speed. Unlike traditional cash systems, where security is largely a matter of physical integrity, CBDCs require advanced digital security measures to counteract sophisticated cyber threats. Cybersecurity risks are a prominent concern, as CBDCs will become a prime target for cybercriminals given their scale and importance. The risk of cyberattacks targeting vulnerabilities in the CBDC system could not only threaten national financial stability but also erode public trust in digital currency if significant breaches occur. Ensuring that CBDC infrastructure is resilient against such attacks requires extensive investment in cybersecurity, as well as continuous monitoring and updates to counter evolving threats. Moreover, scalability and system resilience are crucial for a CBDC to function seamlessly under various usage scenarios, particularly during periods of high demand. For a CBDC to gain acceptance, it must offer the same — if not superior — reliability as existing payment methods, necessitating significant innovation in DLT, encryption and system design.

Privacy and data security represent another critical issue in CBDC deployment, as central banks must strike a balance between preserving user privacy and maintaining control over digital transactions to fulfil regulatory obligations. Public concerns over government surveillance are particularly significant, as CBDCs could allow central authorities unprecedented access to individual transaction data, if designed without adequate privacy protections. This raises the potential for public resistance to CBDC adoption, especially in jurisdictions with strong cultural or legal preferences for privacy. In the United States, where generally more libertarian views toward privacy have resonated with the public, Donald Trump, in his re-election campaign speech in New Hampshire in 2024, quipped "To protect Americans from government tyranny, as your President, I will never allow the creation of a central bank digital currency. Such a currency would give our federal government absolute control over your money" (Ozili 2024). The Republican majority leader from Minnesota Tom Emmer echoed this sentiment in his comments when introducing the CBDC Anti-Surveillance State Act to the US House of Representatives: "A central bank digital currency is government-controlled programmable money that, if not designed to emulate cash, could allow the federal government to surveil and restrict Americans' transactions. This is not just alarming — it's downright un-American" (ibid.).

Additionally, the handling and storage of vast amounts of transaction data by central banks or authorized intermediaries increase the risk of data misuse or unauthorized access. Therefore, any CBDC framework must include rigorous data protection measures, with transparent policies on data usage, limited data collection and secure storage protocols. To mitigate these risks, central banks may employ advanced encryption and privacy-preserving technologies, such as zero-knowledge proofs or decentralized identity systems, which can offer users a degree of anonymity while ensuring that central banks retain necessary oversight over larger, regulated transactions.

The introduction of CBDCs also carries significant economic and financial stability risks, particularly concerning the potential disintermediation of commercial banks. A CBDC that competes directly with commercial bank deposits could prompt users to shift their funds from bank accounts to CBDC wallets, especially in times of economic uncertainty. Such a shift could weaken banks' balance sheets, reduce the availability of deposits for lending, and ultimately diminish their capacity to generate credit, potentially disrupting credit markets and broader economic activity. During financial crises, CBDCs could exacerbate this "flight to safety," where people may prefer holding a risk-free central bank-issued currency over deposits in commercial banks, intensifying financial instability (Das et al. 2023). To mitigate this, central banks may impose limits on CBDC holdings or adopt a tiered interest rate system to discourage excessive accumulation of CBDC by individuals and institutions. However, these measures introduce complexity in managing monetary policy and may affect the transmission of central bank interest rate changes through the economy. Additionally, the introduction of a CBDC could impact inflation control mechanisms if it alters how central banks traditionally manage liquidity and interest rates. By creating a new form of money that coexists with traditional bank deposits, central banks must ensure that CBDCs integrate smoothly with existing monetary tools and do not inadvertently destabilize inflation targets or economic growth. It is also important to note that while disintermediation is often cited as a risk, it could potentially correct inefficiencies and reduce rent-seeking behaviour among traditional banks. Thus, disintermediation may be desirable under certain democratic and financial inclusion objectives.

Legal and regulatory frameworks form another critical area in CBDC implementation. To be widely adopted and effective, CBDCs must achieve legal tender status and comply with existing monetary regulations within each jurisdiction. This may require updating financial laws, revising regulations around digital assets and developing comprehensive frameworks for CBDC governance. Moreover, as CBDCs are inherently digital and potentially borderless, international coordination is essential to ensure that these currencies can be used seamlessly across borders. For instance, CBDC interoperability is key for enabling cross-border transactions and reducing friction in international payments, but achieving this requires standardized protocols, shared regulatory guidelines and a cohesive approach to AML and CTF compliance. Multilateral organizations, such as the BIS, play a critical role in fostering such standards, as CBDCs must adhere to common principles for effective global use. Without standardization and regulatory cooperation, the risk of fragmentation and incompatible CBDC systems could hinder the global integration of digital currencies, creating inefficiencies and complicating regulatory oversight.

The implementation of CBDCs involves navigating a complex landscape of technical, economic and regulatory challenges, each with profound implications for the stability, privacy and functionality of digital currencies. Addressing these issues requires careful policy design, collaboration with both domestic and international stakeholders and continuous technological adaptation. As central banks proceed with CBDC development, they must ensure that these digital currencies not only meet the functional needs of modern financial systems but also maintain public trust by prioritizing security, privacy and regulatory integrity. Successfully overcoming these challenges will determine whether CBDCs can fulfil their potential as transformative tools for the future of finance.

The Future of CBDCs: Trends and Predictions

As we look to the future, despite the array of challenges associated with their development and implementation, the adoption of CBDCs is not inevitable but is becoming more probable across diverse jurisdictions, although the future may involve hybrid or fragmented regimes. The rapid digitalization of economies, alongside the emergence of cryptocurrencies and private digital assets, has underscored the need for central banks to retain control over monetary systems and ensure the resilience of sovereign currencies. Central banks view CBDCs not merely as a digital extension of cash but as a pivotal instrument for maintaining monetary sovereignty and enhancing financial systems in the face of technological disruption.

For central banks, CBDCs could potentially play a pivotal role in reshaping monetary policy. One significant transformation lies in how CBDCs could influence interest rate management and monetary policy transmission. Unlike conventional cash, which is passive and subject to the indirect influence of policy rates through the banking sector, CBDCs would allow central banks to transmit policy rates directly to consumers (Davoodalhosseini, Rivadeneyra and Zhu 2020). This means that changes in interest rates could be immediately reflected in the holdings of CBDC users, bypassing commercial banks and allowing for a more direct and immediate response to policy adjustments. In times of economic downturn, for example, central banks could implement a negative interest rate on CBDC holdings to encourage spending, effectively creating a tool to stimulate demand. The ability to impact individual and business financial behaviour in real-time through CBDCs could significantly enhance the effectiveness of monetary policy and provide central banks with a powerful lever for managing economic conditions. However, this also raises considerations regarding the impact on traditional banking functions, necessitating a carefully balanced approach to avoid disintermediation.

Beyond traditional monetary policy, CBDCs introduce the concept of programmable money, which could extend the scope of fiscal policy tools in unprecedented ways. Unlike traditional cash, programmable CBDCs can be designed to incorporate conditionality, allowing for more targeted and time-sensitive policy measures (International Working Group on Data Protection in Technology 2024). For example, a government could distribute stimulus funds via CBDCs with programmable features that restrict their use to specific sectors, such as essential goods or services, or limit the time frame within which the funds must be spent. This level of control would enable governments to implement fiscal policies that are more precisely tailored to current economic needs, ensuring that financial interventions achieve their intended effects efficiently. Moreover, programmable CBDCs could support targeted social benefits, such as subsidies that can only be spent on designated categories, reducing the risk of misuse and increasing the impact of fiscal measures on public welfare. These programmable features could also facilitate crisis management by enabling rapid, automated responses to economic shocks, such as temporarily suspending fees or adjusting interest rates directly within the CBDC framework. The transformative power of CBDCs could remodel the central banks' role in economic governance, making their influence more direct, adaptive and responsive to the needs of the digital economy era of the twenty-first century.

The future of CBDCs hinges on the close collaboration between the public and private sectors to unlock the full potential of digital currency ecosystems that are both innovative and safe. As the financial landscape becomes more digitalized, the traditional lines between government-issued currencies and private digital assets are beginning to blur, opening the door to hybrid models and partnerships that can foster unique use cases, products and services. This cooperative framework will not only help CBDCs coexist with private digital currencies, such as cryptocurrencies and stablecoins, but could also enable the integration of these assets into regulated financial systems, ensuring transparency, stability and compliance with societal standards. Emerging technologies such as artificial intelligence (AI), blockchain and DLT, and quantum technologies will play a crucial role in making CBDCs both secure and responsive to modern demands around privacy, ethics and cross-border functionality.

CBDCs and private digital currencies can either compete or cooperate within the digital financial ecosystem. A collaborative approach could lead to a variety of benefits, as partnerships

between central banks and private issuers of stablecoins. Collaboration between CBDCs and private cryptocurrencies, including stablecoins, could lead to innovative payment solutions and financial products. By allowing CBDCs and private digital assets to interact on regulated platforms, central banks can create a controlled ecosystem that encourages innovation while maintaining oversight. For instance, a CBDC pegged to a national currency could act as a stable bridge between local users and foreign stablecoin holders, facilitating cross-border remittances or microtransactions with greater confidence in the currency's value. This could be particularly useful for migrant workers who frequently send remittances back home, as the integration would lower transaction fees and speed up processing times, reducing the financial burden on users. This approach would allow for real-time, low-cost international payments, meeting the demands of an increasingly globalized economy while ensuring that transactions comply with financial regulations. Additionally, CBDCs integrated with private crypto assets could provide enhanced liquidity to digital marketplaces, making digital payments more accessible and appealing to a broad base of consumers.

The integration of emerging technologies, particularly DLT, AI and quantum technologies, offers transformative potential for CBDCs, enhancing their functionality and security. DLT, which underpins both blockchain and other distributed networks, allows for secure, transparent and efficient transaction processing, making it an ideal foundation for CBDC infrastructure. With DLT, CBDCs can leverage the benefits of decentralized networks while maintaining central oversight and control, enabling them to provide services that align with regulatory standards and public expectations around security and transparency.

AI further enhances the capabilities of CBDCs, particularly in the areas of fraud detection, risk management and customer service. Advanced machine learning algorithms can analyze vast amounts of transactional data in real-time, identifying suspicious patterns and preventing fraudulent activity more efficiently than traditional monitoring methods (Rey 2024). This capacity for enhanced security is essential in a digital currency system that operates at scale, as CBDCs will need to be robust against a variety of threats, from cybercrime to money laundering. AI can also support seamless customer service experiences by automating responses and providing real-time support, enhancing public trust in CBDCs by offering a user-friendly and secure digital currency experience. In addition, AI can be programmed to ensure compliance with ethical and privacy standards, helping central banks address concerns over surveillance and data misuse by incorporating safeguards that prioritize user privacy (Hong, Zheng and Zilberman 2024).

Quantum technologies, while still in the developmental stages, represent both an opportunity and a challenge for CBDCs. On one hand, quantum computing has the potential to revolutionize cryptographic security, enabling encryption that could be orders of magnitude more secure than current systems. This technology could help central banks secure CBDC transactions against even the most sophisticated cyber threats. However, quantum computing also poses a risk to existing cryptographic protocols, as it could theoretically break many of the encryption methods currently used in financial transactions. To mitigate this, central banks and private partners are beginning to explore quantum-resistant cryptographic techniques, ensuring that CBDCs will remain secure and resilient in the face of quantum advances (Nili, Patterson and Dukatz 2024). Proactively developing these capabilities will be essential to the long-term security and public acceptance of CBDCs as technology continues to evolve.

These collaborative models also allow central banks to address societal concerns around privacy and ethical use of digital currencies. By working with the private sector, central banks can leverage cutting-edge privacy-preserving technologies, such as zero-knowledge proofs, which enable transaction validation without revealing personal data (Fenzi 2019). This would help to address public concerns over data privacy and government surveillance, fostering a CBDC model that aligns with democratic values and ethical standards. This partnership-driven approach promises to unlock the full potential of CBDCs, fostering an ecosystem where state-backed digital currencies and private digital assets coexist and complement one another within a secure, innovative and regulated framework.

Conclusion

CBDCs are poised to reshape global finance as central banks adapt to an increasingly digital economy. As highlighted throughout this analysis, CBDCs potentially offer central banks powerful tools to modernize payment systems, protect monetary sovereignty and foster financial inclusion. Motivated by the rapid digitalization of financial ecosystems and the rise of decentralized cryptocurrencies, central banks worldwide are exploring various models — retail, wholesale and hybrid CBDCs — each designed to address distinct economic needs, whether that means enhancing financial accessibility, streamlining interbank transactions or integrating public and institutional benefits within one cohesive system.

While the potential benefits of CBDCs are significant, their successful implementation requires careful consideration of several key challenges. Ensuring user privacy is paramount, and robust encryption and transparency measures must be implemented to protect sensitive information. Additionally, policy makers must address the potential risks of disintermediation, where a mass shift of deposits to CBDCs could destabilize the traditional banking system. To mitigate this risk, strategies such as tiered interest rates, deposit caps or two-tier distribution models can be employed to maintain financial stability. Finally, international cooperation is essential for the successful implementation of CBDCs. Central banks must work together to establish interoperability standards, ensuring seamless cross-border transactions and reducing fragmentation in the global financial system. By addressing these challenges and fostering international collaboration, policy makers can unlock the full potential of CBDCs to transform the global financial landscape.

In her speech delivered at the Future of Money: Gearing up for CBDC event at the Atlantic Council, IMF Managing Director Kristalina Georgieva remarked that "these are still early days for CBDCs, and we don't quite know how far and how fast they will go. What we know is that central banks are building capacity to harness new technologies — to be ready for what may lie ahead" (Georgieva 2022). From this statement one thing is clear: the CBDC debate is not going anywhere, and it will continue to evolve. CBDCs are likely to become indispensable instruments for monetary policy, potentially providing central banks with direct levers to influence financial behaviour and economic stability. Through prudent design, regulatory foresight and multilateral engagement, CBDCs could become not only digital extensions of cash but also foundational elements of an interconnected, resilient financial landscape. These currencies are therefore not just innovations but strategic imperatives that could redefine the role of central banks in a world where digital finance is the norm, hopefully setting the stage for a more inclusive and efficient global economic system.

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