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Leveraging Central Bank Digital Currency for Sustainable Development in Emerging Economies: Challenges and Strategic Approaches

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9.1 Introduction

Central bank digital currency (CBDC) has emerged as a revolutionary concept in the realm of digital finance, attracting significant attention from policymakers, economists, and technologists alike. CBDCs represent a digital form of a country's fiat currency, issued and regulated by the central bank (Avgouleas & Blair, 2024; Clarke & Hrnjic, 2024; Lannquist & Tan, 2023). Unlike cryptocurrencies such as Bitcoin, CBDCs are centralized and backed by the full faith and credit of the issuing government. The concept has gained traction in recent years, with over 100 countries exploring or actively developing CBDCs as of 2023 (Allen et al., 2022). This surge in interest is driven by various factors, including the digitalization of economies, the decline in cash usage, and the potential to enhance financial inclusion and monetary policy transmission.

As the world grapples with these technological advancements in finance, it simultaneously faces pressing global challenges addressed by the Sustainable Development Goals (SDGs). Adopted by all United Nations Member States in 2015, the SDGs represent a universal call to action to end poverty, protect the planet, and ensure prosperity for all by 2030 (Halisçelik & Soytas, 2019; Sachs, 2015). The 17 interconnected goals address global challenges such as poverty, inequality, climate change, environmental degradation, peace, and justice. As we approach the midpoint of the SDG timeline, progress has been made in some areas, but significant challenges remain, particularly in developing economies. The COVID-19 pandemic has further exacerbated these challenges, reversing years of progress in some cases (United Nations Department of Economic and Social Affairs, 2016). In this context, innovative financial technologies, including CBDCs, are being explored as potential tools to accelerate progress toward the SDGs.

Developing economies, characterized by lower levels of industrialization, income per capita, and human development indices, face unique challenges in achieving the SDGs. These countries often struggle with limited access to financial services, high levels of poverty and inequality, and inadequate infrastructure (Dahlman & Mealy, 2016; Jaiyesimi, 2016). According to the World Bank, about 1.4 billion adults remain unbanked globally, with the majority residing in developing countries (Demirgüç-Kunt et al., 2022). Furthermore, these economies are often more vulnerable to economic shocks, climate change

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impacts, and global crises. The digital divide, in terms of access to both technology and digital literacy, presents another significant hurdle. However, developing economies also offer fertile ground for innovative solutions, as they can potentially leapfrog traditional financial systems and adopt cutting-edge technologies like CBDCs more readily than developed economies with entrenched financial infrastructures.

This research explores the potential role of Central Bank Digital Currencies in accelerating the achievement of Sustainable Development Goals in developing economies. By examining the intersection of digital finance innovation and sustainable development, we aim to assess how CBDCs can address specific challenges faced by developing countries, such as financial exclusion, inefficient government services, and limited economic opportunities. This study will investigate both the opportunities and the risks associated with CBDC implementation in the context of SDGs, providing insights for policymakers, central banks, and development practitioners. Ultimately, this research seeks to contribute to the growing body of knowledge on how financial technologies can be leveraged to create more inclusive, sustainable, and resilient economies in the developing world.

The rest of this chapter is structured as follows: Sect. 9.2 highlights the understanding of Central Bank Digital Currencies (CBDCs). Section 9.3 examines the Sustainable Development Goals (SDGs) in context. Section 9.4 discusses the potential impact of CBDCs on the SDGs. Section 9.5 reviews case studies on CBDCs. Section 9.6 elaborates on challenges and key considerations associated with CBDCs, while Sect. 9.7 offers significant recommendations for their implementation. Finally, Sect. 9.8 concludes this study.

9.2 Understanding Central Bank Digital Currency (CBDC)

Central bank digital currency (CBDC) represents a groundbreaking form of digital money issued by a country's central bank, designed to serve as a complement or alternative to traditional physical currency and commercial bank deposits. The Bank for International Settlements (BIS) defines CBDC as "a digital payment instrument, denominated in the national unit of account, that is a direct liability of the central bank" (Kosse & Mattei, 2023). This definition encapsulates several key characteristics that distinguish CBDCs from other forms of digital money. Unlike cryptocurrencies or stablecoins issued by private entities, CBDCs are direct liabilities of the central bank, backed by its credibility and the nation's economic strength (Auer et al., 2023). They exist purely in digital form, without physical representation, enabling instant transfers and programmability. In many proposed implementations, CBDCs would have legal tender status, meaning they must be accepted for payments of debts and taxes (European Central Bank, 2023a). Furthermore, CBDCs are designed to be interoperable with existing payment systems and financial infrastructure, and their digital nature allows for the implementation of smart contracts and conditional payments, enabling new functionalities in the financial system (Berg, 2022; Sethaput & Innet, 2023).

CBDCs are generally categorized into two main types: wholesale and retail, each serving different purposes and user groups. Wholesale CBDCs are designed for use by financial institutions and are not accessible to the general public. They are primarily intended to enhance the efficiency and security of interbank settlements and large-value transfers (Secretariat, 2022; Lannquist & Tan, 2023; Bindseil et al., 2021). Key features of wholesale CBDCs include restricted access to authorized financial institutions, potential for 24/7 settlement of high-value transactions, improved liquidity management for banks, and enhanced cross-border payment capabilities. The Bank of France, for instance, has conducted several experiments with wholesale CBDCs, demonstrating their potential to streamline cross-border and cross-currency transactions (Jahan et al., 2022).

In contrast, retail CBDCs, also known as general purpose CBDCs, are designed for use by the general public and businesses for everyday transactions. They are intended to complement or potentially replace physical cash and provide an alternative to commercial bank deposits (Schumacher, 2024; Bindseil et al., 2021). Key

features of retail CBDCs include universal accessibility for all citizens and businesses, potential for offline functionality to ensure inclusivity, privacy considerations balanced with regulatory compliance, and integration with existing payment infrastructures. China's digital yuan (e-CNY) is a prominent example of a retail CBDC in the advanced stages of testing, with millions of users participating in pilot programs across multiple cities (Lannquist & Tan, 2023).

The global landscape of CBDC initiatives is rapidly evolving, with countries at various stages of research, development, and implementation. As of 2024, over 100 countries, representing more than 95% of the global GDP, are exploring CBDCs (Brokke & Engen, 2019). Many central banks, including the US Federal Reserve and the European Central Bank, are in the research phase, examining the potential benefits, risks, and technical challenges associated with CBDCs. Several countries have moved beyond research to launch pilot programs. Notable examples include China's e-CNY, which has been tested in multiple cities with millions of users; the Eastern Caribbean Central Bank's (ECCB) DCash, launched in multiple Caribbean nations; and Sweden's e-krona pilot, testing various technical solutions and use cases.

As of 2024, the Bahamas remains one of the few countries to have fully launched a CBDC, with its Sand Dollar in circulation since October 2020 (Colebrook, 2022). Nigeria's eNaira, launched in October 2021, is another example of a fully implemented CBDC. Recognizing the potential impact of CBDCs on cross-border transactions, several international initiatives are underway. The BIS Innovation Hub is coordinating multiple projects, including Project Dunbar and Project mBridge, which explore multi-CBDC arrangements for international settlements (Themistocleous et al., 2023).

The landscape of CBDC initiatives is characterized by diversity in approach, with each country tailoring its CBDC strategy to its specific economic context, policy objectives, and technological capabilities. As more countries progress from research to pilot programs and full implementation, the global financial system is poised for potentially significant transformation, with implications for monetary policy, financial stability, and the future of money itself.

9.3 Sustainable Development Goals in Context

9.3.1 Brief Overview of the 17 SDGs

The Sustainable Development Goals (SDGs), adopted by the United Nations General Assembly in 2015, represent a global commitment to create a more equitable, sustainable, and prosperous world for all. These 17 interconnected goals form the core of the 2030 Agenda for Sustainable Development, encompassing a wide range of social, economic, and environmental issues. From eradicating poverty and hunger to ensuring quality education, gender equality, and climate action, the SDGs are designed to be universal, integrated, and indivisible, recognizing the interconnected nature of global challenges (Weiland et al., 2021).

As we approach the midpoint of this ambitious agenda, progress has been mixed. The United Nations' latest progress report highlights both achievements and setbacks. Significant strides have been made in areas such as maternal and child health, access to electricity, and marine protection. However, progress in many areas has slowed or reversed due to the COVID-19 pandemic, conflicts, and climate change (United Nations, 2024). For instance, global extreme poverty rose in 2020 for the first time in over 20 years, with an estimated 119–124 million people pushed back into extreme poverty in 2020 alone (Millard & Fucci, 2023). This setback underscores the fragility of development gains and the need for sustained, innovative approaches to achieving the SDGs.

9.3.2 Specific Challenges in Achieving SDGs in Developing Economies

Developing economies face particularly acute challenges in achieving the SDGs, often grappling with a complex web of interconnected obstacles. Resource constraints stand out as a pri-

mary hurdle, with many developing countries lacking the financial capacity to invest adequately in critical areas such as healthcare, education, and infrastructure (Sachs et al., 2024). The United Nations Conference on Trade and Development (UNCTAD) estimates an annual investment gap of $2.5 trillion in developing countries for achieving the SDGs (UNCTAD, 2023). This financial shortfall is exacerbated by institutional weaknesses, including weak governance structures, corruption, and inefficient public services, which hinder progress across multiple SDGs. The World Bank's Worldwide Governance Indicators consistently show that low-income countries score lower on measures of government effectiveness, regulatory quality, and control of corruption (Nikolic, 2023).

Economic vulnerabilities further compound these challenges, with developing economies often more susceptible to economic shocks, commodity price fluctuations, and debt crises. The COVID-19 pandemic has starkly illustrated this vulnerability, with the International Monetary Fund (IMF) projecting slower economic recovery for emerging markets and developing economies compared to advanced economies (Ruch, 2020). Climate change adds another layer of complexity, disproportionately affecting developing countries, particularly Small Island Developing States and least developed countries. The Global Climate Risk Index reveals that eight of the ten countries most affected by extreme weather events between 2000 and 2019 were developing countries (Germanwatch, 2024).

The digital divide presents yet another significant barrier to progress on several SDGs, including education, innovation, and economic growth. The International Telecommunication Union (ITU) reports that only 27% of people in least developed countries used the Internet in 2022, compared to 90% in developed countries (ITU, 2023). This disparity in access to digital technologies hampers the ability of developing economies to leverage technological advancements for sustainable development. Additionally, demographic pressures, particularly rapid population growth in many developing countries, strain resources and service delivery systems. The UN projects that more than half of the global population growth between now and 2050 will occur in sub-Saharan Africa (United Nations Population Division, 2023), highlighting the need for sustainable development strategies that can keep pace with demographic changes.

9.3.3 The Role of Financial Technology in Sustainable Development

In the face of these challenges, financial technology (fintech) has emerged as a powerful tool for advancing sustainable development, particularly in developing economies. Fintech solutions, such as mobile money and digital banking platforms, have dramatically expanded access to financial services, directly contributing to SDG 1 (No Poverty) and SDG 10 (Reduced Inequalities). For instance, M-Pesa in Kenya has significantly increased financial inclusion, with 96% of households outside Nairobi having at least one M-Pesa account (FSD Kenya, 2023). Beyond financial inclusion, blockchain- and AI-powered fintech solutions are enhancing transparency and efficiency in resource allocation, potentially addressing corruption and improving public service delivery (SDG 16). The World Food Programme's Building Blocks project, which uses blockchain to deliver cash assistance more efficiently to refugees in Jordan, exemplifies this potential (World Food Programme, 2024).

Fintech is also facilitating the growth of sustainable finance by enabling green bonds, impact investing, and environmental, social, and governance (ESG)-focused financial products. For instance, crowdfunding and peer-to-peer lending platforms enabled by fintech are opening new avenues for funding SDG-related projects. The United Nations Development Programme's (UNDP) Digital X Scale Accelerator has leveraged such platforms to fund innovative solutions for the SDGs in multiple developing countries (Ingram et al., 2022).

The vast amounts of data generated by fintech are also being leveraged for development planning and impact assessment. The Global Partnership for Sustainable Development Data highlights how fintech-generated data is being used to track progress on the SDGs and inform policy decisions (Honcharenko et al., 2021). Additionally, digital platforms and mobile apps are making financial education more accessible, contributing to SDG 4 (quality education) and enhancing overall financial literacy. The Organisation for Economic Co-operation and Development (OECD) reports that fintech-based financial education initiatives have reached millions of people in developing countries (Ariana et al., 2024; Fauziyah et al., 2024).

As we consider the potential of Central Bank Digital Currencies (CBDCs) in achieving the SDGs, it's important to view them within this broader context of fintech's role in sustainable development. CBDCs could potentially amplify many of these positive impacts while addressing some of the limitations of current fintech solutions, particularly in terms of financial stability, monetary policy effectiveness, and regulatory oversight. The intersection of CBDCs, sustainable development, and the specific challenges faced by developing economies presents a rich area for exploration, offering the potential to accelerate progress toward the SDGs in ways that were previously unimaginable.

9.4 Potential Impacts of CBDC on SDGs in Developing Economies

Central Bank Digital Currencies (CBDCs) have the potential to significantly impact the achievement of Sustainable Development Goals (SDGs) in developing economies. This section explores the various ways in which CBDCs could contribute to specific SDGs, focusing on financial inclusion, economic growth, gender equality, improved governance, and environmental sustainability.

9.4.1 Financial Inclusion (SDG 1: No Poverty, SDG 10: Reduced Inequalities)

CBDCs have the potential to dramatically improve financial inclusion, contributing directly to SDG 1 (No Poverty) and SDG 10 (Reduced Inequalities). By providing a digital means of payment and store of value, CBDCs can offer unbanked and underbanked populations a secure, low-cost entry point into the formal financial system. The World Bank estimates that 1.4 billion adults remain unbanked globally, with the majority in developing countries (Ozili, 2023). CBDCs can significantly reduce the cost of financial transactions by leveraging digital technology. The Bank for International Settlements (BIS) suggests that CBDCs could lower the cost of remittances, which averaged 6.3% of the transfer amount in 2023, well above the SDG target of 3% (Westermeier, 2018). Furthermore, CBDCs could enhance financial resilience by facilitating more efficient distribution of social benefits and emergency aid. During the COVID-19 pandemic, countries with advanced digital payment systems were able to disburse financial aid more quickly and efficiently (Bidder et al., 2024). In the realm of cross-border transactions, multi-CBDC arrangements could streamline processes, potentially reducing costs and increasing speed. The BIS's Project mBridge demonstrated the potential for CBDCs to reduce cross-border transaction costs by up to 50% (Sethaput & Innet, 2023).

9.4.2 Economic Growth and Job Creation (SDG 8: Decent Work and Economic Growth)

CBDCs could contribute to economic growth and job creation in several ways. By reducing transaction costs and increasing the speed of payments, CBDCs could enhance overall economic productivity. The European Central Bank estimates that the introduction of a digital euro could increase the European Union's GDP by up to 0.5% over a decade (Brokke & Engen, 2019).

CBDCs could also help bring informal economic activities into the formal sector, potentially increasing tax revenues and improving worker protections. The International Labour Organization estimates that the informal economy in developing countries accounts for about 70% of total employment (Tan, 2023). The programmability feature of CBDCs could spur innovation in financial services and beyond. For example, smart contracts enabled by CBDCs could automate various business processes, potentially creating new jobs in the digital economy (World Economic Forum, 2023). Additionally, the digital footprint created by CBDC transactions could help individuals and small businesses build credit histories, potentially improving their access to loans and other financial services (Wenker, 2022).

9.4.3 Gender Equality in Financial Access (SDG 5: Gender Equality)

CBDCs could play a significant role in promoting gender equality in financial access. In some cultures, where women face restrictions on mobility or interactions with male bank staff, CBDCs could provide a means of accessing financial services from home. The Global System for Mobile Communications Association (GSMA) reports that the gender gap in mobile Internet use in low- and middle-income countries narrowed to 16% in 2023, suggesting that digital solutions can help bridge gender divides (GSMA, 2024). CBDCs could provide women with greater control over their finances, potentially increasing their economic participation and decision-making power within households. A study by UN Women found that digital financial services can have this empowering effect (UN Women, 2023). Moreover, the programmability of CBDCs could enable the creation of financial products tailored to women's needs, such as savings accounts with specific goals or micro-insurance products (Alliance for Financial Inclusion, 2024).

9.4.4 Improved Government Services and Reduced Corruption (SDG 16: Peace, Justice, and Strong Institutions)

CBDCs have the potential to enhance governance and reduce corruption. The digital nature of CBDCs allows for better tracking of financial flows, potentially reducing corruption and illicit financial activities. It is estimated that corruption costs developing countries $1.26 trillion per year (Transparency International, 2019). CBDCs could streamline the delivery of government services, including social benefits, reducing leakages, and ensuring that funds reach intended beneficiaries. The Indian government's direct benefit transfer system, which leverages digital payments, saved an estimated $33 billion over 6 years by reducing fraud and inefficiencies. Furthermore, CBDCs could improve tax collection by providing a more comprehensive view of economic activities. The International Monetary Fund (2024) suggests that the digitalization of tax systems in developing countries could increase tax revenues.

9.4.5 Environmental Sustainability Through Digital Transactions (SDG 13: Climate Action)

While the environmental impact of CBDCs is a subject of ongoing research, they could potentially contribute to environmental sustainability. CBDCs could reduce the need for physical cash, potentially decreasing the environmental impact of cash production and transportation. The European Central Bank estimates that producing and distributing euro banknotes generates about 500,000 tons of CO_2 equivalent per year (ECB, 2023b). Unlike some cryptocurrencies that use energy-intensive consensus mechanisms, CBDCs can be designed to be more energy-efficient. The People's Bank of China (PBOC) claims that its digital yuan uses a fraction of the energy con-

sumed by major cryptocurrencies (Hamilton, 2024). Additionally, CBDCs could potentially facilitate the implementation and tracking of green finance initiatives. The Bank of England is exploring how CBDCs could support the transition to a net-zero economy by enabling more efficient allocation of capital to sustainable projects (Tan, 2023).

While these potential impacts are promising, it's important to note that the actual effects of CBDCs will depend on their specific design, implementation, and the broader policy environment in which they operate. As developing economies consider CBDC initiatives, careful consideration must be given to potential risks and challenges, including privacy concerns, cybersecurity risks, and the need for digital literacy and infrastructure development.

9.5 Case Studies

As Central Bank Digital Currencies (CBDCs) gain traction globally, several developing countries have launched pilot programs or full implementations. This section examines key case studies, analyzing their approaches, outcomes, and the lessons learned.

9.5.1 Analysis of CBDC Pilots or Implementations in Developing Countries

While China is not typically classified as a developing country, its CBDC implementation offers valuable insights for developing economies. The People's Bank of China (PBOC) began piloting the e-CNY in 2020 and has since expanded to multiple cities. The e-CNY operates on a two-tier system where the PBOC issues e-CNY to authorized operators (commercial banks), who then distribute it to the public. It features controllable anonymity, allowing small transactions to be anonymous while larger ones require identification. Notably, the e-CNY can be used without an Internet connection. As of December 2023, the e-CNY pilot had over 300 million individual users and 5.6 million merchant accounts, with transaction volumes exceeding 1.8 trillion yuan (approximately $250 billion) (Mu, 2023). The e-CNY has been used for various purposes, including retail payments, government subsidies, and transportation fees.

Nigeria launched the eNaira in October 2021, becoming the first African country to introduce a CBDC. The eNaira features a tiered Know Your Customer (KYC) system with different wallet tiers having varying transaction limits based on the level of user identification. It integrates with existing banking apps, allowing users to access eNaira through their regular banking applications. The eNaira also offers Unstructured Supplementary Service Data (USSD) functionality, enabling access via feature phones, not just smartphones. As of January 2024, about 13 million eNaira wallets had been created, with transaction volumes reaching 10 billion naira (approximately $22 million) (Ree, 2023). However, adoption has been slower than anticipated, with challenges including low public awareness and technical issues.

The Eastern Caribbean Central Bank (ECCB) launched DCash in March 2021, making it the first currency union to issue a CBDC. DCash is implemented across multiple islands in the Eastern Caribbean, in collaboration with Bitt, a fintech company. It is designed with a focus on disaster recovery, facilitating quick fund transfers in case of natural disasters. However, the system faced a significant outage in January 2022, highlighting the importance of robust technical infrastructure.

The Bahamas launched the Sand Dollar in October 2020, becoming one of the first countries globally to fully implement a CBDC. The Sand Dollar is designed with a focus on financial inclusion, aiming to serve the unbanked population across the country's many islands. It offers interoperability across different wallet providers and supports offline functionality, allowing transactions without Internet connectivity. By the end of 2023, approximately 20% of the Bahamian population had adopted the Sand Dollar, with transaction volumes steadily increasing (Central Bank of The Bahamas, 2024). The CBDC has

been particularly useful in facilitating payments on smaller, less-connected islands.

9.5.2 Lessons Learned and Best Practices

The experiences of these early CBDC adopters offer valuable lessons and best practices for other developing countries considering CBDC implementation. Nigeria's experience with the eNaira highlights the importance of prioritizing user experience and education. CBDCs should be easily accessible and understandable to the general public, with significant resources devoted to public awareness and user-friendly interfaces. The DCash outage underscores the need for ensuring robust technical infrastructure. Adequate investment in resilient and well-tested systems is crucial for CBDC success.

Successful implementations like China's e-CNY and the Bahamas' Sand Dollar demonstrate the importance of focusing on specific use cases, such as government payments or serving unbanked populations. The public–private partnership seen in the DCash implementation shows that collaboration with the private sector can leverage existing expertise and infrastructure effectively. The approaches to tiered KYC and privacy in China's and Nigeria's CBDCs demonstrate the importance of balancing regulatory requirements with user privacy concerns.

Ensuring interoperability, as seen in Nigeria and the Bahamas, is crucial for widespread adoption. The ability to integrate with existing financial systems can significantly boost CBDC uptake. Given infrastructure challenges in many developing countries, offline capability, as implemented in China and the Bahamas, is essential for inclusivity. As digital systems, CBDCs are vulnerable to cyber threats, making robust security measures crucial. A Bank for International Settlements study emphasizes the importance of addressing cybersecurity concerns in CBDC design and implementation (BIS, 2023a).

Environmental considerations should not be overlooked. A United Nations Environment Programme report highlights that the energy efficiency of CBDC systems, compared to some cryptocurrencies, should be a key consideration in their design and deployment (Suratini et al., 2024). While most current implementations focus on domestic use, an International Monetary Fund working paper suggests that the potential for cross-border transactions should be considered in the design phase of CBDCs (Ginneken, 2019).

These case studies and lessons learned provide valuable insights for other developing countries considering CBDC implementation. However, it is important to note that each country's unique economic, social, and technological context will necessitate a tailored approach to CBDC design and deployment. As more countries progress with their CBDC initiatives, continued research and knowledge sharing will be crucial in refining best practices and maximizing the potential of CBDCs to contribute to sustainable development in the developing world.

9.6 Challenges and Considerations

While Central Bank Digital Currencies (CBDCs) offer significant potential benefits for developing economies, their implementation also presents several challenges and important considerations. This section explores these issues in detail, focusing on technological infrastructure, regulatory frameworks, privacy and security concerns, the digital skills gap, and potential impacts on traditional banking systems.

9.6.1 Technological Infrastructure Requirements

Implementing a CBDC requires robust technological infrastructure, which can be a significant challenge for many developing economies. The Bank for International Settlements (BIS) emphasizes that a reliable and widespread telecommunications network is crucial for CBDC adoption (BIS, 2023b). However, many developing countries still struggle with limited Internet connec-

tivity, especially in rural areas. The International Telecommunication Union (ITU) reports that as of 2023, only 36% of individuals in least developed countries used the Internet, compared to 92% in developed countries (ITU, 2023).

Beyond basic connectivity, CBDC systems require significant computational power and data storage capabilities. Cloud computing solutions might offer a way forward, but they come with their own set of challenges related to data sovereignty and security. The World Bank's Digital Economy for Africa initiative highlights the need for substantial investments in digital infrastructure to support financial innovation in developing economies (Resilient Digital Africa, 2024).

Moreover, to ensure financial inclusion, CBDC systems must be designed to work on a variety of devices, including feature phones, and potentially in offline modes. The GSMA's Mobile Economy Report 2024 indicates that while smartphone adoption is growing in developing countries, feature phones still account for a significant portion of mobile devices in use (Joiner et al., 2024).

9.6.2 Regulatory and Legal Frameworks

The introduction of CBDCs necessitates the development of comprehensive regulatory and legal frameworks. Many developing countries may need to update their existing financial regulations or create entirely new ones to accommodate CBDCs. The International Monetary Fund (IMF) emphasizes the need for clear legal foundations for CBDCs, including defining their legal tender status and the central bank's authority to issue digital currency (Bossu et al., 2020).

Regulatory challenges also extend to cross-border transactions. As CBDCs have the potential to facilitate easier cross-border payments, international cooperation and regulatory harmonization become crucial. The Financial Stability Board (FSB) has called for enhanced cross-border cooperation in CBDC regulation to address potential risks to global financial stability (FSB, 2024).

Another key regulatory consideration is the prevention of money laundering and terrorist financing. The Financial Action Task Force (FATF) has issued guidelines for a risk-based approach to virtual assets, including CBDCs, emphasizing the need for robust Know Your Customer (KYC) and anti-money laundering (AML) procedures (FATF, 2021).

9.6.3 Privacy and Security Concerns

Privacy and security are paramount concerns in CBDC implementation. Unlike physical cash, which offers anonymity, digital transactions can potentially be tracked, raising privacy concerns. The European Central Bank's report on the digital euro emphasizes the need to balance transaction privacy with the Anti-Money Laundering and Combating the Financing of Terrorism (AML/CFT) requirements (Thompsett, 2024).

Cybersecurity is another critical concern. As digital systems, CBDCs are vulnerable to cyberattacks, hacking, and fraud. The cost of cybercrime is projected to reach $10.5 trillion annually by 2025, according to Cybersecurity Ventures (2021). Developing economies, which may have less advanced cybersecurity infrastructure, could be particularly vulnerable.

Moreover, the centralized nature of CBDCs raises concerns about potential government surveillance and control. Human Rights Watch has warned about the potential misuse of CBDCs for financial surveillance and control, particularly in countries with weak democratic institutions (Jiang, 2023).

9.6.4 Financial Literacy and Digital Skills Gap

The successful implementation of CBDCs requires a population with adequate financial literacy and digital skills. However, many developing countries face significant challenges in this area. The OECD/INFE 2023 International Survey of Adult Financial Literacy reveals that financial literacy levels in developing countries are gener-

ally lower than those in developed countries (OECD, 2023).

The digital skills gap compounds this challenge. The United Nations Educational, Scientific and Cultural Organization (UNESCO) Global Education Monitoring Report 2024 highlights the persistent digital divide, with many adults in developing countries lacking basic digital skills (UNESCO, 2024). This gap could lead to the exclusion of significant portions of the population from CBDC-based financial systems, potentially exacerbating existing inequalities.

Addressing this challenge requires comprehensive education and training programs. The G20 Global Partnership for Financial Inclusion emphasizes the need for digital financial literacy initiatives to support the adoption of digital financial services, including CBDCs (G20 GPFI, 2023).

9.6.5 Potential Negative Impacts on Traditional Banking Systems

The introduction of CBDCs could have significant impacts on traditional banking systems, particularly in developing economies where banking sectors may be less robust. One key concern is the potential for bank disintermediation. If individuals and businesses can hold CBDCs directly with the central bank, they might reduce their deposits in commercial banks, potentially affecting banks' ability to lend and their overall stability.

The Bank for International Settlements warns that in times of financial stress, the ease of converting bank deposits to CBDC could accelerate bank runs (BIS, 2023a). This risk could be particularly acute in developing economies with less stable banking sectors.

Furthermore, CBDCs could impact banks' business models and profitability (Auer et al., 2024). A report by McKinsey & Company suggests that banks might need to offer new, value-added services to remain competitive in a CBDC environment. This could be challenging for banks in developing economies with limited resources for innovation.

The potential impact on monetary policy transmission is another consideration. While CBDCs could enhance the effectiveness of monetary policy by providing central banks with more direct tools, they could also complicate policy implementation, particularly in developing economies with less sophisticated financial markets (Yang & Zhou, 2022).

In conclusion, while CBDCs offer significant potential benefits for developing economies, their implementation comes with substantial challenges. Addressing these challenges requires careful planning, significant investment in infrastructure and education, and the development of robust regulatory frameworks. Moreover, it necessitates a balanced approach that leverages the benefits of CBDCs while mitigating potential risks to financial stability and individual privacy. As developing economies consider CBDC implementation, these challenges and considerations should be at the forefront of policy discussions and planning processes.

9.7 Recommendations for Implementation

The implementation of Central Bank Digital Currencies (CBDCs) in developing economies requires careful planning and strategic execution. This section provides recommendations for policymakers, central banks, and other stakeholders involved in CBDC implementation, drawing on lessons from early adopters and insights from international organizations.

9.7.1 Policy Considerations for Central Banks and Governments

Central banks and governments must carefully consider several key policy aspects when implementing CBDCs. Firstly, it's crucial to clearly define objectives and use cases for the CBDC, aligning them with broader national development goals. The Bank for International Settlements (BIS) emphasizes that CBDCs should be designed

to serve specific policy objectives, such as enhancing financial inclusion or improving payment system efficiency (Lovegrove, 2023). For instance, Nigeria's eNaira was explicitly designed to increase financial inclusion and facilitate remittances. Adopting a phased approach is also recommended, as implementing a CBDC is a complex process that benefits from gradual rollout. The International Monetary Fund (IMF) suggests starting with pilot programs in limited geographical areas or specific use cases before full-scale implementation. China's approach with the e-CNY, involving multiple pilot phases across different cities, provides a good example of this strategy.

Ensuring interoperability is another critical consideration. CBDCs should be designed to be interoperable with existing payment systems and potentially with other countries' CBDCs. The G20's Roadmap for Enhancing Cross-border Payments emphasizes the importance of interoperability in improving the efficiency of cross-border transactions (Bank for International Settlements, 2022a). While promoting innovation, central banks must also balance this with maintaining financial stability. The European Central Bank's report on the digital euro highlights the need to design CBDCs in a way that prevents excessive shifts from bank deposits to CBDC holdings (ECB, 2023b). Lastly, developing comprehensive legal and regulatory frameworks is essential. Governments need to establish clear legal foundations for CBDCs, including defining their status as legal tender and the central bank's authority to issue digital currency. The World Bank's guide on CBDC implementation stresses the importance of updating existing financial regulations to accommodate CBDCs.

9.7.2 Strategies for Overcoming Challenges

Implementing CBDCs in developing economies comes with unique challenges that require strategic solutions. To address technological infrastructure challenges, governments should prioritize investments in digital infrastructure. The United Nations Conference on Trade and Development (UNCTAD) recommends that developing countries increase their efforts in information and communication technology (ICT) infrastructure development (United Nations, 2021). Public–private partnerships can be an effective way to finance these investments. Balancing financial inclusion with regulatory compliance can be achieved through implementing tiered Know Your Customer (KYC) requirements and wallet limits. The Financial Action Task Force (FATF) guidelines support this approach, allowing for simplified due diligence for lower-risk, small-value accounts (FATF, 2024).

To ensure inclusivity, especially in areas with limited connectivity, CBDCs should have offline functionality. The Bank of Ghana's planned CBDC, the e-Cedi, is being designed with offline capabilities to serve rural areas with limited Internet access. Given the critical nature of CBDC systems, prioritizing cybersecurity is essential. The International Telecommunication Union (ITU) provides guidelines for developing countries on strengthening their national cybersecurity capabilities, which can be applied to CBDC systems (ITU, 2018). Addressing the digital skills gap requires implementing comprehensive digital and financial literacy programs. UNESCO's Strategy on Technological Innovation in Education provides a framework for integrating digital skills into educational curricula.

9.7.3 Collaboration with International Organizations and the Private Sector

Collaboration with international organizations and the private sector is crucial for successful CBDC implementation in developing economies. Engaging with international organizations can provide access to valuable expertise and resources. The IMF and World Bank offer technical assistance programs for countries exploring CBDCs, while the BIS Innovation Hub provides a platform for central banks to collaborate on financial technology projects, including CBDCs.

Fostering public–private partnerships can bring technological expertise and innovative solutions to CBDC projects. The World Economic Forum's CBDC Policy-Maker Toolkit emphasizes the importance of engaging with the private sector throughout the CBDC development process (World Economic Forum, 2020).

Participating in international CBDC initiatives can provide valuable insights and promote interoperability. For example, Project Dunbar, a multi-CBDC initiative involving the central banks of Australia, Malaysia, Singapore, and South Africa, explores the use of CBDCs for international settlements (BIS, 2022a, b). Collaboration with fintech companies can help in developing user-friendly CBDC wallets and innovative use cases. The Eastern Caribbean Central Bank's collaboration with the fintech company Bitt in developing DCash demonstrates the potential of such partnerships. Lastly, engaging in knowledge sharing is crucial. Developing countries should actively participate in international forums and knowledge-sharing platforms focused on CBDCs. The CBDC Think Tank, an initiative supported by the Bill & Melinda Gates Foundation, provides a platform for policymakers from developing countries to exchange experiences and best practices in CBDC implementation.

In a nutshell, the successful implementation of CBDCs in developing economies requires a multi-faceted approach that combines clear policy objectives, strategic planning, and collaboration with various stakeholders. By carefully considering these recommendations and adapting them to their specific contexts, developing countries can harness the potential of CBDCs to promote financial inclusion, enhance payment system efficiency, and support broader economic development goals. However, it is crucial to maintain a flexible approach, continuously learning from experiences and adjusting strategies as the CBDC landscape evolves.

9.8 Conclusion

In conclusion, Central Bank Digital Currencies represent a powerful tool with the potential to significantly contribute to the achievement of multiple Sustainable Development Goals in developing economies. Their ability to enhance financial inclusion, promote economic growth, improve government services, and potentially support environmental sustainability aligns closely with several SDG targets. However, it is crucial to recognize that CBDCs are not a panacea for development challenges. Their effectiveness in supporting SDGs will depend on thoughtful design, careful implementation, and integration with broader development strategies. As noted by the United Nations Development Programme (UNDP), "CBDCs should be viewed as part of a holistic approach to digital financial transformation that puts people and sustainability at the center." Moreover, the potential of CBDCs must be balanced against risks and challenges, including privacy concerns, cybersecurity threats, and potential disruptions to existing financial systems. Addressing these challenges will require ongoing research, international cooperation, and adaptive policymaking. While CBDCs offer significant promise for supporting sustainable development in emerging economies, their success will ultimately depend on how well they are designed and implemented to meet the specific needs and contexts of each country. As developing economies continue to explore and implement CBDCs, it will be crucial to maintain a focus on inclusivity, sustainability, and the broader goals of the SDG agenda. The journey of CBDCs in developing economies is just beginning, and their full potential to support sustainable development remains to be realized. As we move forward, continuous learning, adaptation, and collaboration will be key to harnessing the power of this innovative financial technology for the benefit of all.

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