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CBDC For Financial Inclusion

Evidences from Sand Dollar and e-Naira

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Front Cover: **Atanasio Soldati**, *Il Piccolo Campo*, 1949.

Executive Summary

The integration of technological innovation and sustainable development represents one of the main challenges for every actor within the global economic system. In particular, to build more efficient and resilient economic systems, the issue of financial inclusion has always played a key role, as emphasized in the United Nations (UN) 2030 Agenda, which highlights the importance of promoting economic systems that ensure universal access to basic financial infrastructure and services for all economic participants. This objective has been integrated into the United Nations (UN) 17 Sustainable Development Goals (SDGs). This study aims to analyze the potential effects that the issuance of a Central Bank Digital Currency (CBDC) could have in enhancing financial inclusion within an economic system. The first part of the research will introduce the key characteristics of CBDCs, highlighting the potential implications that issuing this innovative form of central bank money could have on an economic system. The second part will analyze the current state of financial inclusion worldwide and the main actions that could be taken to improve it within the economic system. Finally, the last part of the analysis will explore and assess the effects that the introduction of a CBDC could have in enhancing financial inclusion, examining both the theoretical implications and the observed impact of the Sand Dollar and e-Naira on financial inclusion in The Bahamas and Nigeria, respectively.

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CBDC For Financial Inclusion

Evidences from Sand Dollar and e-Naira

Nicola Mazzoni *

FINANCIAL innovation and digital advancements are leading to profound transformations in financial market infrastructure. While these changes are often associated with increased efficiency in payments and banking services, their potential impact on financial inclusion is equally significant, as they have the potential to bridge economic gaps by providing accessible, affordable, and secure financial services to unbanked and underbanked populations. This paper aims to analyze how Central Bank Digital Currencies (CBDCs) can foster financial inclusion by addressing barriers to financial access and promoting broader economic participation. Focusing on the effects of the first two issued CBDCs-the Sand Dollar in The Bahamas and the e-Naira in Nigeria-the study explores how digital financial tools can mitigate financial exclusion and expand economic opportunities. The analysis is structured into three main sections. The first section introduces the foundations of CBDCs, delving into their key features and architectural configurations. The second section examines the current state of financial inclusion worldwide, relying on the latest studies and data from the World Bank. The final section evaluates the real-world impact of the Sand Dollar and the e-Naira, assessing their design, adoption, and effectiveness in enhancing financial accessibility.

1. Central Bank Digital Currencies

The rapid development of digital innovation and the increasing use of new technologies within economic and financial systems have led to radical changes, both in terms of the products offered and the infrastructures on which they rely. In this context, the rise of digital payments and new native digital currencies (e.g., cryptocurrencies) has also prompted central banks to reconsider their internal models for managing and distributing money to avoid a diminished role as the focal point of the economic system. This scenario has led to growing interest in the study and development of Central Bank Digital Currencies (CBDCs). CBDCs are nothing more than Central Bank money[2] issued in digital form. They are issued at par with cash, fully representing their digital counterpart, which can be used for all the purposes for which physical cash is typically employed. This introductory chapter aims to outline the key characteristics that define CBDCs and the main implications and benefits they may bring to the economic system.

1.1 CBDC Environment

In literature, three types of models are typically distinguished for how a Central Bank can structure the "deployment of a CBDC":

- **Direct Model:** in this model, the Central Bank is responsible for all functions related to the management of CBDC. It records the issued CBDCs in its accounting books as liabilities and directly handles transaction settlement. Additionally, it performs tasks typically carried out by the private sector, such as user management (e.g., relationship management and onboarding activities).

*At the time of the writing of this article, the authors were working for Iason Consulting.

[2]Central Bank money is the money directly issued by a Central Bank and guaranteed by public authority and regulators. This has not to be confused with commercial money, which is the money detained in bank accounts and guaranteed only by the financial stability of the intermediary.

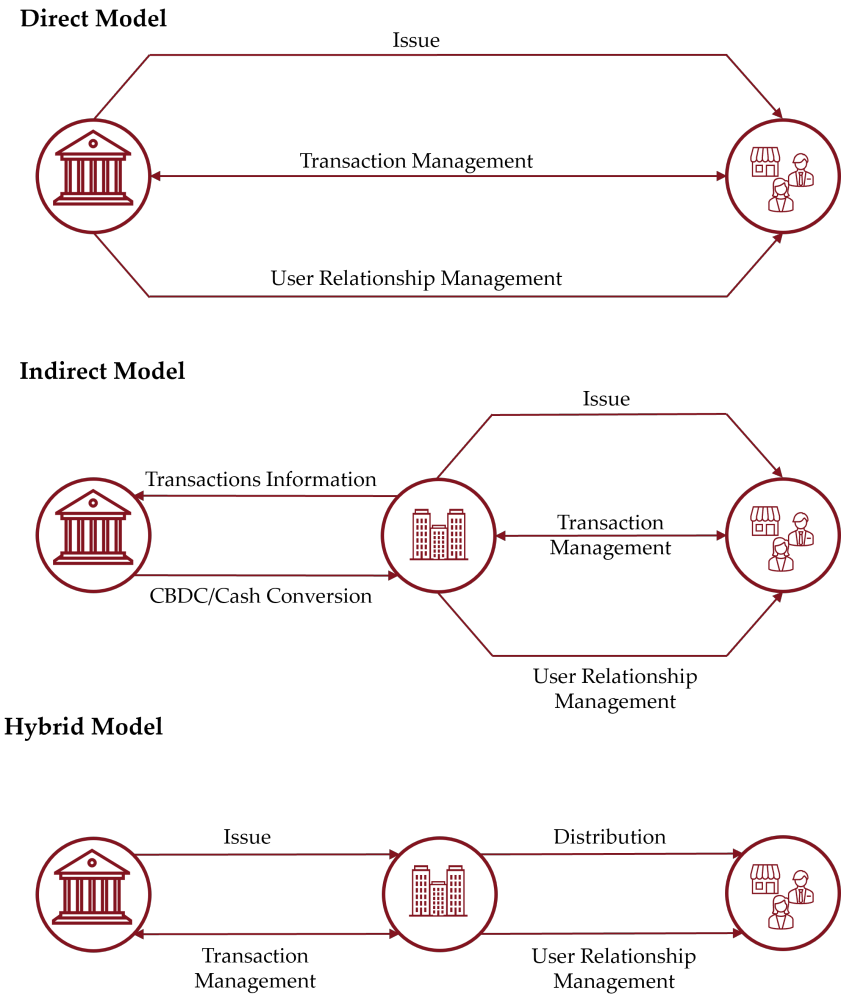


FIGURE 1: Distribution Models [9]

- **Indirect Model:** this model delegates the management of CBDC-related activities, such as issuance and transaction processing, to the private sector, such as banks. The Central Bank's role is to guarantee the exchange parity between CBDCs and physical banknotes while also maintaining control over the total supply of CBDCs within the system.
- **Hybrid Model:** compared to the previous two models, this approach divides responsibilities between the Central Bank and the private sector. The Central Bank handles CBDC issuance and transaction management, while the private sector is responsible for distributing CBDC within the economic system and managing user relationships.

The definition of the deployment model represents a key decision to determine the evolution of the CBDC as well as reflecting the strategic choices of the Central Bank, which, also based on this, will define the architectural model on which to build the CBDC environment. An architectural model defines the IT structure on which the whole CBDC model will be built, which can be identified in two possible architectural choices:

- **Centralized Model:** in this configuration, the CBDC is based on a traditional Ledger governed by a central entity, an electronic register that collects and manages financial transactions or data.
- **Distributed Ledger Technology (DLT) Model:** in this model, the CBDC will rely on a DLT, which is "a database distributed in identical copies among the nodes that compose the environment. The peculiarity of DLTs is that the ledgers among the nodes chain are simultaneously updated through a consensus mechanism. The node's network is in charge of

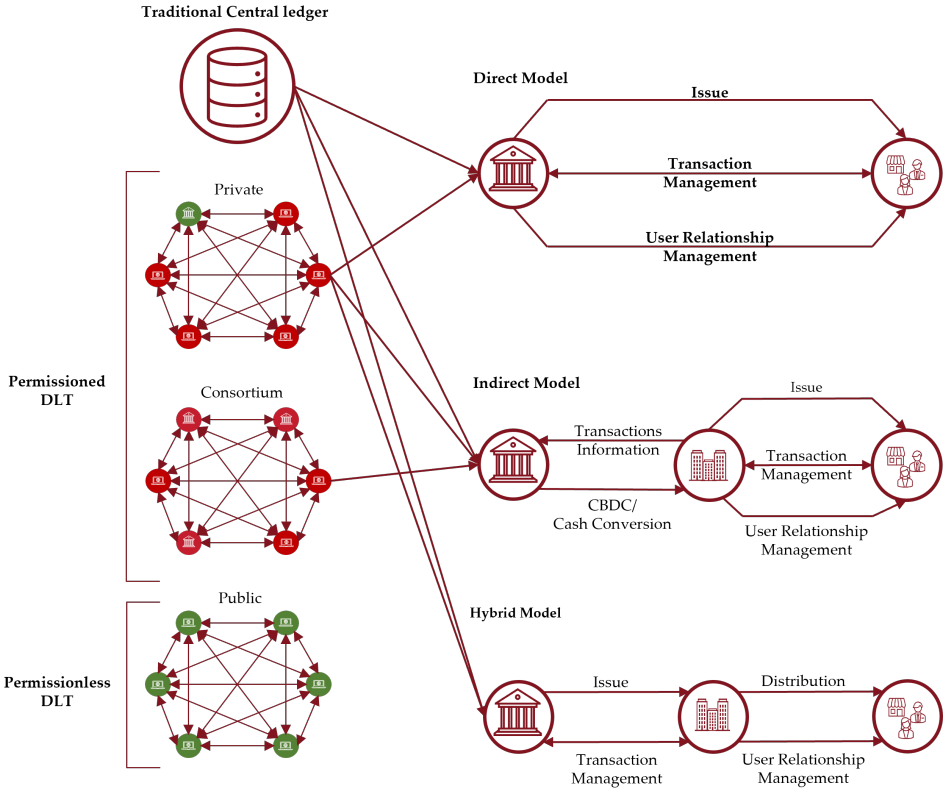


FIGURE 2: Architectural Models [9]

the maintenance of the ledgers implying the continuous update of the information stored in the registries."[10] DLTs, depending on the governance and management of the system, can be divided into:

- **Private Permissioned:** in which the network is managed by a single central authority that validates transactions and decides the participants in the network.
- **Consortium Permissioned:** in which the network is managed by a limited number of trusted administrators.

Considering the characteristics of the main types of DLT, it is easy to find that, due to the type of instrument that CBDCs represent for Central Banks, the application of a decentralized network, such as a permissionless DLT, seems unlikely, both because of the lack of control over the network and the issues related to speed and scalability of transactions typically associated with this type of network. In contrast, the application of a permissioned network aligns with the objectives of Central Bank. In particular, the application of a private network would find its use in all the possible distribution configurations previously outlined, as it would tend to replicate the application of a traditional centralized model. However, the consortium model would be easily applicable in an indirect model, where the network of private operators acting as the main actors of the system (such as banks) could operate as the network managers.
Considering the technical features of CBDCs, the configuration through which transactions are verified, and how users can access and exchange rights related to digital currency covers a crucial role. In this context, two different types can be distinguished:

- **CBDC Account-Based:** in this configuration, access to the CBDC mirrors the approach of bank accounts, meaning each user has their identity linked to a specific account through which CBDC operations are performed. The application of this typology brings:
  - A reduction in the level of privacy for users, as the user's identity is linked to the account.
  - No effects in terms of innovation and financial inclusion.

However, an Account-Based CBDC will facilitate AML/CFT controls with a reduction in the architecture development costs, as this architecture is based on systems already widely used in traditional banking models. Additionally, with an Account-Based system, the Central Bank could "more adequately control the stock of digital currency in circulation...contributing to preserving monetary sovereignty"[2].

- **CBDC Token-Based:** the Token-Based approach, on the other hand, relies on cryptographic algorithms that allow the exchange of tokens only if private keys/codes are known. This model has many analogies with the Blockchain model and offers significant advantages in terms of both privacy and financial inclusion. However, the high level of privacy can lead to negative effects on KYC and AML activities and could also encourage an increase in fraud.

When issuing CBDC, a Central Bank must also consider which type of users it wants to distribute its digital currency to, thus distinguishing between:

- **Wholesale CBDC:** this type of CBDC is designed to be distributed only to financial institutions and aims to facilitate interbank transactions and the settlement of payments between various institutional players.
- **Retail CBDC:** this type of CBDC is designed to be distributed to the public, including private individuals and businesses. Retail CBDCs are issued with the goal of complementing cash within the economic system.

1.2 Implications of CBDCs on the Economic System

Since the early hypotheses regarding the possible creation of a Central Bank Digital Currency, studies, and analyses have sought to capture and hypothesize the possible effects that a CBDC could have on:

- **The Banking System**;
- **The Monetary Policy**.

1.2.1 Implications for Bank Industry

The main focus of studies on the potential effects of CBDC issuance on the banking system primarily revolves around two key topics:

- **Bank Run:** the introduction of a Central Bank Digital Currency that can be held directly in digital wallets could lead to a change in the preferences of individuals against bank deposits. This shift in preferences would be primarily due to the lower credit risk embedded in Central Bank currency compared to commercial money guaranteed by a private credit institution. In particular, the risk of a bank run would still be present even in models where digital wallets are managed by private institutions, as these, in order to maintain the characteristics of a Central Bank currency for the CBDC, would need to represent a segregated asset compared to the bank's own assets. In addition to the above, when issuing a CBDC, it must also be taken into account that the potential remuneration of this could further incentivize depositors to move away from the private system, thereby increasing the liquidity risk for the banking system.
- **Funding Cost and Credit Crunch:** shifts in preferences could also lead to a negative effect on the banks' funding activity, as, due to a lower deposit rate, they would have to use more expensive instruments (such as debt issuance) to support their fund-raising activities. The increase in funding costs would lead to a consequent increase in the cost of credit access, thereby generating a decrease in demand and a credit crunch effect on the economic system.

In order to reduce the potential negative effects that CBDC could have on bank industry, some solutions have been proposed:

	Cat.1	Cat.2	Cat.3	Cat.4	Cat.5
Sign up	In person	Remote	Remote	Remote	Remote
Authentication	ID and phone number	ID and phone number	ID and phone number	E-mail and phone number	E-mail and foreign phone number
Connected account	Yes	Yes	No	No	No
Balance limit	None	500.000	20.000	10.000	1.000
Transaction limit	None	50.000	5.000	2.000	500
Daily limit	None	100.000	10.000	5.000	1.000
Annual limit	None	500.000	100.000	50.000	10.000

TABLE 1: e-CNY Digital Wallets[9]

	Personal Wallet Liv.1	Personal Wallet Liv.2	Commercial Wallet
Sign Up	ID	ID and KYC controls	Corporate Documentations (e.g. Financial Statements) and KYC controls
Detention Limit	500 BSD	8.000 BSD	1.000.000 BSD
Daily Transactions Limit	1.500 BSD	10.000 BSD	Variable

TABLE 2: Sand Dollar Wallets

- **Detention Limits**: the introduction of detention limits could help in mitigating run from bank deposits. For example:
  - **e-CNY:** the PBOC (People's Bank of China) introduced a system of holding limits for the e-CNY based on the identity verification levels of users, with a maximum limit of 1.000 CNY if the wallet holder's authentication is done remotely by providing only email and wallet details; and a maximum limit of 500.000 CNY if authentication is done in person by providing an ID and phone number (ref. Table 1).
  - **Digital Euro:** the ECB has confirmed, with the conclusion of the exploratory phase, that the Digital Euro will have holding limits, not yet defined for individuals; while businesses will always be required to maintain a zero balance of digital euros in their wallets. Therefore, every transaction made will trigger the waterfall mechanism (or reverse waterfall) that will deposit the Digital Euros received, converting them into euros, directly into the business's bank account.
  - **Sand Dollar (Bahamas):** the Sand Dollar has different detention limits depending on whether the user is a private person or a company (ref. Table 2).
- **Remuneration Limits (ref. Figure 3):** one of the main models theorized to guarantee a CBDC that offers remuneration, but at the same time does not become more attractive than bank deposits, was hypothesized by U. Bindesil[3]. This model foresees the introduction of two scenarios for the remuneration of the CBDC depending on the Deposit Facility Rate[3]. The model requires that, up to a certain amount of CBDC held, the remuneration of the CBDC will range between a maximum of 0% and the Deposit Facility Rate -1%, while beyond the holding threshold, the remuneration of the CBDC becomes punitive, settling at the minimum between zero and the Deposit Facility Rate minus 1%. According to the model, this configuration should ensure that, in a high-interest-rate environment, the remuneration of the CBDC is lower than that of bank deposits, while in a low-interest-rate environment, the remuneration rate offered on the CBDC should be zero or negative. In both scenarios, therefore, holding a CBDC should still be less attractive than bank deposits. In practice, in order to avoid competition between the digital currency issued and bank deposits, many central banks are considering or have designed their CBDCs with zero remuneration. Among these, can be mentioned: the Digital Renminbi, the Sand Dollar, the Digital Euro, and the e-Naira.

[3]O/N interest rate that the ECB sets on the bank reserves deposited with it.

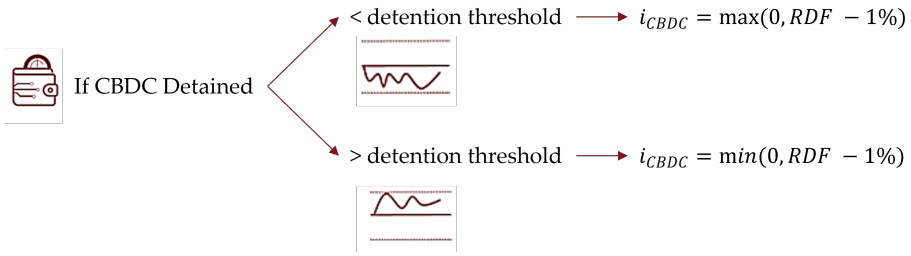


FIGURE 3: U.Bindseil Two-Tier Model

1.2.2 Implications for Monetary Policy

Three main implications are usually considered when analyzing the effects that the introduction of a CBDC can have on Monetary Policy:

- **Effects on Money Velocity:** "the introduction of a CBDC into the economic system could lead to a shift into the detention preferences of households and businesses that could prefer to fund digital wallets with CBDCs instead of detaining cash in their pockets or bank deposits. The implications of the possible shift in preferences could lead to severe causes affecting money velocity. The digital nature of CBDC could easily affect the monetary exchanges in the economic system as digital payments do not have the same physical barriers that characterize cash exchanges and also the settlement and the accounting of monetary units on the digital wallet will occur with a lower lag than the necessary time to deposit cash into bank accounts. Considering the Velocity of Money as:

  $$V_t = T_n / M. \tag{1}$$

  It is easy to figure that the increase of exchanges T_n driven by the digital nature of the CBDC could lead to an increase of the Velocity of Money, this could break the relationship between money and inflation affecting the monetary targeting of the Central Bank. In fact, looking at the relation between Monetary Mass and the GDP of a country defined by the equation:

  $$M_t x V_t = P_t x Q_t; \tag{2}$$

  $$P_t = (M_t x V_t) / Q_t, \tag{3}$$

  where:

  - M_t: Money Mass[4];
  - V_t: Velocity of Money;
  - P_t: Average Price Level;
  - Q_t: Production.

  We can state that the average price level increases with increasing in the total money volume ($M_t x V_t$). So considering the Money Mass as a variable under the control of the Central Bank, is it clear that the possible quick growth of the transactions that a digital, unconstrained, central bank currency could carry should bring a steepen in the inflation levels"[9].

- **Open Market Operations:** among the potential effects that the introduction of CBDC may have on the banking system, the possible reduction of bank deposits due to a change in user preferences can be highlighted. A reduction in the level of bank deposits would lead to a chain reduction in the deposits held by banks at the Central Bank, impacting open market operations and the Central Bank's economic policy strategies. Again, the adoption of configurations that impose limits on CBDC holdings could mitigate these potential negative effects.

[4]The total average nominal amount of money in circulation in the economy.

- **Seigniorage Income:** seigniorage income consists of the income generated by a central institution through the difference between the nominal value of the currency and the cost of printing and issuing it into the economic system. CBDCs can, on one hand, reduce the costs of printing money, but on the other hand, they may introduce new costs related to their issuance and maintenance, with potential negative effects on the seigniorage earnings of a state.

1.3 Potential Benefit Associated with the Issuance of a CBDC

The introduction of a CBDC does not only entail potential implications that require careful design and regulatory considerations by the Central Bank to mitigate the potential effects on the economic system but also brings benefits with significant positive impacts on both the economic and social systems. The introduction of the infrastructure supporting the issuance and management of a CBDC can indeed be a pivotal engine to increase the technological development of the economic system, with positive effects on both technological and financial innovation. The application of a technologically neutral framework based on a hybrid or indirect model can foster the development of innovative solutions by the private sector. Specifically, it could encourage the deployment of diverse innovative solutions to meet market needs, with beneficial effects on market competition. Financial innovation linked to the introduction of CBDCs could also promote improvements in cross-border transactions (e.g., the development of the mBridge project[4], which aims to implement a system for the exchange and interoperability of CBDCs). Another significant positive effect on society that could be generated by the introduction of a CBDC is the increase in financial inclusion, a CBDC that relies on digital wallets, could reduce the entry barriers to the financial system for populations facing challenges in accessing the traditional banking system.
These challenges may include, for example, the costs associated with maintaining a bank account and the difficulty in providing the necessary documentation to open a banking account. The development of digital wallets could thus facilitate access to accounts that provide digital deposit and payment services without relying on the traditional banking system. This would help reach historically "unbanked" populations (in 2021, approximately 1.4 billion adults lacked access to a bank account). This principle relies also on the development of in-house solutions that offer essential services for CBDCs, such as providing digital wallets and payment services. These solutions have been deployed or are being considered by various central banks, such as the e-CNY app developed by the PBOC or the Digital Euro app hypnotized during the ECB's analysis of the Digital Euro.

2. Financial Inclusion

Financial inclusion refers to individuals within an economic system's ability to easily access essential financial services, enabling them to participate in the economy in a simple, effective, and sustainable manner. These services include:

- **Bank Accounts;**
- **Insurance Services;**
- **Payment Services.**

The importance of financial inclusion as one of the pillars that enable the sustainable development of a healthy economic and social system has also been recognized within the UN 2030 Agenda, which affirmed within the UN 17 SDGs (Sustainable Development Goals)[5] the importance of promoting economic systems that allow access to basic financial infrastructures and services for all actors in an economic system, as financial inclusion represents a key element for reducing poverty and supporting sustainable global economic growth.

2.1 Status of Financial Inclusion

A key indicator used to represent the state of financial inclusion in an economic system is based on evaluating the level of access to a bank account by economic system participants. Having access to

[5]https://sdgs.un.org/goals

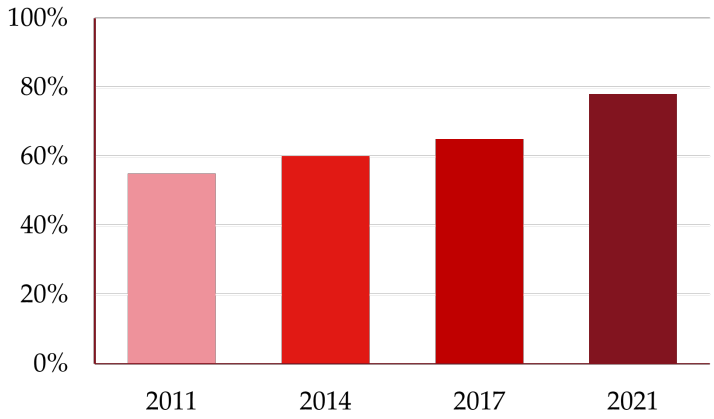


FIGURE 4: Worldwide Increase in Bank and Bank-Like Accounts

	2011	2014	2017	2021
Low Income	11%	18%	30%	38%
Medium Income	33%	44%	52%	60%
High Income	84%	89%	92%	96%

TABLE 3: Bank Account and Bank-Like Account Owners Growth divided by Economy

a bank account enables the use of a wide range of essential financial services, such as electronic payments, money transfers, and easier access to the credit market. Therefore, an economic system in which all participants have access to this type of service is more efficient and resilient compared to an economic system lacking access to such services. According to the latest research conducted by the World Bank in 2021[6], 76% of individuals worldwide had a bank account (or an account providing similar services, such as a mobile payment service). Over the past 10 years, data showed exponential growth, with an increase from 51% in 2011 to 76% in 2021, representing an almost 50% rise (ref. Figure 4).
With a more detailed analysis of the data, it can be observed that in "low-income" countries, the growth rate of individuals with an account experienced a significantly higher increase during the 2011-2021 period compared to the same period in "middle-income" and "high-income" countries, reaching 236% (ref. Table 3, Figure 5).
During the 2011-2021 period, the following changes occurred:

- **Low Income:** increased from 11% to 38%, with a total growth of 236%;
- **Middle Income:** increased from 33% to 60%, with a total growth of 81%;
- **High Income:** increased from 84% to 96%, with a total growth of 13%.

Focusing on the gender gap within different economies, we can observe the following (ref. Figure 6):

- **Low Income:** as of 2021, the average rate of individuals with access to a bank account (or similar service) shows a 10% difference between men and women, a gap that has narrowed over the last three years (in 2017, the gap was 12%). The growth rate of individuals with access to an account has shown significant increases for both genders, with a +219% growth for men and +265% for women during the analysis period.
- **Middle Income:** as of 2021, the average rate of individuals with access to a bank account (or similar service) shows an 8% difference between men and women, which has remained relatively stable over the last three years. The growth rate of individuals with access to an account has increased for both genders, with a +77% growth for men and +87% for women during the analysis period.

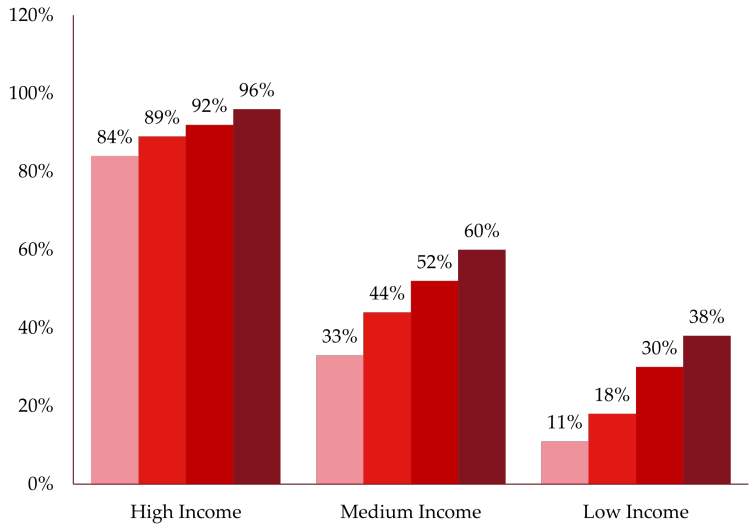


FIGURE 5: Bank Account and Bank-Like Account Owners Growth divided by Economy

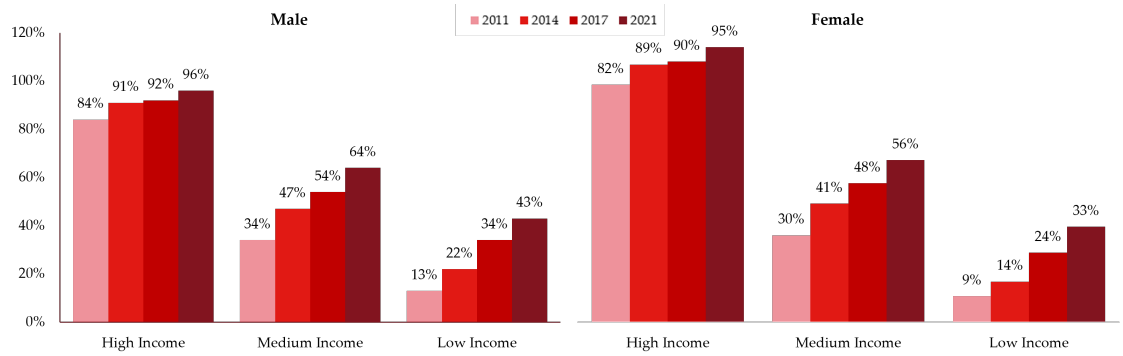


FIGURE 6: Gender Gap

- **High Income:** as of 2021, the average rate of individuals with access to a bank account (or similar service) shows only a 1% difference between men and women, which has decreased by about 2% over the last three years. This suggests that in higher-income economies, the gender gap in financial inclusion is virtually nonexistent. The growth rate of individuals with access to an account has increased for both genders, with a +11% growth for men and +16% for women during the analysis period.

Considering aggregate data about analyzed economies, 78% of men have access to a bank account (or similar service), compared to 74% of women, highlighting a general financial inclusion gender gap of 4%. Moreover, for the purpose of this analysis, it is important to note that in developing economies, bank account ownership tends to be lower in rural areas compared to urban areas. However, data on this comparison remains fragmented, making it difficult to establish a clear and comprehensive assessment. In particular, as highlighted by the World Bank in the report "Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19"[6], defining what constitutes an urban or rural area is challenging due to the heterogeneity of countries worldwide. As the report states: "What might be considered rural in Bangladesh or India, for example, might be considered urban in less populous economies."[6] However, using the proxy definitions of urban vs. rural determined by the Gallup World Poll survey, the World Bank's data reveals that, in the selected developing economies (Bangladesh, India, and Malaysia), there is no significant difference in account ownership between individuals living in urban and rural areas. Nevertheless, when analyzing the entire sample, the data shows an average 10% gap in bank account ownership between urban and rural inhabitants. Among the most notable cases, Laos stands out, where the difference between urban and rural areas reaches 39%. Similar disparities are also observed in Zambia and Cambodia. Overall, as seen in Figure 7, living in a rural area tends to be a barrier to financial inclusion across

the sample analyzed (ref. Figure 7).

Between 2014 and 2021, the number of individuals who made and/or received payments via mobile saw a substantial increase of +41%, reaching a total of 64% of adults worldwide in 2021 (equivalent to 84% of bank and bank-like account holders). The total increase in mobile payment usage by account holders was +27% from 2014 to 2021 (ref. Figure 8).

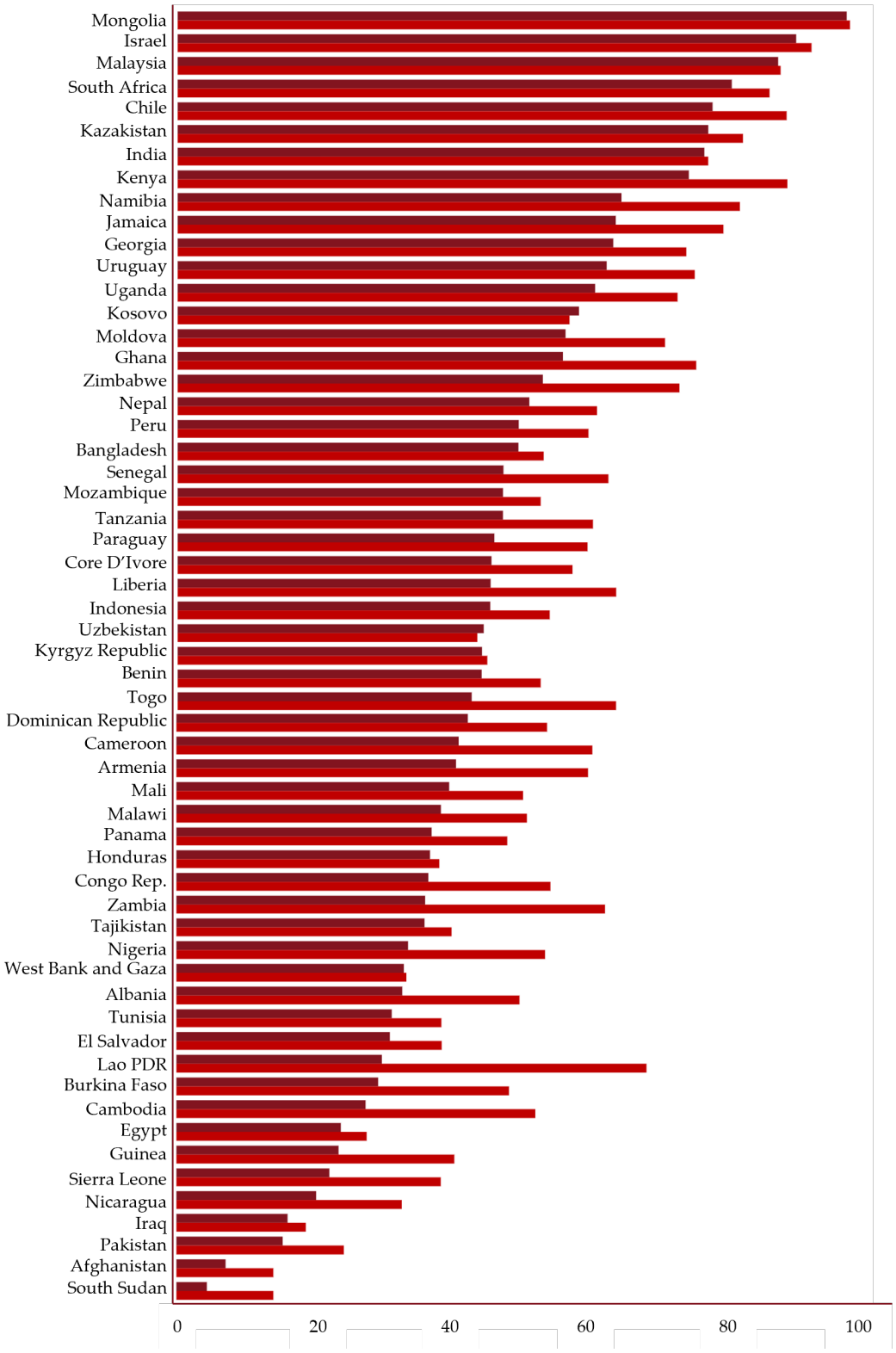


FIGURE 7: Urban-Rural Gap

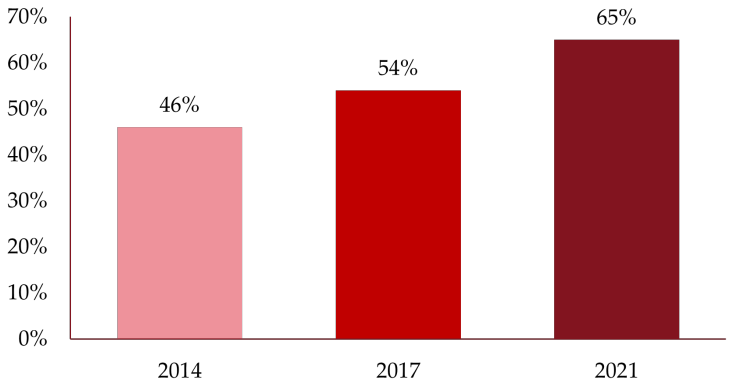


FIGURE 8: Mobile Payment Growth

As reported by the World Bank[6], in high-income economies, 95% of adults in 2021 used a mobile service to make or receive payments, compared to 57% in developing economies. However, this latter figure should be viewed positively, as from 2011 to 2021, the growth in mobile payment users in developing economies registered an increase of +22%.

2.2 Potential Solutions to Increase Financial Inclusion

As previously stated, the ability to access essential financial services plays a key role in determining the sustainability and resilience of an economic system. In this context, the ability to access a bank account or receive money quickly is a key feature in enabling a population to cope with potential difficulties, even within relatively short timeframes. Furthermore, access to a bank account (or similar) can simplify access to the credit system, which in turn plays a fundamental role in any sustainable economic system. Currently, the global unbanked population stands at 1.4 billion individuals, including 740 million adult women, who still represent the majority among the unbanked adults. With about 52% of people excluded from the banking system belonging to seven countries:

- **India 17%;**
- **China 9%;**
- **Pakistan 8%;**
- **Indonesia 7%;**
- **Nigeria 5%;**
- **Egypt 4%;**
- **Bangladesh 4%.**

The main causes of financial exclusion include:

- **Monetary difficulties**, which would be aggravated by the costs of financial services and maintaining a bank account.
- **Distance from financial institutions**, especially in large rural areas, can be one of the major deterrents to entering the traditional banking system.
- **Having a household member with an account**, this point, especially regarding the gender gap, is more frequently indicated by women.

Key points to increase financial inclusion include the following:

- The implementation of effective policies that could reduce bureaucratic requirements for opening bank accounts (e.g., introducing alternative forms of identification).

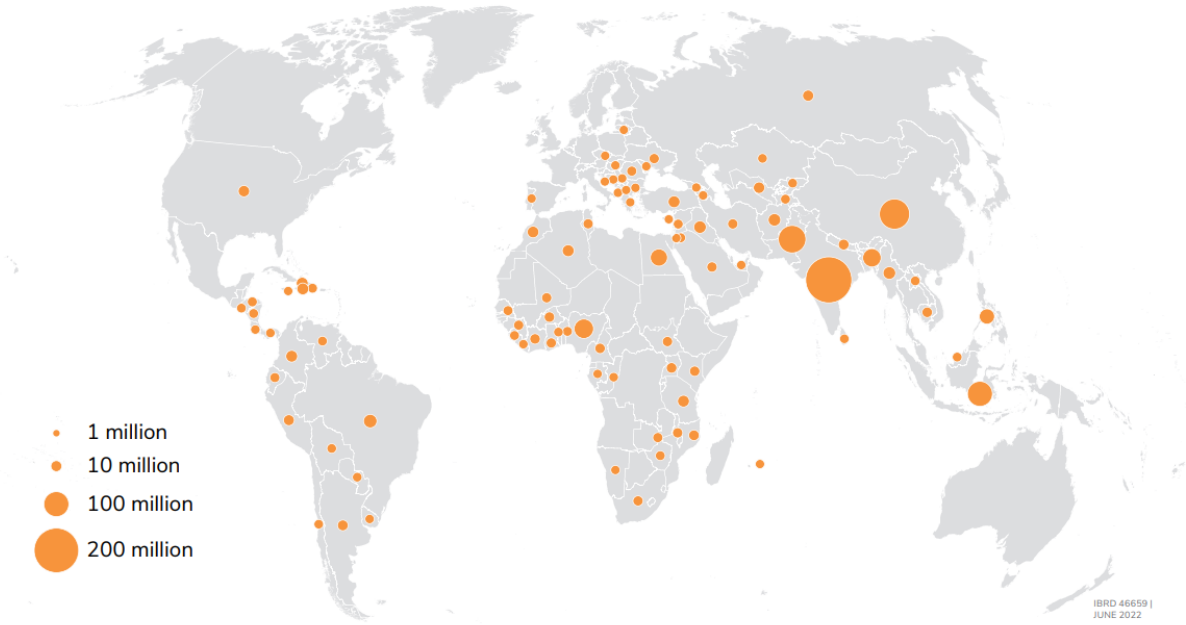


FIGURE 9: Unbanked Adults across the Wolrd[6]

- Introducing inclusive policies aimed at improving access to financial services for vulnerable populations, such as conditional transfers and/or subsidies.
- Foster the use of innovative technologies that can integrate into the current economic-financial system (Mobile Banking, Payment Apps, Digital Wallets, Blockchain, etc.).

These issues are closely related to the development of CBDCs. Specifically, as outlined in the first chapter, CBDCs could provide access to a digital payment system to a wide range of individuals, and the development of applications by Central Banks that enable the use of digital wallets and at least the minimum services related to the CBDC could effectively support this hypothesis. Additionally, the deployment of various types of wallets based on the granularity of the provided identification data, as implemented by the PBOC, would reduce the bureaucratic costs associated with opening a bank account and address issues related to obtaining official identification documents in some underdeveloped areas of the world. Furthermore, an economic system that guarantees a universally accepted digital payment tool, issued by the Central Bank itself, reduces the physical barriers posed by distance to traditional financial operators. To access such services, all that would be needed is the CBDC app. In the continuation of the analysis, we will focus specifically on the concrete effects that CBDCs could have on financial inclusion.

3. CBDC For Financial Inclusion

The integration of technological advancements in financial systems can promote greater financial inclusion. Specifically, the introduction of a CBDC, supported by an adequate environment (e.g., digital wallets, apps developed by the Central Bank, reduced bureaucracy compared to the traditional financial system...), could play a key role in enabling individuals excluded from the traditional financial system to access various financial services. Literature[11] supports the potential increase in financial inclusion due to the issuance of a CBDC:

- The introduction of CBDC can act as a catalyst for the digitalization of the entire financial value chain. In particular, by offering businesses access to wholesale CBDCs, the Central Bank can encourage their integration into the digital financial system. This transition can generate benefits not only for financial inclusion within the economy, but also for greater transparency across various business processes, ultimately leading to a more efficient and resilient economic system.

- A CBDC can facilitate the use of financial services for all individuals within the economic system. A universally accepted digital currency, supported by an adequate technological infrastructure (e.g., apps, digital wallets...), can expand the number of users who can access financial services, such as wallet peer-to-peer transfers, without relying on cash or the traditional financial system.
- In systems that adopt a "technology-neutral" approach and an indirect or hybrid distribution model, the development of a CBDC can drive the development of various technological solutions leading to greater efficiency in the financial system, with positive spillover effects on financial access for participants in the economy.
- The availability of different types of digital wallets with varying levels of required identification information (and different levels of access to CBDC-related services) can allow individuals typically excluded from the traditional financial system due to a lack of credit history or valid identification documents to access financial services linked to CBDCs.
- The introduction of CBDC can also lead to a reduction, through digital wallets, in transaction and account maintenance costs, which often act as barriers to opening bank accounts in economies with higher poverty rates.
- The development of offline functionality can enable the continuous use of CBDCs even in regions with limited internet access. This prevents financial exclusion in countries with lower network coverage.

While theory suggests that CBDCs could have a positive impact on financial inclusion, it is essential to evaluate the actual outcomes of CBDCs already deployed. In the following sections, we will analyze the real-world impact of the Sand Dollar and e-Naira on financial inclusion in the Bahamas and Nigeria.

3.1 Sand Dollar

The Sand Dollar is the CBDC issued by the Central Bank of The Bahamas, launched in October 2020 (following a pilot conducted in 2019 in the Exuma district). It was the first CBDC to be developed and issued on a national scale. The main goal that inspire CBoB to analyze and develop a CBDC was to increase access to financial services among the population of The Bahamas. In fact, financial service access has often been a challenge within the archipelago. In 2018, 18% of the adult population in the Bahamas was unbanked, mainly due to the following factors:

- The geographical structure of The Bahamas (an archipelago of approximately 700 islands) entails high commuting costs for individuals wanting to open a bank account, as some smaller islands lack bank branches[14].
- The de-risking process undertaken by large international banks led to a significant reduction in the number of bank branches operating within the country.
- The cost associated with opening a bank account has often been a barrier for the population of the archipelago.

Thus, in order to increase financial inclusion within the country and modernize the payment system, the Central Bank of The Bahamas with the deployment of the Sand Dollar established the following goals:

- Enhancing the efficiency of the payment system in The Bahamas through safer transactions and faster settlements;
- Providing non-discriminatory access to payment systems, regardless of age, immigration status, or residency;
- Achieving greater financial inclusion, economic convenience, and expanded access to financial services across all of The Bahamas;

- Strengthening national defenses against money laundering.

In this context, considering the widespread adoption of mobile devices (96% of the adult population), the introduction of a fully digitalized Central Bank currency, supported by an environment that enables secure and controlled financial transactions, could reduce barriers to entry and increase the use of financial services among the population of the archipelago.

3.1.1 Features

The Sand Dollar is a CBDC that does not accrue interest and is issued at par with the Bahamian dollar, and Since the Bahamian dollar is pegged 1:1 to the US dollar, the Sand Dollar is also effectively pegged 1:1 to the US dollar. The Sand Dollar operates on an indirect two-tier model, in which:

- The Central Bank of The Bahamas issues the Sand Dollar and distributes it to authorized financial institutions (banks, payment service providers);
- Authorized intermediaries provide CBDCs, digital wallets, and facilitate transactions for individuals and businesses.

Sand Dollars can be deposited in a digital wallet provided by authorized financial institutions. CBoB has set different types of wallets, categorized based on the level of information required, deposit limits, and monthly transaction limits:

- **Tier 1:**
  - **Deposit limit:** 500 Sand Dollars;
  - **Monthly transaction limit:** 1.500 Sand Dollars;
  - **KYC requirements:** No specific KYC requirements.
- **Tier 2 (Premium Wallet):**
  - **Deposit limit:** 8.000 Sand Dollars;
  - **Monthly transaction limit:** 1.000.000 Sand Dollars;
  - **KYC requirements:** Valid government-issued ID from The Bahamas.
- **Tier 3 (Merchant Wallet):**
  - **Deposit limit:** 1.000.000 Sand Dollars;
  - **No transaction limits**;
  - **KYC requirements:** Bank account connection and valid business license.

To ensure interoperability between devices and providers, CBoB has developed an app (Sand Dollar App) to support exchanges and transactions with the Sand Dollar. Additionally, the Sand Dollar also supports offline transactions, in fact, by leveraging technologies such as Bluetooth and NFC, individuals, in the absence of a network connection, can connect their devices and exchange Sand Dollars. In this scenario, transaction validation is carried out directly by the individuals involved in the transaction on their devices. Once the network is restored, the digital wallets are updated, reflecting the changes that occurred offline.

3.1.2 Financial Inclusion Results

Since the introduction of the Sand Dollar in 2019, the total amount of Sand Dollars in circulation has steadily increased, from 48.000 Sand Dollars in December 2019 to over 2 million in February 2024. It is interesting to note that since June 2022, there has been an increase of over 500% (ref. Figure 10). Similarly, the total number of Sand Dollar wallets has seen a constant increase over time, reaching a total of 121.901 at the beginning of 2024, of these, 120.101 are consumer wallets (Tier 1 and Tier 2 wallets) and 1.800 are merchant wallets (Tier 3 wallets), with a total increase of 300% since 2019 (ref. Table 4). Considering the total adult population (approximately 320.000 individuals), we can highlight that 38% of the adult population has potentially opened a Sand Dollar wallet.

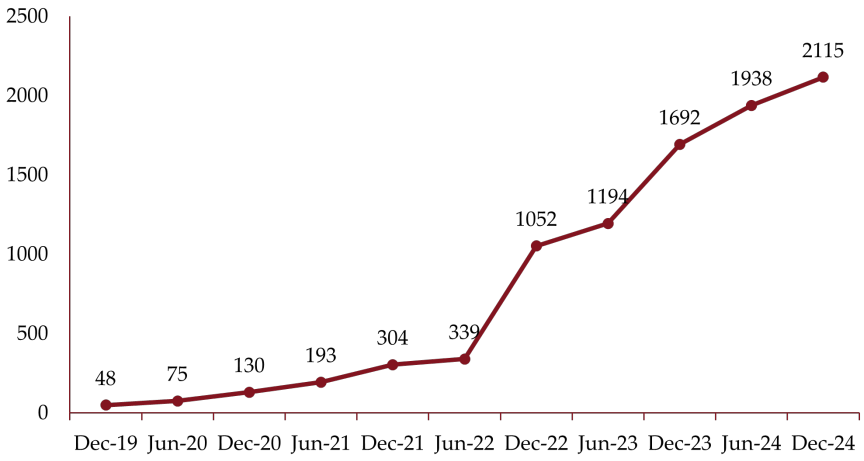
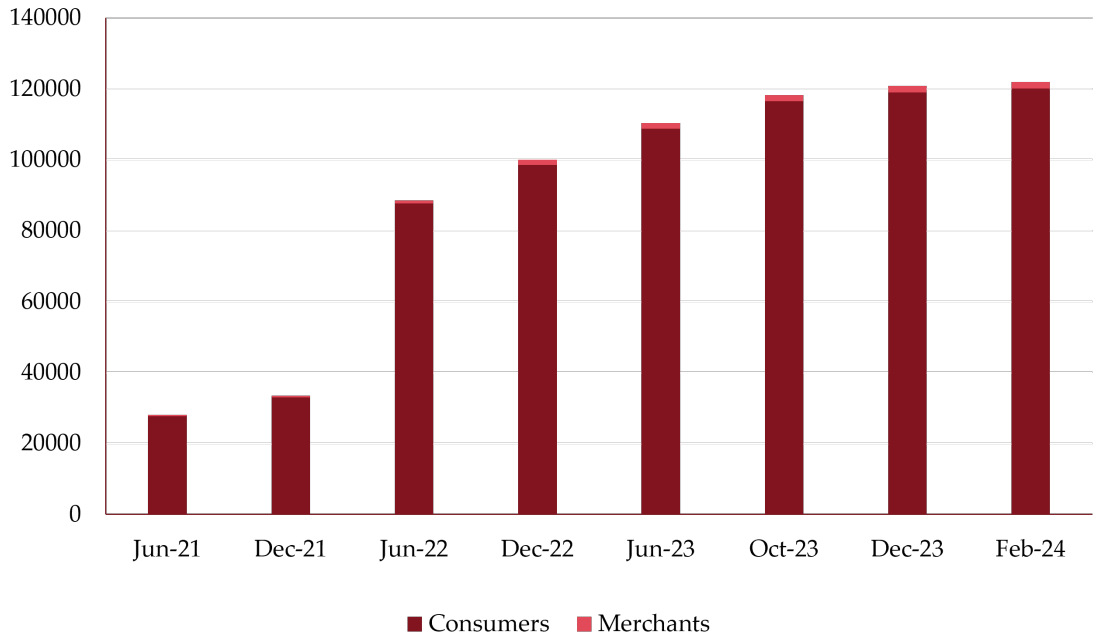


FIGURE 10: Total Amount of Sand Dollar, Data in Thousands of Bahamas Dollars



	Jun-21	Dec-21	Jun-22	Dec-22	Jun-23	Oct-23	Dec-23	Feb-24
Consumers	27.671	32.905	87.682	98.551	108.707	116.493	118.991	120.101
Merchants	372	565	813	1.429	1.622	1.732	1.797	1.800
Total	28.043	33.470	88.495	99.980	110.329	118.225	120.788	121.901

TABLE 4: Active Sand Dollar Wallets

Despite the encouraging figures, it is important to highlight that the current amount of Sand Dollar in circulation corresponds to only 0.5% of the total money supply within the archipelago. This indicates that the adoption and use of the CBDC remain marginal among the population compared to the Central Bank of Bahamas' objectives of increasing financial inclusion. However, the CBoB is continuously carrying out various initiatives to further integrate the use of the Sand Dollar into the daily habits of the population, specifically:

- **Integration of the Sand Dollar with the Automated Clearing House (ACH):** in 2022, the CBoB completed the integration of the CBDC with the automated clearing system of commercial banks. This allowed Tier 2 wallet holders to transfer funds directly from bank accounts to Sand

Dollar wallets via online banking platforms. Additionally, since 2023, the reverse functionality has been introduced, enabling users to transfer funds from wallets back to bank accounts.

- **Partnership Strategies with Commercial Banks:** by 2025, the Central Bank of Bahamas aims to strengthen its dialogue with commercial banks to simplify the issuance and adoption processes of the Sand Dollar. The goal is to enhance Sand Dollar adoption among commercial bank customers.

During his speech at last year's CBDC Conference, S. Porter (Central Bank of Bahamas) outlined the future financial inclusion objectives for the Sand Dollar. "In terms of financial inclusion, we expect that in the near future, the Sand Dollar will be an ubiquitous form of digital money that does not require traditional banking services. This will help us to reach the under-served communities, where we see unbanked and under-banked individuals, and we can include them in basic financial services"[13].

3.2 E-Naira

In October 2021, the Central Bank of Nigeria (CBN) officially launched its own CBDC, the e-Naira, making Nigeria the second country, after the Bahamas, to officially issue a nationwide CBDC. The primary goals of the CBN in issuing the e-Naira are:

- **Increasing Financial Inclusion:** Nigeria has a high percentage of unbanked individuals, equal to 26% of the total adult population. However, 93% of these individuals have access to a smartphone[1]. Based on these considerations, the CBN decided to implement its CBDC to provide financial services to those with a smartphone but without a bank account. Initially, access to an e-Naira wallet was only possible for individuals with a bank account. However, since August 2022, it has become possible to activate a wallet directly from a smartphone without requiring a bank account.

- **Strengthening the Online Payment System:** following the COVID-19 pandemic, there has been continuous and rapid growth in the use of e-payments, reflecting a significant shift in consumer habits worldwide. This trend is also evident in the Nigerian economy, where, after 2020, online transactions increased by 113%, leading to a decline in cash usage. In this evolving payment landscape, CBN implemented the e-Naira with the dual objective of preserving the role of central bank money and strengthening the country's electronic payment system.

- **Enhancing Transparency:** like many African countries, Nigeria has a significant share of unregistered transactions. By developing a CBDC as a payment method, the CBN aims to make transaction tracking more transparent and efficient, thereby reducing the impact of the "informal economy" within the country. The increase in cashless transactions could also help mitigate inflation, which now is near 25% (at the end of 2024 exceeded 30%) and has remained in double digits for over a decade. According to Ozili[12], reducing cash usage as a payment method could decrease the accumulation of banknotes outside the banking system, leading to direct positive effects on inflation reduction. Additionally, limiting the use of cash for untraceable speculative activities could further contribute to lowering inflation.

3.2.1 Features

The e-Naira is a non-interest-bearing CBDC, exchanged at parity with the Naira, and operates under a two-tier indirect model, where:

- The Central Bank of Nigeria (CBN) is responsible for the issuance and settlement of e-Naira transactions, leveraging a private, permissioned DLT system. Additionally, CBN monitors the total stock of e-Naira in circulation and oversees all transactions to ensure regulatory compliance and security.

- Financial institutions handle the distribution of e-Naira to individuals and the management of digital wallets.

CBN has introduced different types of wallets, categorized based on user type and the level of personal information required during wallet creation. Each wallet tier has specific limits on holdings and transaction values:

- **Wallet Tier 0**:
  - **Target Users**: retail individuals, including those without a bank account;
  - **Requirements**: only a mobile phone number (no personal identification required);
  - **Transaction Limit**: 20.000 Naira per day;
  - **Holding Limit**: 120.000 Naira.
- **Wallet Tier 1**:
  - **Target Users**: retail individuals, including those without a bank account;
  - **Requirements**:
    - Mobile phone number;
    - Photo ID;
    - Basic personal information (name, date of birth, etc.);
  - **Transaction Limit**: 50.000 Naira per day;
  - **Holding Limit**: 300.000 Naira.
- **Wallet Tier 2**:
  - **Target Users**: retail individuals with a bank account;
  - **Requirements**:
    - Bank Verification Number (BVN);
    - Photo ID;
    - Basic personal information verified against the bank database;
  - **Transaction Limit**: 200.000 Naira per day;
  - **Holding Limit**: 500.000 Naira.
- **Wallet Tier 3**:
  - **Target Users**: retail individuals with a bank account;
  - **Requirements**:
    - Bank Verification Number (BVN);
    - All information required under Nigerian AML/KYC regulations;
  - **Transaction Limit**: 1.000.000 Naira per day;
  - **Holding Limit**: 5.000.000 Naira.
- **Wallet Merchant**:
  - **Target Users**: businesses;
  - **Requirements**:
    - Existing bank account;
    - Tax Identification Number (TIN);
    - BVN of the CEO/Managing Director;
    - Email address;
    - Valid business registration certificate;
  - **Transaction & Holding Limits**: no restrictions.

To facilitate interoperability across devices and service providers, the CBN developed the e-Naira Speed Wallet app, to support seamless transactions using the e-Naira. Since 2022, the e-Naira also supports offline transactions, developed in collaboration with telecommunications companies (Telcos). This functionality operates through a USSD-based service, accessible via the code *997#, allowing users to transact without an internet connection or smartphone. The USSD system was chosen over alternative peer-to-peer authentication methods to expand e-Naira accessibility among rural populations, where banking penetration is low and digital literacy is limited.

3.2.2 Financial Inclusion Results

Despite the efforts made by the Central Bank of Nigeria to promote the spread of e-Naira, the adoption of the CBDC within the country is currently slow. Since its release, the e-Naira has faced slow adoption by individuals, with the number of wallets opened at the end of 2021 standing at only 860.000 (out of an adult population of about 130 million people). Although data published by the International Monetary Fund[8] shows that the total number of e-Naira wallets is now around 13 million (a significant increase since its launch), it should be noted that approximately 98% of these are currently inactive. Furthermore, since its launch, e-Naira transactions have accounted for an average of about 0.0018% of the country's M3 money supply. Despite the results from these early years showing slow adoption of the CBDC within the country, and therefore a limited effect on increasing financial inclusion of the population, this could partly be due to the gradual release of e-Naira features by the CBN. As already explained, in the initial period after its release, e-Naira wallets were available only to individuals who already had a bank account, while the functionality for conducting offline transactions was only made available in 2022. Additionally, it should also be considered that, as shown by network dynamics, the increase in the use of the CBDC and the expansion of its adoption by businesses and merchants as a payment method may generate a gradual increase in the spread of the CBDC and a shift in individuals' preferences.

4. Conclusions

As reported, financial inclusion has proven to be one of the main drivers in central banks' decisions regarding the implementation of CBDCs already deployed in the market. The literature and theory[5] have shown that the issuance of CBDC within an economic system can lead to positive impacts on financial inclusion within that system. In particular, the issuance of CBDC can lead to a generalized increase in financial inclusion within an economic system through:

- The introduction of different types of wallets that require different levels of information to be opened. The possibility of not necessarily needing a bank account and not having to undergo complex identification processes (as with the e-Naira) can allow even unbanked individuals to access a service similar to deposits.
- The implementation of a CBDC that allows offline transactions also ensures service continuity and availability of funds even if the issuing country does not guarantee full internet coverage across the entire territory. This way, even individuals living in areas with limited network access could still benefit from basic financial services such as deposits and transfers.
- The implementation of a national app could ensure a "minimum" level of service, as well as interoperability between all the solutions present in the system. Furthermore, through this, governments could be facilitated in making money transfers and subsidies to the less affluent segments of the population.
- The development of a "technologically neutral" context could also lead system operators to implement both innovative solutions and new types of products that meet the needs of different customer segments.

However, as shown by the data related to Sand Dollar and e-Naira, the introduction of a CBDC, in practice, does not have clear and immediate effects on the development of financial inclusion within an economic system. In this regard, the historical series available is still not very relevant, and the real effects will need to be studied in detail over the next few years. It should, however, be undelighted that, despite the speed at which financial inclusion has increased often not meeting the expectations of the issuing central banks, the results still show a slight trend towards improving the situation within the system in which these are introduced. It should also be specified that, although there has been a recent increase in online transactions in favor of a reduction in the use of cash, the change in individuals' habits, especially when these are "imposed" or "suggested" by a regulator, requires timeframes that are not always measurable in the short term. Aware of that, some central banks, to foster their CBDC programs and facilitate a post-release broad adoption, have chosen

to adopt strategies to include all the relevant stakeholders through collaborative and involvement practices in the development and design of the CBDC. For instance:

- **Digital Euro:** the European Central Bank[7] is proactively promoting several initiatives to fulfill the expectations of all internal and external stakeholders. In particular, to understand the needs of stakeholders, the ECB has scheduled several touchpoints to shape a Digital Euro that fulfills market needs, in particular:
  - **Financial Market Participants:** technical sessions where, for instance, the CBDC effects on banks' deposits are analyzed in order to calibrate the detention limits.
  - **Merchants:** the ECB promoted and attended different category conferences and round tables to both introduce the Digital Euro project and gather insights from merchants.
  - **General Users:** for instance, user research analyses have been conducted to gather insights about detention limits and user segmentation.
- **E-CNY**: The PBOC[9] since 2020 prompted an intensive stakeholder engagement strategy, in particular:
  - **Pilots:** several pilots involving different cities and regions have been developed by the PBoC since 2020 (e.g., Shenzhen, Suzhou, Xiong'an, Chengdu) to gather important insights related to user payment habits and future feature development.
  - **Payment Systems Integration:** other than traditional financial intermediaries such as banks, the PBoC is involved in the e-CNY design process with several important FinTech corporations and payment service providers, such as Alipay and WeChat Pay, with the goal of deploying an integrated environment for the usage of e-CNY.
  - **National and International Events:** leveraging relevant events, such as the 2022 Beijing Winter Olympics, the PBoC, in collaboration with merchants and payment service providers, permitted the usage of e-CNY by athletes, tourists, and residents-even without a Chinese bank account-to gather important data about the usage of the CBDC.

Therefore, to provide an overall judgment on the effect that the issuance of a CBDC may have on increasing the financial inclusion of a country, we will need to wait for both the increase in issuing countries of CBDCs and for the supporting data to cover longer periods of time.

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