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# FROM MOBILE MONEY TO DIGITAL CASH

Learnings from Africa's Experience  
with Mobile Money for the Introduction  
of Central Bank Digital Currencies

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# Glossary

API	Application Programming Interface
ATM	Automated Teller Machine
CBDC	Central Bank Digital Currency
DLT	Distributed Ledger Technology
GB	Gigabyte
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GNI	Gross National Income
GSM	Global System for Mobile Communications
KYC	Know-your-customer
MFI	Microfinance institution
MNO	Mobile Network Operator
SIM card	Subscriber identity module card
SMEs	Small and Medium-size Enterprises
SSA	Sub-Saharan Africa
USSD	Unstructured Supplementary Service Data

# Executive Summary

Central bank-issued digital currencies (CBDCs) hold the promise to complement paper currency, which is used globally to settle transactions today, while transforming the financial landscape and providing enormous social and economic gains. However, the realization of this promise is dependent on the successful adoption and widespread use of digital currencies, and comprehensively addressing prevailing risks and concerns. While CBDCs are still nascent, mobile money ecosystems have a long history of implementation spanning over a decade, and have had a transformative impact on financial systems in a large number of countries around the world. The mobile money experience therefore stands to shed light and provide key regulatory, economic, socio-cultural and technological lessons that can support the successful implementation of CBDCs.

Paper money derives its value from facilitating transactions that transfer goods and services amongst individuals and organizations, and its use is based on the high level of trust accorded by those who use it. In essence, the use of paper currency is based on the belief that any unknown person will also accept it. Unlike paper currency, which involves the exchange of physical notes, a digital currency is designed as a digital ledger that records transactions. In this case, trust is not dependent on belief, but on guaranteeing the accuracy, completeness and immutability of the ledger. Trade between two parties is executed by updating their relative balances to reflect the value of a given transaction instead of transferring physical notes.

There are three main types of digital currencies: private network e-currencies, cryptocurrencies and central bank digital currencies. Private network e-currencies are issued and controlled by private networks, including mobile money. Cryptocurrencies use cryptography to verify and secure transactions, frequently through a distributed system. Central bank digital currencies (CBDCs) are fiat currencies (that is, legal tender issued by decree by governments and not backed by any commodity) issued by central banks in digital form. Interest in CBDCs has increased dramatically in recent years, and the majority of countries around the world are at various stages of research, testing or implementation.

The first adopters of mobile money were economies in sub-Saharan Africa, and over time adoption rates have increased rapidly particularly in Asia and Latin America. As of 2020, there were 1.2 billion mobile money accounts globally, with US\$ 767 billion in transactions during the year. Sub-Saharan Africa accounts for 45.2 percent of all registered mobile money accounts, while South Asia and East Asia and the Pacific account for 25.2 percent and 20 percent of registered accounts respectively. A wide range of transactions are executed on mobile money networks, including person-

to-person transfers (which account for the largest share), as well as merchant payments, mobile-bank payments, international remittances, bill payments, government transfers and payments, business-to-business payments and airtime purchases.

The overall trend shows mobile money continuing to scale rapidly in a number of countries globally, although a number of implementations have been unsuccessful. This report details the key lessons from the mobile money experience in Africa that can contribute to the effective design, regulation and operation of CBDCs, based on the wealth of theoretical and empirical evidence on the social, economic and cultural impact of mobile money. The lessons are categorized into regulatory, technology, economic and socio-cultural.

## Regulatory

- 1) An appropriate legal and regulatory infrastructure has been critical to support the successful deployment of mobile money, including the appropriate delineation and licensing of financial and non-financial entities that are authorized to perform functions within the ecosystem using a risk-based system.
- 2) Leveraging the capabilities and infrastructure of non-financial institutions, especially mobile network operators and technology firms, through legislation that allows these institutions, either solely or in partnership with financial institutions, to offer a set of services traditionally offered only by financial institutions such as transfers and payments, has created a conducive environment allowing for rapid scaling of mobile money, and supported financial inclusion.
- 3) Regulatory flexibility, using an incremental approach as the mobile money ecosystem develops, has supported an enabling environment that allows for the entry of institutions and promotes innovation.
- 4) A tiered approach to the regulation of digital products offered through mobile money minimizes the compliance burden on users, through tiers and compliance burdens that differentiate users by their usage and capacity.
- 5) A comprehensive set of regulations to ensure the availability and persistence of services deployed through mobile money is essential, including ensuring real-time completion of transactions between parties. This includes requirements such as mandatory confirmation of transactions, a robust set of requirements for systems to handle user complaints, and maximum mandated timelines to do so.

## 6 FROM MOBILE MONEY TO DIGITAL CASH

- 6) The protection of user privacy and user-generated data is critical to support uptake in the usage of mobile money, including embedding regulations ensuring transparency in the collection and usage of data, and requiring user consent prior to data utilization in services and products deployed through mobile money.
- 7) The imposition of progressive, or at the very least non-regressive pricing systems for digital products and services offered through mobile money will further increase uptake and support financial inclusion.
- 8) Transparency on usage costs levied for products and services is essential to increase trust in mobile money systems and prevent unexpected user charges.
- 2) The use of mobile money has led to a significant increase in the efficiency of smaller-value transactions, which now account for the majority of the volume of digital transfers and payments.
- 3) However, while financial inclusion has increased mobile money has raised concerns about overall individual financial health, for example due to over-indebtedness arising from the issuance of digital credit.
- 4) Mobile money has had a transformative impact on financial inclusion, particularly amongst those located in remote regions where the location of bank branches is unprofitable.

### Technology

- 1) The establishment of trust in mobile money systems is directly linked to the quality of the underlying technology. It is critical to ensure persistence and availability of the technological platform, through resilience to technical failure, minimizing downtime, and implementing robust systems against counterfeiting and cyber risks. Countries in which there has been poor connectivity or failure to complete transactions have seen distrust amongst users and a preference to use other products instead of mobile money.
- 2) The underlying technological system must ensure real-time completion of transactions, account reconciliation, and immediate transmission of transaction receipts (and transaction reversals where necessary) between parties.
- 3) A comprehensive complaints system must be implemented through multiple channels, with maximum turnaround deadlines upon which complaints must be addressed, and an appeal route for complaints to a relevant independent authority must be specified to build confidence.
- 4) The implementation of application programming interfaces (APIs) is an integral part of ensuring the widespread deployment of third-party services using mobile money.
- 5) Education and onboarding of end-users has been essential to encourage mobile money uptake, by sensitizing users on the services they can access, and creating familiarity and comfort in using text or graphical interfaces.
- 5) The use of mobile money has dramatically increased the efficiency of making payments across individuals separated by distance, and also allowed the quick deployment of funds to finance activities in disparate locations. This in turn has contributed to household consumption smoothing, increased allocational efficiency across economic agents, and spurred risk-taking by individuals, thereby contributing to economic growth.
- 6) The introduction of mobile money has prompted a significant reorganization of physical infrastructure within the financial sector. Countries that have seen significant uptake in the use of mobile money have also seen a decline in the use of ATMs, prompting banks to retire ATMs and significantly reduce the number in use.
- 7) Despite the dramatic increase in the velocity of money through an increase in transaction volumes enabled by mobile money, there is little evidence of inflationary pressure due to mobile money usage, possibly due to the contribution of mobile money to growth.
- 8) Mobile money has increased transfer of informal cash into the formal banking system, thereby increasing the value of digital assets. This in turn has increased money supply by increasing the money multiplier, and potentially increases the effectiveness of monetary policy transmission due to the broader coverage of assets in the formal banking system.
- 9) Mobile money transaction costs, the cost of data access and the price of smartphones with the capacity to run third-party applications have contributed to a digital divide that excludes low-income households from accessing digital services including financial services, and participating in the digital economy.

### Economic

- 1) By some estimates, the usage of digital financial services has led to a 1-2 percentage point increase in economic growth in countries that have successfully adopted mobile money.

## Socio-cultural

- 1) There are differences in the initial adoption of mobile money by demography. Evidence from mobile money across countries shows that the first adopters are typically urban, educated and wealthier middle-class individuals. Additionally, mobile money has tended to be adopted first by younger individuals. Similar patterns may be observed in the adoption of CBDCs.
- 2) Usage of mobile money for payments, credit, insurance and investment has led to an improvement of attitudes towards digital financial services. Further, mobile money has increased levels of trust in the usage of digital financial technology, increasing its perception as an efficient and reliable store of value.
- 3) Mobile money has a positive impact on the savings habits of individuals, particularly female, lower-education and lower-income individuals, and those in rural areas.
- 4) Technical literacy and attitudes towards mobile money are barriers that limit access to mobile money amongst some individuals.
- 5) Despite access to mobile money, a large share of transactions today occurs through cash even in economies that have successfully adopted and used mobile money for a long period of time, indicating an enduring positive attitude for the use of cash.
- 6) The availability of digital credit has led to increased borrowing, and encouraged digital betting. Overborrowing and excessive gambling pose significant risks to households.
- 7) While mobile money has supported the growth of the digital economy, social inequalities may be exacerbated by those excluded from the digital economy either because of low technical ability, or due to the high costs of data access and mobile money transaction fees.

# 1. Introduction

## 1.1. The Fundamentals of Money

Agents in market economies freely agree on the exchange of goods or services, and also agree on the means of payment to settle transactions. Dating back throughout history, various modes of exchange have been used to facilitate the exchange of goods and services. Frequently, a commodity that had some intrinsic value and which was limited in supply was used as currency, such as cowrie shells in Africa, or the broader use of precious metals such as gold and silver globally. The use of paper money is believed to have originated in China in the 11th Century<sup>1</sup>, and over time, has become globally ubiquitous for the settlement of transactions. Between the 1870s and 1970s, currency notes were fixed to gold through the international gold standard, with monetary authorities standing ready to convert gold to and from currency at a fixed price. Today, fiat money is issued by decree as legal tender by governments, and is not backed by any commodity.

Although paper money is intrinsically worthless, it yields utility indirectly by facilitating transactions to obtain goods and services that directly provide utility. Its value is then derived from the level of trust that is accorded by the parties that recognize its use for transactions, whereby an agent accepts to use a currency for the purpose of carrying out a transaction on the belief that any unknown third party will also accept the same currency for further transactions. This encapsulation of trust is embodied through inscription on legal tender in some countries, such as the inscription on the British Sterling Pound that states “I promise to pay the bearer on demand”.

Any currency must satisfy some fundamental underlying properties in order to enable its widespread use. First, the currency must be accepted as a unit of account, as a baseline benchmark relative to which goods and services within an economy are referenced, and relative to which all prices of tradable items are established and quoted. Therefore, the currency must also be expressible in divisible units that allow the quantification of value across a wide range of goods and services. Second, the currency must serve as a store of value, with the face value of each note universally recognized in terms of convertibility into goods or services, with the convertibility holding persistently over time such that redemption in trade today does not differ wildly from redemption in trade tomorrow. And third, the currency must be readily accepted as a medium of exchange, such that notes are freely accepted in trade in exchange for goods and services and vice-versa. In addition to these core properties, other important properties that support the widespread use of a currency are durability, portability and limited supply.

## 1.2. The Role of Central Banks

While the value of paper money lies in the level of trust established across counterparties unknown to each other, there is no guarantee that this trust will persist into the future. There must therefore be an established mechanism to reinforce trust in a given currency system. This is enabled by the institutional back-stopping of the functions of the currency, so that agents holding the currency know that its value is stable and expected to remain persistently stable into the future. In the majority of economies globally, central banks are established to serve this function. In the absence of price stability, individuals are unable to establish accurate pricing signals, and markets do not have the guidance needed to function efficiently. If money loses value rapidly through high inflation, then its level of acceptability declines. At a fundamental level, money is woven into the fabric of trust in society, by playing a key role in enabling households to plan for the future, through saving for assets or retirement. Sudden fluctuations in the value of a currency can have significant ramifications by impacting the distribution of wealth amongst households, impacting in particular those saving money as a store of value, or those with lower exposure to other types of assets, in particular less-wealthy segments of the population.

Central banks have the core mandate of ensuring economic and financial stability within an economy, by means of conducting monetary policy to achieve price stability. A central bank serves the critical role of establishing trust in a given currency system by issuing the currency circulating in an economy as its own liabilities, meaning that the central bank stands ready to redeem the face value of each note upon demand. Issuance of paper currency within an economy also gives the central bank an important set of instruments to control the circulation of money, and thereby enables it to perform its crucial role of maintaining economic stability, while also allowing it to influence other important factors such as economic growth and employment.

Since the 1980s, inflation targeting has emerged as the leading framework for monetary policy, whereby the central bank keeps inflation expectations within the economy firmly anchored to a low and stable target, which may be explicitly stated. The central bank implements a monetary policy rule to return deviations in inflation back in line with the target. High levels of inflation erode the value of a currency, in turn eroding trust and confidence within the economy, thereby negatively impacting growth. Throughout history, the impact of high levels of inflation on growth has been well documented. Famously, the United States Federal Reserve implemented aggressive monetary policy in the 1980s to bring double-digit inflation under control, in the process plunging the US economy into a recession and raising unemployment.<sup>2</sup>

1 See “The Song Economic Revolution”; <http://afe.easia.columbia.edu/songdynasty-module/econ-rev-money.html>.

2 See VoxEU, “How the Fed ended the last great American inflation”, 2022.



The central bank also ensures adherence to its core mandate through macroprudential supervision of the financial system, ensuring that systemic risks or exposures do not build up within financial institutions. Beyond its core mandate of economic and financial stability, the central bank has other important objectives that differ in terms of emphasis across countries. Some of these objectives include supporting economic growth, maximizing employment, increasing financial inclusion amongst households, and supporting privacy.

While the central bank issues paper money, commercial banks are established to facilitate financial intermediation. This is done by providing interest to currency deposits, and lending deposits to agents in need of finance to facilitate investment. This process of intermediation creates a set of commercial bank assets and agent liabilities in the form of loans, which in turn may be deposited within commercial banks. The extension of credit therefore creates a money multiplier effect, which extends base money circulating in the economy into broad money.

### 1.3. Digital Currencies

A digital currency is designed as a verified digital ledger that records all transactions that occur within a given system. Trust within the system is established by guaranteeing the accuracy and immutability of the ledger, which signifies a critical role for security. Trade between parties is frequently executed by updating the relative balances to reflect the value of a given transaction, and thus a token is not transferred from one party to the other. This reflects a key difference relative to paper currency, where physical tokens exchange hands in trade, and where the supply of these tokens is under limited

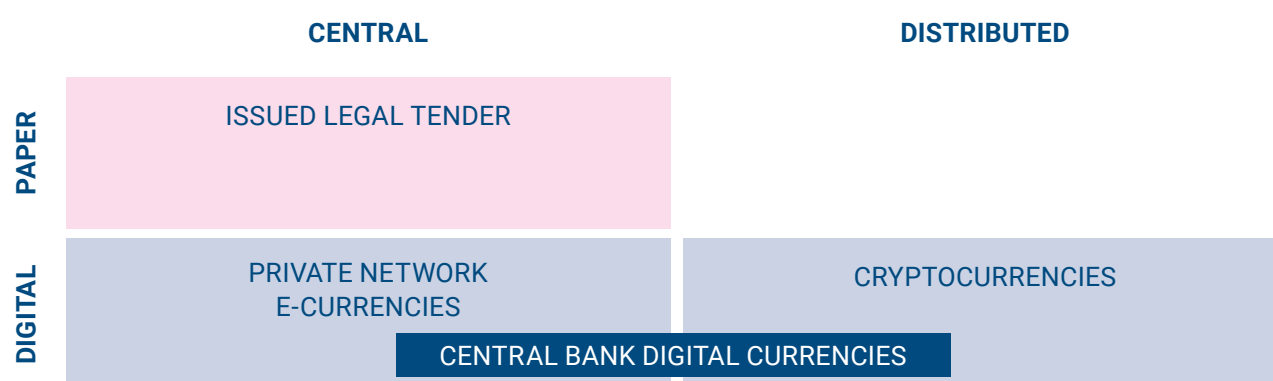
supply. A digital currency can be designed to be token-based, but the replicability of such tokens within a virtual network creates significant security concerns.

Digital currency performs all the core functions of paper currency, and is better suited in terms of certain properties, including portability, durability and divisibility. These underlying efficiencies, coupled with the ubiquity of access to data through telecommunication networks, create major scope for the utilization of digital currencies globally.

Digital payments have been increasing rapidly across the world. Already, the majority of money is held electronically within commercial banks and transactions within the global banking system are completed electronically without the need to exchange physical bank notes.<sup>3</sup> In addition, today, two-thirds of adults worldwide make digital payments, up from 35 per cent in 2014. Mobile money in particular has driven the huge increase in digital payments, particularly amongst lower-income households and in sub-Saharan Africa.<sup>4</sup>

There are three main types of digital currencies: private network e-currencies, cryptocurrencies and central bank digital currencies. Private network e-currencies are issued and controlled by private network protocols, and include mobile e-currencies, such as MPESA in Kenya. Cryptocurrencies use cryptography to verify and secure transactions, as well as to manage the creation of new currency units. The most prevalent cryptocurrencies are distributed and establish trust through a transparent and collective method of validating transactions rather than through a centralized process. Central bank digital currencies, which have received a high level of attention in recent years, are fiat currencies issued by central banks in digital form.

Figure 1 | Taxonomy of currencies



Notes & Sources: Author.

Digital currencies enable electronic banking, whereby functions such as payments for goods and services, money transfers, and deposit-taking and lending are enabled through electronic means within a financial system. These functions are already widespread throughout financial systems, and accessible through mobile devices. The distinguishing feature

of private network e-currencies is that they enable individuals without access to the formal banking system to perform banking functions, whereas typical existing mobile banking platforms, particularly in advanced economies with highly developed financial systems, simply allow digital access to traditional banking functions through a mobile phone.<sup>5</sup>

3 Bank of England, "Understanding the Central Bank Balance Sheet", 2015.

4 Global Findex Database, 2021.

5 See GSMA Mobile Money for the Unbanked Programme (Aron, 2017).

## 2. Mobile Money

### 2.1. Overview

Mobile money is e-currency that is issued by private vendors on a one-to-one basis for cash deposits, where the e-currency is then available for transmission across the vendor's network (or an integrated set of vendor networks), with the ability to be redeemed into domestic hard currency on demand in locations certified and included as part of the vendor's network. Mobile money networks are centralized, privately-operated digital currency systems, where the operator controls the settlement of transactions by increasing or decreasing individual ledger balances upon the execution of a transaction. These networks are typically deployed by mobile network operators (MNOs), although a variety of models and regulations have evolved across countries.

Issued mobile money is stored electronically on a mobile wallet (or mobile account), typically accessible through a mobile device, and can be used for transactions through transfer to a third party's mobile wallet. The mobile wallet is a ledger of the individual's transactions, uniquely identified, linked and secured to the person through personal identifying information. Any person with access to a mobile phone can open a mobile money account upon registration through a simple and free process. Registration does not require a minimum balance, in contrast to requirements frequently imposed to open bank accounts, and therefore increases the base of users to include those who are discouraged by minimum balance requirements. However, transaction fees are charged for mobile money transactions, as well as for cashing out of the mobile money platform.

Mobile money functions are accessible through a text-based USSD interface on basic mobile phones, or through a mobile money application in smartphones.<sup>6</sup> The key functions performed within mobile money networks include:

- 1) the conversion of paper money to and from electronic money through licensed agents, who are also responsible for the onboarding of new users;
- 2) secure access to mobile money balances and digital saving of currency through end-user wallets, which are secure software applications installed in user mobile phones;
- 3) execution of digital transfers, remittances and payments to individuals within the mobile money network, as well as individuals in other electronic or banking networks that are integrated to the individual's network;

- 4) the real-time reconciliation of balances upon execution of a transaction, as well as the provision of support services including the reversal of erroneous transactions and identification of resolution of fraud; and
- 5) support of value-added services such as credit or insurance, which are enabled and provided by third-parties through mobile money APIs.

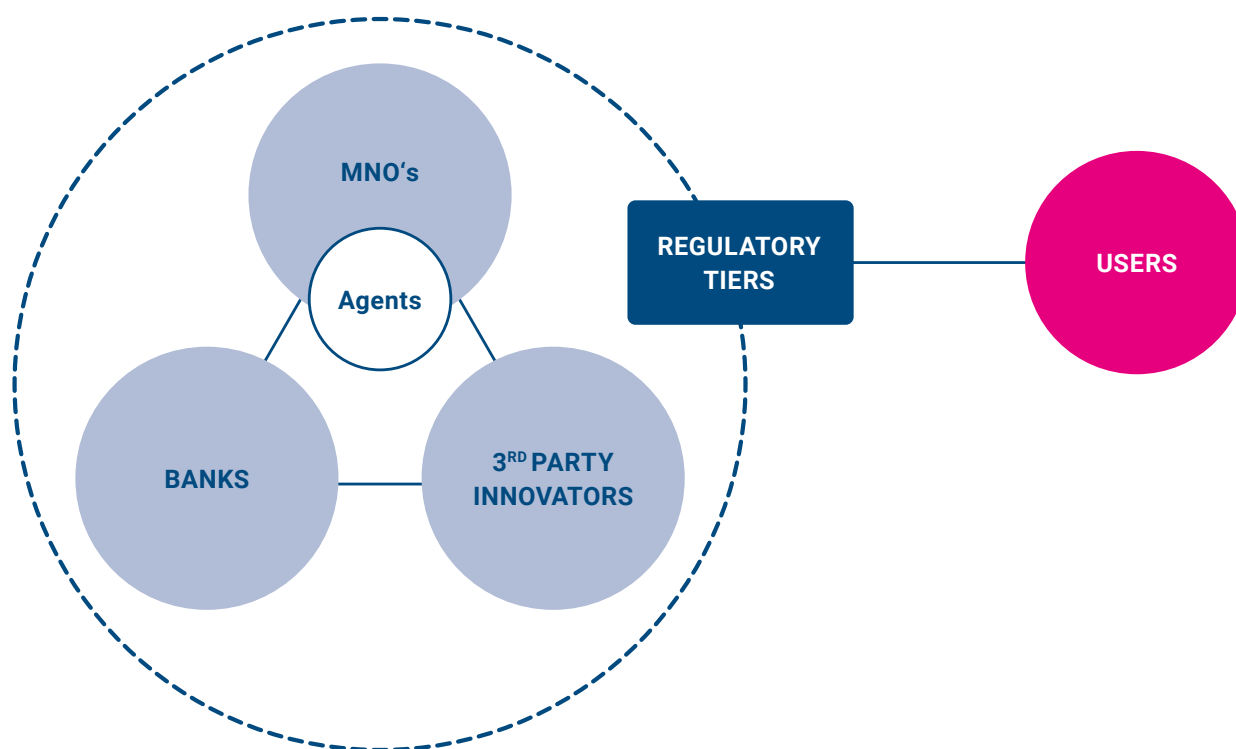
In all cases, the issuance of mobile money is fully or partially backed by cash deposits, which may be held in escrow or trust accounts<sup>7</sup> and which are closely supervised by regulatory authorities. While all electronic funds are therefore fully backed with paper currency, the system in many cases does not provide full coverage of funds in the case of bank default. In many jurisdictions deposit insurance is capped to a given amount at the account level, and therefore translates into coverage of only a fraction of the amount held in the escrow accounts. There is therefore a strong need to ensure that better protection is accorded to mobile money users against systemic risks within the banking system.

The central players within the mobile money ecosystem include the MNO, a network of licensed agents, commercial banks, users (individual and business) and the regulator. Other players with an increasingly important role in the ecosystem as it matures include other financial service providers (such as insurance) and technology firms (such as big data and analytics firms). The mobile money ecosystem is illustrated in Figure 2. The MNO provides the core infrastructure, the set of digital conduits through which mobile money transactions are performed, and depending on the regulatory environment, is either licensed to provide mobile money services directly, or is required to provide services in conjunction with a licensed commercial bank. Legally, the MNO is generally required to hold its cash deposits with one or more commercial banks.

The network of agents consists of businesses (typically small shops or retail outlets) that are trained and authorized by the MNO to provide mobile money services. These networks are critical for the functioning of mobile money as they have a much wider reach than commercial bank branches, and they are essential in onboarding and educating customers on the use of mobile money. Agents also offer cash-in and cash-out services between mobile money and cash. Depending on the development of mobile money infrastructure, there may exist wholesale and retail agents. Wholesale agents retain higher limits of electronic money, and facilitate cash management across retail agents, who are required to maintain sufficient cash float to service demand.

6 Unstructured Supplementary Service Data (USSD) is a GSM protocol used to send text messages, whereby a connection is opened that allows the real-time two-way exchange of data.

Figure 2 | Mobile money ecosystem



Notes &amp; Sources: Author.

The MNO typically has to make a significant upfront investment in growing its network of agents, in building their capacity to offer services to clients, and in enabling their capacity to hold sufficient cash balances to support cash-in and cash-out transactions. Despite the initial investment, the costs to an MNO of building and maintaining an agent network are much lower than the costs incurred by commercial banks in maintaining bank branches, as each licensed agent is an independent and functional outlet engaged in its own trade, in addition to offering mobile money services. Some commercial banks also deploy agency banking as a model to lower costs and increase their network footprints.

Commercial banks, other financial institutions and technology companies may partner with mobile money providers to offer a range of value-added services to customers. The provision of third-party services is enabled through an application-programming interface, which provides access to tools that enable the integration of mobile money payments into third-party products, thereby easing, streamlining and increasing the reachability of payments. The range of products is ever-expanding, and some key products include credit, insurance, pay-as-you go services and blockchain-enabled contracts. Commercial bank branches may also be licensed by MNOs to perform some wholesale agent functions, or banks may integrate and deploy their ATMs to perform agent functions.

The regulator plays a central but delicate role that straddles enabling innovation while also protecting consumers. Mobile money has changed the financial landscape in some countries by increasing financial inclusion far beyond the capabilities of the existing financial system, and enabling the bankability of large segments of unbanked individuals, particularly in developing countries. This has only been possible through an enabling regulatory environment that has allowed mobile money innovation. However, the introduction of new financial products, particularly by innovating entities that are not traditionally within the sphere of financial regulation, poses new risks to the regulator, and creates avenues for fraud and the exploitation of private consumer data. Therefore, the regulator plays the role of monitoring innovations in order to ensure consumer protection. In order to safeguard consumers, regulators frequently impose limits on the usage of mobile money, such as setting a maximum allowed amount per transaction or a maximum total value of transactions per day.

Mobile money network technology enables the real-time execution of transfers and payments, as well as the settlement of balances amongst transacting parties. Upon execution of a transaction, a notification message is immediately sent to each of the transacting parties, and account balances are immediately updated. The persistence and accuracy of the network is critical to build and maintain trust amongst users.

7 A trustee typically has a broader set of duties than an escrow agent. Thus, escrow accounts can be considered a special and narrow type of trust relationship (Aron, 2017).

Strong network security protocols are also essential to secure transaction traffic within the network, and to secure individual mobile money accounts. Additionally, protocols for the timely resolution of erroneous transactions and quick resolution of fraud incidences are essential. And given the large amount of transactional data collected through mobile money transactions, individual data privacy is essential to build trust in mobile money usage.

Integration and interoperability across mobile money service providers is important for ensuring broad access of mobile money and increasing financial inclusion. Regulation plays a role in ensuring integration and interoperability, taking into account the tradeoff between the incentives that MNOs have to invest in agent networks, and the disincentives that dominant MNOs have to share network or agent access with other networks.

Pricing of mobile money transactions varies by the type of service and by the recipient's network. Transactions within the same mobile money network are cheaper than transactions to other networks. Additionally, different rates are charged for person-to-person transfers, payments to businesses or for utilities, and withdrawals from agents. Third-parties that build platforms on mobile money networks typically have to pay fees for the utilization of mobile money APIs, and this in turn is also reflected in the pricing of their products.

Two main models are used to price mobile money transactions: slab-based pricing and percentage-based pricing.<sup>8</sup> In slab-based pricing, transactions within a pre-defined price range are charged a flat fee. In virtually all cases, slab-based pricing models are regressive, such that small-value transactions incur higher fees in percentage terms than large-value transactions. For example, in the case of MPESA in Kenya, transactions in the range of \$1 incur a 10 percent fee, whereas transactions in the range of \$1,500 incur a 0.2 percent fee.<sup>9</sup> Thus, smaller transactions are charged a fee that is 50 times higher in relative terms. In contrast, with percentage-based pricing a flat percentage is charged regardless of the amount transferred.

Communication between the mobile money service provider and a given user is not charged when using a SIM toolkit installed in the user's phone. Therefore, the completion of services such as checking of balances, purchasing of airtime or money transfers does not require the user to have already purchased a data bundle. This allows access to key functions at no cost, and enables widespread use of mobile money.

However, accessing the same services through an application on a smartphone requires access to a data bundle. There is wide global variation in the costs of access to data. The global average cost of an entry-level mobile broadband basket of 2GB is 1.9 percent of GNI per capita, relative to the UN Broadband Commission for Sustainable Development affordability target for entry-level broadband services, which is 2 percent

of monthly GNI per capita.<sup>10</sup> However, affordability varies widely, with the cost in Africa as high as 6.5 percent of GNI per capita, relative to a cost of 0.5 percent of GNI per capita in Europe. Given the significantly high access in Africa relative to the target, free access to mobile money services is important to support widespread usage.

### 2.2. Effective Design Elements

The effective design and operation of mobile money networks requires consideration of economic, technological, socio-cultural and regulatory dimensions. The economic, social and cultural impact of mobile money is critically dependent on proper design, the creation of an enabling environment, existing financial sector infrastructure, and levels of financial literacy and inclusion.

Mobile money network regulation varies by country, and its success is highly dependent on an enabling regulatory framework. Light-touch regulation has been critical in enabling mobile money to thrive. This has meant offering flexibility within existing regulatory frameworks to encourage the deployment of mobile money services, with the adaptation and tightening of regulation as the level of penetration grows. Regulatory frameworks vary in terms of entities allowed to provide mobile money services, with some countries allowing non-bank operators such as MNOs to provide basic services such as transfers and payments directly to customers, while other countries restrict the role of the MNO to providing the infrastructure, and requiring partnership with a bank to provide any type of financial service. Global experience has shown that countries that have tended to employ stringent mobile money regulations at an early stage have tended to stunt mobile money growth. For example, mobile money deployment in Nigeria, where stringent regulations were employed at an early stage, has lagged behind other countries in SSA.

Tiers of regulation based on individual characteristics and levels of expenditure allow regulatory flexibility based on the capacity of the mobile money user. For example, more stringent regulation for corporations relative to small businesses and households allows each the flexibility to adhere to different levels of compliance, and therefore lowers regulatory overheads.

Ideally, mobile money networks should be regulated on a set of frameworks that are unbundled on the basis of function as opposed to the type of entity offering a service. For example, the provision of payments services should be regulated as opposed to the entity providing the provision service. This supports regulatory flexibility, and encourages the formation of partnerships amongst various institutions depending on their relative competitive advantages. This approach in turn enables the application of existing regulations to mobile money offerings, and is provides efficiency gains. For example, if credit is to be offered through a mobile money net-

8 See Innovations for Poverty Action; and CGAP, "How do mobile money fee structures impact the poor" (2017).

9 MPESA transaction fees for 2022 are available from the Safaricom website; <https://www.safaricom.co.ke/personal/m-pesa/mpesa-rates>.

10 International Telecommunication Union, *The affordability of ICT Services*, Policy Brief, 2021.

work, then regulation of the credit function allows the direct application of existing regulation to licensed banks, which are able to partner with mobile money service providers to offer credit products. This is in contrast to some countries, where new regulations are created to regulate entities offering the new service, for example by enabling non-bank operators to provide a subset of financial sector services.

Leveraging telecommunications networks is essential for the deployment of mobile money. Telecommunications networks are already self-sustaining due to their core business of providing voice and data services, which provide a stable platform on which to deploy mobile money as a value-added service, and which MNOs do not view as a threat that would cannibalize existing revenue streams. Conversely, the deployment of mobile money led by bank networks gives rise to conflicting incentives due to competition of mobile money with established product lines.

Effective implementation of mobile money requires significant expenditure in ensuring service availability, instant reconciliation of accounts, and the transmission of notification messages to end-users. This is critical in establishing and maintaining trust amongst end-users. MNOs also have strong and relevant experience in building and operating data transmission networks, and have a strong foundation to build upon.

### 2.3. Data Privacy

Mobile money service providers collect a large quantity of personal data, including telephone numbers, personal identity information, transactional history (including amounts spent, vendors of goods and services, and types of items purchased), debt history and location data. In addition, mobile money agents, who typically operate as third parties, collect data on behalf of mobile money service providers, and also have access to personal data. The large volumes of private information collected raise data privacy concerns due to the risk of data misuse. Risks arise from the large number of stakeholders with access to personal data, as well as at every point in the data lifecycle, from data creation to processing, storage, transfer, analysis, archiving and destruction. The most significant risks within mobile money platforms are related to data security, where fraud or system hacking can result in financial losses. In addition, unauthorized data sharing can compromise individual privacy and may also carry reputational risks or perpetuate fraud.

Individuals place a high value on data privacy. Studies on mobile money networks show that users are willing to pay a premium to maintain data privacy, with some individuals willing to pay fees up to 50 percent higher in order to control access to their private information.<sup>11</sup> These findings hold for low-income households, and are persistent during the COVID-19 pandemic. Where individuals are financially unable to pay a premium to access a service with data privacy, many decide to forego the service altogether. However, the studies

also find that low-income individuals are willing to forego data privacy if keeping their information private limits their chances of accessing loans.

A system of effective data governance, which establishes principles to enable data sharing to improve living standards while at the same time recognizing and protecting the rights of data originators and users, is essential to safeguard data privacy within mobile money platforms. The development of an effective framework requires careful scrutiny of the attendant economic, legal and institutional concerns, as well as the establishment of proper standards for the exchange and protection of data. Overall, sub-Saharan Africa lacks a comprehensive and harmonized data governance infrastructure, and most nations are yet to develop legislation to safeguard the use of data. The African Union adopted the Malabo Convention in 2014, which seeks to encourage cybersecurity and personal data protection amongst partner countries. However, the Convention has not been fully implemented and is not enforceable. Globally, the establishment of data governance frameworks to safeguard privacy while creating an enabling environment for data sharing, has become a central issue. The European Union established the General Data Protection Regulation (GDPR) in 2018, one of the most comprehensive frameworks globally, as the legally recognized framework for data privacy and protection amongst its member states.

Regulatory authorities in some countries have established guidelines to promote data security amongst payment service providers. For example, the Central Bank of Kenya has published minimum requirements that necessitate high-level management engagement and support to underpin information security. This includes the role of a Chief Information Security Officer, who is responsible for developing and implementing an information security program, as well as clear procedures to identify and respond to data security breaches.

### 2.4. Challenges

Mobile money ecosystems tend to be dominated by a few players, and each provider has an incentive to maximize traffic within its own network. This creates a major disincentive for network integration and interoperability, and dominant networks in particular have little incentive to integrate with new and smaller networks. In turn, this means that mobile money networks tend to be dominated by a small number of major players, and networks will tend to be fragmented across service providers. As a result, global experience shows that the interoperability of networks has lagged.

While consumer protection is afforded by legislation requiring backing of electronic funds with cash deposits in escrow accounts, there are serious gaps with regard to the provision of deposit insurance. Legislation is required to provide pass-through deposit insurance for each mobile money account held in trust within a bank in order to accord adequate security against financial system risks.

<sup>11</sup> See Vidal and Medine (2020).

# 3. Adoption and Impact of Mobile Money

## 3.1. Mobile Money Adoption in SSA

Mobile e-currency has been successfully adopted in a large number of economies, particularly in sub-Saharan Africa (SSA), and has had a dramatic impact on financial intermediation. As of 2020, there were 1.2 billion mobile money accounts globally, with the value of global transactions exceeding US\$ 2 billion daily. Of the total accounts, 46 percent are registered in SSA, and 20 percent in East Asia and the Pacific. Further, international remittances processed via mobile money have reached US\$ 1 billion monthly. The interoperability between mobile money networks and banks has expanded significantly over the last five years, with US\$ 68 billion now processed annually between mobile money platforms and banks globally.

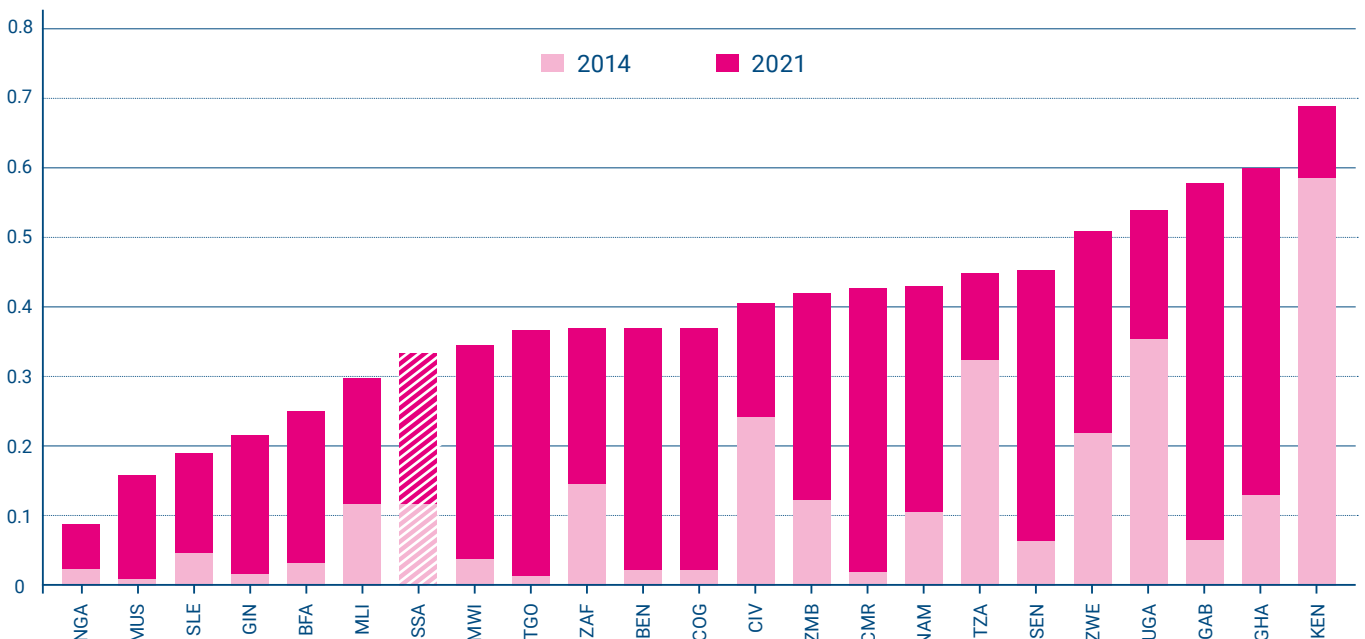
Mobile money implementation has seen mixed success, with many countries across SSA seeing significant growth in adoption and enjoying significant economic and welfare gains, while others have experienced a muted impact. On average, 30 percent of individuals aged 15 or more in SSA have mobile money accounts. The highest adoption rate is in Kenya, where 87 percent of individuals aged 15 or more have mobile money accounts. In Nigeria adoption rates are below 10 percent.

The most successful implementation of mobile money globally has been the case of MPESA in Kenya, where the penetration rate as of 2014 was already 58 percent. MPESA was the first mobile money network launched globally in 2007, following a pilot that began in 2003. The system designed and tested during the pilot was an account management system

for microfinance institutions, and was implemented jointly between Safaricom, Kenya's largest MNO, and Faulu Kenya, a large microfinance institution (MFI). The pilot was funded by DFID's Financial Deepening Challenge Fund, whose aim was to identify ICT solutions to increase microfinance. The initial pilot had limited success, and resulted in the MFI effectively running two record-keeping systems. However, the pilot also demonstrated the large potential for mobile e-cash transfers, and led to a repositioning of the project, with Safaricom becoming the sole implementing entity.<sup>12</sup>

Beginning in 2007, Safaricom began growing a network of agents, beginning with its existing network of airtime distributors. The expansion of the network required management of a number of challenges, including the efficient management of cash float at agent locations to enable conversion between cash and e-currency, building capacity to deal with increasing demand for digital transfers, as well as services such as balance checking, and implementing regulatory requirements that came into play with increasing usage of the platform, such as anti-money laundering rules. The successful navigation of these challenges enabled MPESA to grow rapidly. The initial users were mostly wealthier and better educated individuals, and the major use of MPESA was for transfers. However, MPESA rapidly expanded to include lower-income segments of the population, and led to a rapid increase in financial inclusion amongst previously unbanked individuals. The successful expansion of MPESA was also dependent on high levels of mobile phone penetration in Kenya.

Figure 3 | Mobile money accounts (Percent of population aged 15+)



Notes & Sources: Data from Global Findex database, 2014 and 2021. 3-digit ISO alphabetic codes indicated.

12 Foster (2013).

With Kenya's successful MPESA deployment, mobile money usage also experienced significant growth in other East African countries. By 2014, East Africa had the highest mobile money penetration rates globally; in addition to Kenya, over one-third of individuals over 15 years of age owned mobile money accounts in Uganda and Tanzania.

Over the last 7 years, the most rapid adoption of mobile money in SSA has occurred in West Africa. Over this period, mobile money account ownership in Gabon has increased by 51 percent, in Ghana by 47 percent of the population aged 15 or more. Other countries in the region that have experienced strong growth in mobile money are Cameroon, Senegal, Benin, Togo and the Republic of Congo. The key activity supporting growth of mobile money services in West Africa is transfers and remittances, which have significantly improved the efficiency with which funds are made available amongst individuals. Other key underpinning factors supporting growth are supporting regulatory environments, high rates of mobile phone penetration, and growth in agent networks.<sup>13</sup>

Different regulatory models have seen some level of success. For example, in Ghana, banks are authorized to provide services as electronic money issuers and non-banks are authorized as dedicated electronic money issuers, in an activity-based approach. Conversely in Cote d'Ivoire an institution-based approach has been followed, where commercial banks, and payment service providers are licensed to provide mobile money services, and MNOs are required to establish a dedicated subsidiary to apply for a license.

In Southern Africa, mobile money adoption in Zimbabwe is 51 percent of the population aged 15 or more. Zimbabwe experienced hyperinflation in the early 2000s, followed by rapid disinflation at the end of the decade. With the recent global shocks due to COVID-19 and political uncertainty, the Zimbabwean dollar has depreciated rapidly and prices have spiked. Inflation in 2019 and 2020 was 255 percent and 557 percent respectively.<sup>14</sup> Inflationary pressure in the economy has coincided with a rapid decline in per-capita income and decline in living standards amongst Zimbabweans. However, the use of mobile money has expanded significantly in Zimbabwe despite the turbulent domestic economic environment, supported by some key advantages of mobile money. First, the government has actively supported the use of electronic payment methods as a strategy to circumvent cash shortages, particularly acute during periods of hyperinflation. Second, the convenience afforded by mobile money has led to increased use amongst households, decreasing the need to handle physical cash, leveraging broader reach relative to existing financial infrastructure, and also enabling households to take advantage of lower transaction fees relative to banking sector payments. And third, mobile money offers secure storage of account balances, particularly for individuals not included within the formal banking system.

A number of mobile money implementations in sub-Saharan Africa have failed to experience significant traction to date. The most prominent case in the Nigerian mobile money deployment, where mobile money account ownership was only 2 percent as of 2014, and has subsequently only grown by 6 percentage points between 2014 and 2021. The key reason for the low growth of mobile money in Nigeria is the restrictive regulatory environment, which has promoted a bank-led model and resulted in conflict between established bank products and new mobile money products. The country has not managed to grow its network of mobile money agents, and therefore access to mobile money services is restricted particularly for those located in rural areas. In addition, access to mobile money products is costly due to high transaction fees, and navigation of mobile money interfaces is cumbersome.

South Africa has Africa's most developed financial infrastructure. The relative sophistication of the South African financial ecosystem has allowed more widespread access to digital payments offered through banks. In turn, these have products have been able to compete with mobile money deployments, and limited the growth of mobile money. As a consequence, although mobile money usage has grown, levels of adoption have been muted in comparison to other countries. As of 2021, mobile money penetration in South Africa was at 37 percent.

Additionally, the deployment of mobile money has seen limited growth in fragile economies. In Sierra Leone and Guinea, mobile money penetration rates were 19 percent and 21 percent respectively as of 2021.

### 3.2. Empirical Evidence on Mobile Money

Empirical evidence shows a significant impact of mobile money at the micro- and macro-economic level. At the micro-economic level, the most significant impact has been the increase in financial inclusion that has occurred through access to financial services on mobile money platforms. In sub-Saharan Africa (SSA) mobile money usage has grown significantly, and the region accounts for more than half of the 1.2 billion active mobile money accounts today.

A large body of academic literature has focused on quantifying the impact of mobile money in increasing financial inclusion. There is wide agreement from research findings that MPESA has significantly increased access to finance, particularly for lower income and rural households. Additionally, the literature documents a positive impact of improved financial inclusion on household and individual welfare. Some of the channels through which mobile money improves welfare are by enabling smoothing of household consumption, improved risk-sharing across households, and increased

<sup>13</sup> See GSMA; <https://www.gsma.com/mobilefordevelopment/uncategorized/east-west-growth-mobile-money-sub-saharan-africa/>.

<sup>14</sup> World Bank World Development Indicator Database, March 2022.

access to informal credit, leading to improved gender equity and lower poverty rates. Mbiti and Weil (2014) find that MPESA in Kenya had a significant positive impact on individual welfare. Over the long-term, Jack and Suri (2016) find that the adoption of mobile money has resulted in long-term increases in household welfare by increasing household savings and consumption, and thereby reducing poverty rates.

Mobile money has increased the facilitation of trade by speeding up transaction execution, improved timing of receipts and higher security, in turn contributing to higher allocational efficiency and contributing to economic growth. Further, mobile money is an effective tool in transmitting social payments, allowing transparency and tracking, and thereby increasing accountability. Mbiti and Weil (2014) perform an analysis of the market for Kenyan mobile money remittances through MPESA, and find that MPESA led to increased competition in the supply of remittance services, whereby lower mobile money transaction costs led to decreases in prices of competing services such as Western Union and MoneyGram. Jack and Suri (2011) document that on average, mobile money transactions in Kenya connected parties separated by 208km in distance, dramatically reducing the cost of remittance relative to physically transferring funds. Beck et al. (2018) find that mobile money boosts entrepreneurial activity by reducing the incidence of theft, and also speeds up transaction execution.

Although mobile money systems have tended to start with use predominantly for private domestic transfers, they have evolved into payments platforms with broader reach as they have matured. Over time, payments through mobile money have expanded to include business payments, public utility payments and other personal expenses. Additionally, mobile money has been integrated into pay-as-you-use systems that track usage of a given asset, enabling an efficient system where the user leases an asset pays for consumption as needed, thus increasing affordability. However, while mobile money has increased the reach of financial intermediation and agent networks, it has negatively impacted traditional financial infrastructure, evidenced by the decreasing deployment of ATMs.<sup>15</sup>

However, the usage of mobile money has also raised concerns about overall individual health. While mobile money usage has led to increased financial inclusion, evidence in some countries indicates that overall financial health has declined. In Kenya, a financial health index measured by vulnerability to shocks, including the ability to pay for day-to-day needs, ability to cope with shocks or risks, and the ability to invest in future goals, shows that financially healthy adults declined 39.4 percent in 2016 to 17.1 percent in 2021.<sup>16</sup> Although a causal link between financial health and mobile money is not established, and it is possible that financial health would have been worse without the impact of mobile money, this highlights the need for financial access to translate into an overall net improvement in financial health.

In addition, access to mobile money has also led to significant growth in digital credit. In turn this has raised concerns about over-indebtedness arising from increased access to credit. Evidence shows that digital borrowers are more likely to default than those who use other types of formal or informal credit: in Kenya, 21 percent of digital borrowers defaulted in 2019, relative to 16 percent from informal sources or credit and 7 percent from formal sources of credit excluding digital credit.<sup>17</sup>

Further, mobile money transaction costs, the cost of data access and the price of smartphones with the capacity to run third-party applications have contributed to a digital divide that excludes low-income households from accessing digital services including financial services, and participating in the digital economy.

Macroeconomic research has shown that digital payments can generate annual gains of up to 1-2 percent of GDP.<sup>18</sup> A smaller body of research has looked at the monetary and financial stability impact of mobile money. The findings are that mobile money has increased transfer of informal cash into the formal banking system, thereby increasing the value of digital assets. This in turn has increased money supply by increasing the money multiplier, and potentially increases the effectiveness of monetary policy transmission due to the broader coverage of assets in the formal banking system. Additionally, despite higher competition, there is evidence of increased banking sector profitability due to the increased value of transactions channeled through mobile money platforms, and there is no conclusive evidence of a link between mobile money and higher inflation, or higher levels of financial instability.

GSMA (2019) looks at the impact of mobile money on monetary and financial stability across several countries in Africa. From an economic stability perspective, the paper investigates whether mobile cash has resulted in a transfer of informal assets and cash into the banking sector, potentially impacting the money multiplier, the velocity of money, and inflation. The authors support the correlation between mobile money adoption and informal cash transfer into the formal banking sector but do not establish a causal relationship. This trend enhances the effectiveness of monetary policy tools due to the broader coverage of assets held in the formal financial system.

Studies on the impact of mobile money on the velocity of money are inconclusive. Weil et al. (2012) do not find a higher velocity of mobile money than cash in a study of Kenya, Tanzania and Uganda. GSMA (2019) finds evidence of a link between mobile money adoption and a larger money multiplier but no direct connection to inflation. The authors also do not see a tangible link between mobile money adoption and financial instability. Similarly, Aron et al. (2015) do not find a link between mobile money and inflation using inflation forecasting models in Uganda.

<sup>15</sup> World Bank WDI database.

<sup>16</sup> FSD Kenya (2021), p. 62.

<sup>17</sup> FSD Kenya (2019), p. 12.

<sup>18</sup> World Bank (2020), p. 5.



Tirongo and Wamalwa (2020) find that mobile money issuance has positively impacted banking sector profitability through an increase in the value of transactions channeled through mobile money platforms. Further, the mobilization of deposits through mobile banking platforms has not impeded bank profitability, despite concerns registered by the banking sector. The authors also find that mobile money has reduced commercial bank liquidity ratios and capital adequacy ratios by facilitating savings mobilization by banks, which has supported credit extension. However, they also find loosened risk-profiling and higher levels of non-performing loans. Muthiora (2015) argues that mobile money may not introduce systemic risk to the financial system since mobile money accounts for less than 10 per cent of the total national payment system throughput.

The introduction of mobile money has also improved competition in transfers and payments. Mobile money has increased the value and frequency of transfers. In particular, low-value transactions through mobile money platforms today comprise 90 percent or more of the total number of transactions, as evidenced in countries including Ghana, Kenya and Zambia.<sup>19</sup> In addition, mobile money platforms have increased domestic and international remittances.

Socio-cultural factors have played a major role in mobile money uptake. First-adopters of mobile money have tended to be wealthier middle-class, urban individuals, and adoption of mobile money is higher amongst individuals with higher levels of education. In addition, the first adopters of mobile money have tended to be younger individuals. In some countries, mobile money adoption rates have also initially been higher amongst males. Jack and Suri (2011) find that wealthy urban households were the first adopters on mobile money in Kenya.

A number of key factors contribute to the adoption of mobile money. These are idiosyncratic and based on country characteristics, and research does not find a single set of characteristics that consistently and accurately predict mobile money adoption across all countries. Some of the key factors that have been documented as influencing adoption include agent quality, measured in terms of pricing transparency and expertise, and agent competition (Balasubramanian and Drake, 2015), the regulatory environment, including the level of accommodativeness of the central bank (Mas and Radcliffe, 2010), and the degree of mobile phone penetration, quality of retail infrastructure, and volume and momentum of the innovation (Heyer and Mas, 2009). Foster (2013) documents onboarding and education of users, as well as access to agent networks, as important factors.

19 FSD Africa studies on credit in Ghana and Zambia document the increase in transactions.

## 4. Central Bank Digital Currencies

### 4.1. Overview

Central banks across the world have taken a major interest in the merits of issuing digital currencies. Central Bank Digital Currencies (CBDCs) are under active research, development and evaluation across the majority of central banks, with 105 countries representing 95 percent of global GDP currently exploring the implementation of a CBDC.<sup>20</sup> Some have already issued CBDCs, such as the Bahamas and China. The objectives for the issuance of CBDCs differ widely, and are informed by each country's unique socio-economic environment and policy objectives. Policy goals include increasing payment system access, efficiency and resilience, increasing financial inclusion, broadening the tax base, promoting economic competition and growth, securing monetary sovereignty and reducing illicit flows of money.

CBDCs offer vast potential to transform financial sector intermediation. They can increase allocative efficiency by broadening the reach and availability of financial services, and lowering the time and costs of transferring resources to productive activity, through the ability to reduce or eliminate transaction costs, and to reduce transaction settlement time. CBDCs can therefore improve financial infrastructure efficiency, transparency, competition and resilience, with potentially major effects on economic growth.

A CBDC is a form of central bank currency issued alongside physical bank notes and reserve money. Through its backing by a central bank, this digital currency is intended to be universally accepted within an economy as a store of value and a unit of account. CBDCs are managed on digital ledgers, where money is issued through digital tokens that are redeemable for central bank reserves in a country's domestic currency, and which are used for transactions that are validated and settled on the ledger. The implementation technology of a ledger may be centrally controlled, distributed or employ a partially distributed system. The choice of a distributed ledger technology (DLT) accounts for tradeoffs in satisfying three key properties that cannot be simultaneously achieved: correctness, decentralization and cost efficiency. While all trusted systems must maintain correctness and integrity, centralized systems sacrifice decentralization for correctness, while fully decentralized systems sacrifice cost efficiency for correctness by imposing punitive penalties on malicious actions.

Despite their potential, these emerging currencies also pose risks that must be properly understood in order to safeguard financial and monetary stability, and many of the risks to implementation are still to under active research. CBDCs could diminish the role of commercial banks in the settlement of payments by obviating the need for bank platforms in the settlement process, thereby precipitating a decline in bank deposits. In turn, this could have a negative impact on the ability

of banks to extend credit. During adverse economic shocks, easy access to a safe digital asset that can potentially be held in large volumes at no cost could increase the frequency and severity of digital runs within the financial system. CBDCs could also have a negative impact on the transmission of monetary policy, and result in greater risk-taking by financial institutions. And further, cyber-security risks are heightened with the issuance of digital currencies.

### 4.2. CBDC Framework

A CBDC is comprised of a policy and regulatory framework outlining its legal basis, a governance and risk management system, access and transaction protocols for participants, and standards to allow interoperability. This framework is implemented upon a core technological infrastructure that allows the central bank to issue as well as redeem and settle digital currency.

Unlike paper currencies, where actual notes are exchanged during transactions, digital currencies use an accounting system that updates the balances of the transacting parties upon execution of a transaction. The set of transactions is maintained on an ever-growing ledger, and the integrity of the system is dependent on the immutability of the ledger.

A CBDC system may be implemented using a centralized ledger, a decentralized ledger, or using distributed ledger technology. The chosen CBDC design reflects the privacy choices of the central bank. A centralized ledger keeps the settlement of all transactions within the operational control of the central bank, and is dependent upon the central bank's reputation and reliability of its platform to ensure the overall integrity of the system. On the other end of the spectrum, a fully distributed system leverages blockchain technology to maintain the reliability and integrity of the system, by utilizing a network of independent computing systems to verify the accuracy of each transaction, and imposing significant costs on any false or fraudulent transactions. Unlike distributed cryptocurrency implementations, which are fully transparent, the central bank needs to balance transaction verification with user privacy. Decentralized implementations lie between fully centralized and fully distributed systems, where only a subset of the system's components is kept centralized.

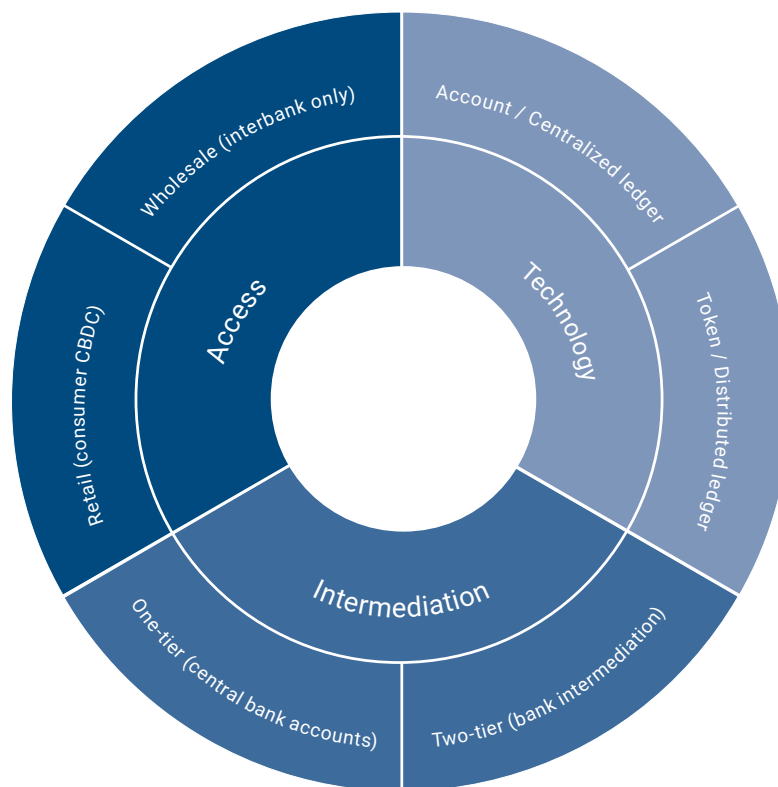
Within any CBDC system, the central bank has to make critical decisions on which functions to implement directly (operate), which functions to delegate to other institutions (outsource), and which functions to allow others to perform under supervision (oversight). Broadly, the key functions within a CBDC ecosystem include: universal access by agents through open technological infrastructure, including connection to end-user wallets; transaction processing services, through the core

CBDC infrastructure, and connectivity with digital identity systems; execution of payments, reconciliation of balances, and provision of support services; support for other value-added services enabled by digital currency (for example lending, insurance and smart contracting); and interoperability across various services, through implementation of common standards. In order to support the implementation of these functions universally within a given economy, integration of a broad set of existing systems is critical.

The central bank and end users interact directly or indirectly through a set of intermediaries, depending on the design and objectives of the CBDC. A completely centralized implementation of a CBDCs is a significant undertaking for a central bank, and requires direct implementation by the central bank of functions previously undertaken by other intermediaries, including payments settlement. This requires a significant deployment of resources by the central bank, and carries high operational risks.

Intermediaries within a CBDC ecosystem include commercial banks, MNOs, payment service providers, fintech companies and big tech companies. The role of commercial banks, MNOs and other payment solution providers in undertaking the execution and settlement of transfers and payments is a critical design choice, as these functions have traditionally been offered by commercial banks, and contributed significantly to bank profitability. Design choices must also consider the ability of commercial banks to continue their role of financial intermediation through deposit-taking and lending, the implications of digital currency on this role, and the ability on new entrants, such as fintech companies driven by big data, to compete in environments where CBDCs are in use.

Figure 4 | CBDC design



Notes & Sources: Figure adapted from SUERF Policy Note, Issue No. 241 (May 2021), Exhibit 2.

## 5. Lessons from Mobile Money for the Implementation of CBDCs

Mobile money networks have a history of deployment spanning over a decade, and are rapidly scaling in an increasing number of countries globally. The design, regulation and operation of mobile money networks offers important lessons for the deployment of CBDCs. A wealth of empirical evidence on the social, economic and cultural impact of mobile money provides guidance and lessons for the deployment of CBDCs. The lessons are categorized into regulatory, technology, economic and socio-cultural.

### 5.1. Regulatory

Regulation of the CBDC ecosystem will play an important role in determining how successfully and how quickly CBDCs are adopted in an economy. Regulatory flexibility is critical to create an enabling environment for the growth of digital currencies. Thus, regulation should support innovation by all players within the CBDC ecosystem, and should ensure that intermediaries traditionally excluded from financial intermediation, such as MNOs and big data companies, are encouraged to participate in financial sector innovation. In mobile money ecosystems, a legal and regulatory infrastructure to enable non-bank electronic money issuance has been a critical enabler. The key components have included a clear definition of e-money as a distinct instrument, a legal requirement for the licensing of e-money issuers and the qualification criteria for licensed entities, and a set of activities that licensed e-money issuers are permitted to perform.<sup>21</sup>

The set of permitted activities balances the need to increase financial inclusion, while using a risk-based system to protect the integrity of the mobile money ecosystem and manage the costs of service provision. Thus, the activities are restricted to transfers, payments and cash-in/cash-out transactions, and also completed with a lower regulatory threshold than required for banks. This enables e-money issuers to provide services at a lower cost than banks, and in turn allows them to serve a broader segment of lower-income individuals than traditional banks are able to serve. Additionally, the minimum capital requirements for e-money issuers are significantly lower than those for banks.

Mobile money experience shows that allowing piloting of innovations with oversight is an effective model. As the innovations grow in success, additional and appropriate controls can be added by the regulator. Additionally, from a demand perspective, a tiered system of regulation maximizes uptake across individuals, SMEs and corporates while minimizing the compliance burden. Thus, smaller businesses and individuals can face lower compliance requirements than larger corporates, and therefore lower the likelihood that they are discouraged in participating.

There is a wide range of approaches taken by countries on licensing of electronic money issuers. In most countries, the approach is to allow the issuance of e-money exclusively by payment service providers. In Ghana, non-banks are licensed as dedicated e-money issuers, and must create a separate legal entity to engage in e-money issuance if they are engaged in other activities. However, banks, who are already subject to stricter regulations, are authorized as e-money issuers in addition to their other activities. In contrast, in Uganda non-banks can become mobile money services providers only in partnership with banks. In this case, the regulator approves the partner bank, and mobile money is recognized as the bank's product. In Kenya the regulatory environment is the least restrictive, which allows banks and other financial institutions to issue e-money.

The regulation of function as opposed to entity allows the leveraging of existing legislation, and encourages the formation of partnerships amongst intermediaries who may be specialized in delivering various aspects of a given product, such as commercial banks and big data specialists. In addition, regulation of function precludes the need to create new regulatory frameworks for the deployment of CBDCs, which could significantly slow down CBDC implementation.

The uptake and reach of CBDCs will likely be maximized by leveraging mobile telephony networks to transmit data, and mobile phones to hold e-wallets. However, mobile money deployments have shown that market concentration is likely to occur, with most markets having a small number of dominant mobile money providers. Regulation has in some cases played a part in contributing to market domination by an MNO. For example, in Kenya, the MNO was granted exclusive rights to a network of agents in order to encourage it to invest in building out the agent network. However, as mobile money uptake increased, exclusive agent rights were outlawed in order to encourage competition. In a similar vein, enabling legislation is likely to be required to avoid market concentration in the deployment of services, and to promote competition.

Mobile money pricing structures are regressive, whereby small-value transactions are in some cases charged up to 50 times more than large-value transactions as a percent of transaction amount. As lower-income individuals are most likely to engage in executing low-value transactions, the pricing structure is likely to be disproportionately more expensive to lower-income individuals. Regulations in countries that have enjoyed high levels of mobile money growth have not imposed restrictions on pricing. During the COVID-19 outbreak, some mobile money providers allowed the execution of some small-value transactions for free, and this led to a surge in the number of small-value transactions. This suggests that even when mobile money is relatively more accessible than other

<sup>21</sup> CGAP, "Basic Regulatory Enablers for DFS", May 2018.

forms of digital payments, pricing still discourages use for the completion of some transactions. With regard to CBDCs, this suggests that should costs be imposed for transactions, a progressive (or at the very least a non-regressive) costing system should be implemented.

The establishment of trust in CBDCs requires careful management of transparency relative to privacy. In this regard, the regulatory environment needs to account for the systems required to verify transactions, depending on the CBDC implementation infrastructure, and the high value that users place on transaction privacy.

## 5.2. Technology

The establishment of trust in a CBDC is crucial to ensure successful uptake, and is in turn directly linked to the quality of the underlying technology. It is critical to ensure persistence and availability of the technological platform, through resilience to technical failure, minimizing downtime, and implementing robust systems against counterfeiting and cyber risks. The underlying system must ensure real-time completion of transactions, account reconciliation and transmission of transaction receipts (and transaction reversals where necessary) between parties. Regulatory approaches in most countries where mobile money is deployed require mandatory confirmation of transactions to clients. For example, in Tanzania, providers and agents are prohibited from completing a transaction if a receipt or acknowledgment cannot be generated. Further, in Rwanda and Kenya, all transactions must be processed in real-time.<sup>22</sup> The impact of system downtime on trust in mobile money systems can be significant. A recent study in Rwanda, Sierra Leone and Zambia found that poor connectivity and failure to update transactions in mobile money systems has led to distrust amongst users, in some cases with groups preferring the use of informal savings groups to mobile money.<sup>23</sup>

Mobile money regulations require that a comprehensive complaints system must be implemented through multiple channels, including in-person channels through toll-free telephone numbers, as well as through technology-enabled channels such as SMS and USSD. In addition, maximum turnaround deadlines are specified upon which complaints must be addressed, with some countries, such as Ghana and Tanzania, requiring the tracking of all stages of complaints with receipts. Additionally, an appeal route is specified for complainants, either to the financial regulator or to the relevant competition authority.

The establishment of trust is also closely linked to the provision of security, whereby many countries take a tiered approach to minimize the compliance burden on mobile money users, while at the same time ensuring system integrity. Risk tiers are established that create different levels of access based on the type of account. E-money accounts are typi-

cally segmented into a combination of the following tiers: a basic account with minimal opening requirements and low transaction ceilings; a mid-range account with higher transaction limits and correspondingly higher know-your-customer (KYC) requirements; and special accounts typically designed for businesses, which include higher limits than individual accounts and a rigorous set of KYC requirements. For example, in Ghana, there are three tiers for e-money issuers: minimum, which requires any type of photo identification; medium, which requires official ID documentation; and enhanced, which has the same requirements as opening a bank account.<sup>24</sup>

Application programming interfaces (APIs) allow the deployment of critical value-added services. Within mobile money networks, MNOs have provided APIs to third-party vendors in order to enable them to build new product offerings that utilize mobile money. This has enabled the deployment of a growing set of innovative products, including credit, insurance, and Internet-of-Things (IoT) services linked directly to digital payments. In a similar vein, APIs will be an integral part of ensuring the widespread deployment of third-party services using CBDCs. However, mobile money value-added service models are frequently built on technology that requires the collection and analysis of historical transaction data in order to build risk profiles, and therefore intersect with client privacy concerns. In many countries, this is an area where regulations are actively being developed. Many countries require that consumer data must be kept confidential by providers and agents. Additionally, some countries require disclosure to clients of the conditions under which their data is kept, while others require customer consent for the use of their data.

Beyond the technological infrastructure, mobile money experience shows that education and onboarding of end-users is critical to spurring uptake. Education sensitizes users on the functions that they can perform using digital currency, and creates familiarity and comfort in using text or graphical interfaces in order to access services. This is particularly important for some segments of the population, including those that may not be technologically savvy (such as older individuals), or segments of the population with low access and low familiarity with financial services.

Although third-party vendor applications are central to the growth of digital finance and more broadly the digital economy, they also contribute to rising levels of inequality. The deployment of these applications frequently requires the use of smartphones, which are expensive in particular for low-income households. In addition, these applications require access to data, which is expensive and charged by the MNO independently of the application. The pricing of services offered by applications will also frequently account for the costs the MNO will charge the vendor for delivering the service through its network. Given the costs of accessing digital services, lower-income households face a higher risk of exclusion relative to higher-income households.

<sup>22</sup> CGAP (2018), p. 21.

<sup>23</sup> See CGAP (2022); <https://www.cgap.org/blog/mitigating-dfs-consumer-risks-insights-sub-saharan-africa>.

<sup>24</sup> CGAP (2018), p. 24.

Interoperability standards are critical to ensuring the seamless integration of intermediaries, and the integration of CBDC platforms across countries. Mobile money platforms have lagged in achieving interoperability due to disincentives that competing entities have in integrating their platforms. By definition, a CBDC deployed for retail use must be universally accessible, and must therefore ensure that standardization and interoperability of intermediary systems is maintained, so that no one is excluded from accessing a service due to interoperability constraints.

### **5.3. Economic**

Evidence from the deployment of mobile money in countries such as Kenya, Ghana and Zambia shows a dramatic increase in the number of transactions performed using mobile money transactions, quickly surpassing all other financial sector transactions and accounting for over 90 percent of the total number of transactions. This has been achieved through the wide accessibility and lower transaction costs of mobile money transactions relative to banking sector electronic transfers. However, the average value per mobile money transaction is much lower than other transactions, and hence the total value of transactions on other digital platforms still accounts for the majority of total transactions by value. The use of mobile money has therefore led to a significant increase in the efficiency of smaller-value transactions, with a consequent positive impact on overall economic growth. Further, the introduction of mobile money prompted a significant reorganization of physical infrastructure within the financial sector. Countries that have seen significant uptake in the use of mobile money have also seen a decline in the use of ATMs, and this in turn has prompted banks to retire ATMs and significantly reduce the number in use. In a similar vein, CBDCs have the potential to enable massive economic efficiencies, and transform the landscape of financial sector infrastructure, and their introduction may lead to a dramatic increase in the number of low-value transactions completed digitally, while also leading to a reorganization in the physical deployment of financial sector assets such as ATMs and bank branch networks.

The first major use of mobile money was for digital transfers, which enabled individuals in urban areas to send money to those in rural areas, thereby lending support to households to cushion shocks by enabling consumption smoothing. Additionally, the use of mobile money dramatically increased the efficiency of making payments across individuals separated by distance, and also allowed the quick deployment of funds to finance activities in disparate locations. This in turn has spurred risk-taking and contributed to economic growth. By increasing the efficiency and lowering the costs of transactions, CBDCs may similarly be able to support household consumption smoothing and increase allocational efficiency across economic agents.

From a macroeconomic perspective, despite the dramatic increase in the number of transactions with uptake of mobile money across a large number of countries globally, there is little evidence of inflationary pressure due to mobile money usage in any economy despite the increased velocity of money. It is posited that one of the key reasons is because the resulting use of mobile money has also provided a major contribution to economic growth, thereby muting inflationary pressure from increased velocity. This is a key lesson for CBDCs, whereby issuing authorities should account for both the potential impact of inflationary pressure due to higher transaction volumes and the resultant boost in economic output.

The increased formalization of transactions with the introduction of CBDCs may expand broad money through money multiplier effects. There are two possible impacts, first through the introduction of currency that was previously untracked into the formal financial system, and second, through the introduction into the financial system of cash transactions previously performed outside the financial system. Dependent on the CBDC design, the increased formalization of transactions may in turn increase the stock of banking sector deposits, and therefore increase the commercial banking sector's lending base. With greater transaction formalization, CBDCs will also improve the tracking and transparency of transactions, and therefore allow an expansion of the tax base. However, strong incentives will persist for illicit activities to avoid usage of CBDCs.

CBDC's are likely to increase financial inclusion. A commonly cited concern about the implementation of CBDCs is that service provision may cater to users that are most likely to generate the highest profit for network operators. Additionally, an ecosystem controlled by private intermediaries may generate data privacy concerns, and thereby discourage usage. However, mobile money networks have greatly increased financial inclusion despite these constraints.

### **5.4. Socio-cultural**

Socio-cultural dimensions consider social factors including health, education, nutrition and demographics, as well as cultural dimensions including attitudes, beliefs, values and habits. The socio-cultural impact of the adoption of CBDCs therefore considers the effect of pre-existing social and cultural conditions on adoption rates, as well as the effect that adoption in turn has on social and cultural factors.

Pre-existing social conditions are likely to have an impact on the initial adoption rates of CBDCs. Evidence from mobile money across countries shows important differences in the initial adoption of mobile money by demography. The first adopters of mobile money are typically urban, educated and wealthier middle-class individuals. Additionally, mobile money has tended to be adopted first by younger individuals.

Similar patterns may be observed in the adoption of CBDCs. Pre-existing levels of education also affect user technical ability to use mobile money, which in turn influences mobile money adoption. Individuals that have low literacy levels or who have limited ability to use technology face a barrier to adoption, and therefore tend to have lower adoption rates.

The adoption of mobile money has also had an impact on social factors. Usage of mobile money was initially driven by remittances, whereby evidence shows that easier access has provided a cushion to many households from shocks, and has positively impacted food security. However, there is also evidence that overall financial health has declined amongst households, as measured by their short-term ability to manage financial obligations and consumption needs, their ability to absorb shocks, and staying on track to reach long-term financial goals. In turn, this negatively affects household ability to securely obtain food, health and education. This means that although evidence suggests mobile money has had a positive impact on social factors, its impact has not been large enough to lead to an overall improvement of social factors, particularly in the face of shocks such as the COVID-19 pandemic.

Further, mobile money has supported the implementation of third-party applications and services that can be paid for through digital means. Overall, this has supported the digital economy, which has also seen rapid growth with the COVID-19 pandemic. However, the digital economy also carries the risk of further increasing social inequality. Those with lower levels of education risk being excluded. In addition, costs of data access and mobile money transaction fees risk excluding poorer segments of society. More broadly, companies that are digitally proficient and adaptive may dominate the digital economy, and there may be a higher need for technical skills to work in the digital economy, putting some segments of the labor force at a disadvantage.

Pre-existing cultural attitudes, beliefs, values and habits are likely to impact CBDC adoption rates. As evidenced by mobile money, some key pre-existing cultural factors have contributed to differences in the rates of adoption of mobile money based on preferences and trust. A large segment of the population within SSA maintains a preference for the use of cash for transactions, reflected by the existence of a large cash economy even in countries where mobile money has been successfully adopted and used for a long period of time. In addition, adoption rates are highly dependent on trust, and are lower where users are unclear on transaction charges, or experience losses either through transaction errors or fraud.

Additionally, evidence suggests that mobile money has had a significant impact on household behavior. Evidence shows that the use of mobile money has encouraged savings amongst households, particularly amongst individuals that recognize it as a secure store of value. In particular, women and households in rural areas have shown the most significant increase in their levels of savings. The usage of mobile money for payments, credit, insurance, investment and other financial services has also improved attitudes towards the adoption of digital financial services.

Further, mobile money has increased the levels of trust and comfort in using digital technology for financial transactions. This has been encouraged through the intensive campaigns that mobile money agent networks have implemented to familiarize individuals with the use of mobile money. Thus, those households located far from branch networks have gained access to some financial services at low cost, and their attitudes towards usage of digital financial services have improved. Further, individuals with little experience in using digital technology, such as elderly individuals, have become users of digital technology in order to benefit from mobile money.

However, access to digital lending products has led to a dramatic increase in digital lending thereby increasing overall household debt burdens. Further, mobile money has increased digital betting. Over-borrowing and excessive betting expose households to significant risks of worsening their welfare.

## 6. Conclusion

The long history of mobile money deployment, including both successful and unsuccessful deployments within sub-Saharan Africa, offers valuable lessons for the deployment of CBDCs. CBDCs offer great potential to transform financial sector intermediation, with varying policy goals amongst the various countries across the world currently actively investigating their implementation. Some of the key policy goals include increasing payment system access, efficiency and resilience, increasing financial inclusion, broadening the tax base, promoting economic competition and growth, securing monetary sovereignty and reducing illicit flows of money. However, CBDCs also pose risks that must be properly understood in order to safeguard financial and monetary stability, and many of the risks to implementation are still not clearly understood. These include risks to monetary and financial stability, ensuring that introduction does not introduce inequality across different demographic segments, and implementing a framework that builds trust and promotes the adoption of CBDCs.

The previous chapters have provided detail on the key learnings from mobile money deployments, in particular focusing on sub-Saharan Africa, which has seen the greatest global success in the implementation of mobile money. The following key recommendations can be garnered from the successful deployment of mobile money that will support the successful deployment of CBDCs:

- 1) An appropriate legal and regulatory infrastructure is critical to support the successful deployment of CBDCs. This includes the appropriate delineation of financial and non-financial entities that are authorized to perform functions within the CBDC ecosystem, and the licensing of these entities using a risk-based system to preserve the integrity of the ecosystem.
- 2) Leveraging the capabilities and infrastructure of non-financial institutions, especially mobile network operators and technology firms, through legislation that allows these institutions, either solely or in partnership with financial institutions, to offer a set of services traditionally offered only by financial institutions such as transfers and payments, will create the most conducive environment for rapid scaling of CBDCs, and support financial inclusion.
- 3) Regulatory flexibility, using an incremental approach as the CBDC ecosystem develops, will create a balance between an enabling environment that allows for the entry of institutions and supports innovation, while also protecting the privacy of individual CBDC users. This will in turn provide the most conducive environment to allow the growth of CBDCs. The level of regulation should be dynamic and increase appropriately as the ecosystem matures.
- 4) A tiered approach to the regulation of digital products offered through CBDCs will minimize the compliance burden on users, while at the same time ensuring system integrity. The tiers and compliance requirements should differentiate users by their usage and capacity.
- 5) A comprehensive set of regulations to ensure the availability and persistence of services deployed through CBDCs is essential, including ensuring real-time completion of transactions, account reconciliation and transmission of transaction receipts (and transaction reversals where necessary) between parties. This includes requirements such as mandatory confirmation of transactions, a robust set of requirements for systems to handle user complaints, and maximum mandated timelines to do so.
- 6) The protection of user privacy and user-generated data is critical to support uptake in the usage of CBDCs. Thus, regulations protecting user privacy, ensuring transparency in the collection and usage of data, and requiring user consent prior to data utilization, should be embedded in services and products deployed through CBDCs.
- 7) The imposition of progressive, or at the very least non-regressive pricing systems for digital products and services offered through CBDCs will maximize uptake, and support financial inclusion.
- 8) The regulation of CBDCs should ensure appropriate consideration of macroeconomic concerns, with regulation balancing inflation concerns raised through the increased velocity of money and the increased economic activity supported through digital transactions.



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